PROCEEDINGS

Private Irrigation in sub-Saharan Africa

Regional Seminar on Private Sector Participation and Irrigation Expansion in sub-Saharan Africa

22-26 October 2001, Accra, Ghana

Hilmy Sally and Charles L. Abernethy, editors

IWMI International Water Management Institute

FAO

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IWMI receives its principal funding from 58 governments, private foundations, and international and regional organizations known as the Consultative Group on International Agricultural Research (CGIAR). Support is also given by the Governments of Ghana, Pakistan, South Africa, Sri Lanka and Thailand.

Sally, H. ; and C. L. Abernethy (Eds.) 2002. *Private irrigation in sub-Saharan Africa.* Colombo, Sri Lanka: International Water Management Institute, Food and Agriculture Organization of the United Nations and ACP-EU Technical Centre for Agricultural and Rural Cooperation.

Irrigation management / Privatization / Small scale systems / Social impacts / Economic impacts / Food security / Agricultural production / Financing / Micro-irrigation / Gender / Women / Sustainability / Government managed irrigation systems/ Farmer managed irrigation systems / Rice / Horticulture / Technology transfer / Environment / Pumps / Capacity building / sub-Saharan Africa / Asia / Zimbabwe / Kenya / Bolivia / Ghana / Burkina Faso / Niger / India / Senegal / Mali / South Africa / Uganda / Gambia / Nigeria

ISBN: 92-9090-494-1

Cover photograph from IWMI-South Africa.

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Foreword

The context for irrigation development in Africa has been changing rapidly and drastically over the past decade. On the one hand, there is increasing scepticism about the returns to public investment in irrigation development, and a resulting decline in such investment. On the other hand, there are continued serious concerns about food insecurity and economic under-development in Africa. The Forum for Agricultural Research in Africa (FARA) adopted the ambitious goal of achieving and sustaining a 6 percent annual growth rate, a goal that has since been endorsed by Africa's Heads of State under the New Partnership for Africa's Development (NEPAD). How is Africa to achieve such a growth rate in agriculture and attain the World Food Summit goal of halving the number of undernourished people by 2015 without substantial irrigation investments?

The good news is that while public investment has declined in the past, there is increasing evidence of positive experiences with small-scale private sector supported irrigation development. Some 70 million ha are currently under private irrigation in developing countries but are not well accounted for in official government statistics. It is estimated that nearly three-quarters of the future investment needed in the developing countries would consist of private commitments. We now realise that in the past the potential role of the private sector has been under-estimated. It is this realisation which gave impetus to this workshop.

In 2000, the Africa Regional Office of the Food and Agriculture Organization (FAO) approached the International Water Management Institute (IWMI) and the ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA) and proposed to co-organise the workshop. IWMI and CTA accepted the idea at a time when the former was establishing a new Africa Regional Office in Pretoria, South Africa and because it was in line with the latter's policy and programme. While FAO led the organisation of the workshop, IWMI prepared these Proceedings for co-publication by the three co-sponsors.

As evidenced in these Proceedings, we believe the expectations we had for the Workshop were more than fulfilled. There are a number of interesting and promising projects in Africa that demonstrate the potential of the private sector in promoting irrigation. These projects are promoted by NGOs, local private firms and individuals. They include interesting cases of the public sector encouraging and enabling private sector participation and development. Some of these cases are presented in this volume.

FAO, IWMI and CTA continue to work together on a range of programmes globally and in Africa. We perceive that together we can accomplish a lot in terms of supporting an African agricultural renaissance by mutual co-operation and partnerships with a range of African institutions.

We are confident that these Proceedings will be useful for many researchers, policy makers and practitioners in agricultural development in Africa.

Douglas J. Merrey	M. J. Omar	Carl B. Greenidge
Director for Africa	Officer-in-Charge	Director
IWMI	FAO Regional Office for Africa	CTA

Preface

Many governments in Africa suffer budgetary difficulties. The history of public-sector installation of irrigation facilities in sub-Saharan Africa has been characterised by high development costs; the governments have difficulty in affording these, so capital investment has tended to depend heavily on external donors. Many cases have been noted where these externally-financed schemes are in some ways inappropriate to their environment, and they may give the countries further difficulty and cost in management and operation.

On the other hand, episodes of food scarcity continue to occur too frequently in sub-Saharan countries. Expansion of irrigation facilities would seem to be an important way of addressing the issue of food security.

The combination of the food supply need and the constraint of inadequate public investment capital leads to increasing interest in alternative ways of obtaining irrigation investment, with reduced reliance on the public sector. If such a result can be achieved, it should bring various kinds of associated benefits in terms of rural and peri-urban development, health and nutritional improvements, and other aspects of socio-economic welfare that are often associated with irrigation.

These considerations were among the reasons for holding the workshop at Accra, whose papers are presented here. The workshop attracted a large range of people, and a diverse set of contributions, reflecting different kinds of experiences and different ways in which the private sector can relate to irrigation development. Most of the inputs described African experiences, but there were contributions also from South America (Höllinger) and from India (Shah and Keller), as well as global reviews of experiences in irrigation management transfer (Merrey et al; Samad), and general African reviews of irrigation progress (Sonou; Gadelle; Bangoura).

Private investment can occur in many ways. Several of the papers here describe activities of non-governmental organisations (NGOs), which in many cases address the very small scale of individual investment, and the provision of potential enhancement of livelihoods for the poorest sections of society (van Leeuwen; Shah and Keller). Others focus on investment by export-oriented companies, growing higher-value crops (Gyamfi; Agodzo and Blay).

A different path to non-governmental investment may be through transfer of management, to existing users, of schemes that were initially constructed and operated by governments. This does not immediately bring in cash investment, but may bring labour inputs by the users, and through time they may improve or expand their new property. This movement has been in progress in different parts of the world since the middle 1970s, so it is useful to have reviews such as that of Samad, which is however not very encouraging in general and suggests that there are needs for adapting the past approaches to this kind of policy. There are needs to identify better practices in transfer programmes, and the paper of Hermiteau et al., aims to investigate that aspect.

An example of what might be called “enforced” management transfer is described by Kabutha and Mutero, showing what can happen when a public agency is unresponsive to growing dissatisfaction among the users of its irrigation facilities, provoking them to frustration and ultimately to a violent takeover of the facilities.

Marketing is an obvious constraint in many parts of Africa, especially in smaller communities where poor transportation links make market access difficult and also make it easy for small local markets to become saturated, with consequent price weaknesses. This problem, however, is not severe in the cities, so peri-urban cultivation has relatively prospered (Barry), but faces its own set of constraints, such as small land units and lack of legal rights to land or water.

There is a need for appropriate and affordable equipment, especially pumps and micro-irrigation devices (van ‘t Hof; van Leeuwen; Beaujault and Dotson; Shah and Keller). Investment in these can bring its own problems of maintenance, marketing, spare parts and so on, so it needs to be supported by increases of capacity in such aspects. The role of NGOs, both local and foreign, in such capacity-building is clear in several of these contributions and in that of Shirra.

Gender issues are relevant in all parts of Africa, and perhaps especially so in countries with substantial industrialised sectors, such as South Africa or Zimbabwe, where male labour in the rural environments is relatively scarce. Chancellor describes opportunities and constraints for women cultivators, and van Koppen presents a way of assessing gender-related impacts.

Finance, and financial institutions and processes, are clearly central to any programme for enhancing private investment. Aeschliman gives a wide-ranging assessment of the issues, offering a great deal of practical guidance, and Höllinger describes a specific technique of equipment leasing from Bolivia. Dosso describes the processes followed by the African Development Bank. In addition to financing mechanisms, Abernethy discusses the improvement of the enabling environment, and the question of equitable access to irrigation.

Several of the authors improve our understanding of how these issues interact in real field situations, by providing case studies of single irrigation systems or small sets of systems (Mudima, in Zimbabwe; Agodzo and Blay, in Ghana; Abubakar, in Nigeria; Sally, in Burkina Faso and Niger; Freeman and Silim, in Kenya). Such case studies tend to demonstrate that the issues are complex and multi-dimensional, so policies should be multi-sectoral and must be pursued consistently over many years.

There is no general message that comes from these varied descriptions of the present situation of irrigation in sub-Saharan Africa. It seems clear that the need for expansion of irrigation and of food production is great; but the constraints and difficulties attending such expansion are also large. The workshop has made one thing clear: there is a large and increasing number of professional people working to solve these issues, and great effort and enthusiasm are being applied.

Hilmy Sally

Charles L. Abernethy

Acknowledgements

The organisation of the seminar on this topical subject was a joint initiative of the Africa Regional Office of the Food and Agriculture Organization of the United Nations (FAO), the International Water Management Institute (IWMI) and the ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA). We thank the management of these three organisations for their support in making this venture a reality.

The meeting provided an opportunity for interactions among people from several different spheres of activity, whose efforts are all needed if irrigation is to make an increased contribution to agricultural production and food security in Africa. Almost 80 people, with nearly 90 percent representing sub-Saharan Africa, attended this seminar that took place over 5 days in October 2001 in Accra, Ghana. As well as hearing contributions from representatives of national governmental organisations and international bodies, the meeting welcomed presentations by non-governmental organisations, universities, and private firms that market equipment or conduct research. There was also useful transfer of experiences from outside Africa, through presentations from South America and Asia.

This event would not have been the success it was if not for the commitment and active contributions of the authors and presenters of these papers, the panel members, the resource persons and all the participants, which are greatly appreciated. Their participation was made possible on account of the assistance received from their respective institutions, the three co-sponsors mentioned above as well as the Colombo Plan. Their support is gratefully acknowledged.

We would also like to record our appreciation of the management and staff of the Volta River Estates for allowing the seminar participants to visit their facilities during the field visit.

In addition to the practical organisation of the seminar, the staff of FAO-Accra and IWMI-Ghana often went out their way to deal with and resolve various logistical and administrative problems confronting the participants; they deserve a special word of thanks for their friendly co-operation and effectiveness.

Finally, we would like to extend our sincere thanks to the editorial and production staff of IWMI-Headquarters in Colombo, Sri Lanka who provided invaluable assistance in the production of this book, co-sponsored by IWMI, FAO and CTA.

Welcome address

Bamidele F. Dada
FAO Assistant Director-General/Regional Representative for Africa

Mr. Chairman
Honourable Minister of Food and Agriculture
Regional Representative of IWMI for Africa
Representative of CTA
Distinguished Participants
Ladies and Gentlemen,

It is indeed a great pleasure for me to address this important Seminar on "Private Sector Participation and Irrigation Expansion in sub-Saharan Africa." On behalf of the FAO Director-General, Dr. Jacques Diouf, and on my own behalf, I warmly welcome all participants to the beautiful city of Accra.

I am particularly delighted at the presence of the Honourable Minister of Food and Agriculture, H.E. Major (rtd.) Courage Quashigah, who has made time to be with us in spite of his very busy schedule. This is a concrete evidence of the close collaboration that I would like us to maintain between your Ministry and FAO in our common vision to improve the food security of our people.

I would also like to acknowledge the presence of two representatives of the institutions that have joined hands with the Food and Agriculture Organization of the United Nations (FAO), to sponsor this Seminar. They are Dr. Douglas Merrey, the Regional Representative for Africa of the International Water Management Institute (IWMI); Dr. Gesa Wesseler, representing the Technical Centre for Agricultural and Rural Cooperation (CTA) — ACP-EC Cotonou Agreement. I am very happy to have you with us. We also appreciate the contribution of two of our co-sponsors who could not be physically represented here namely, the International Programme for Technology Research in Irrigation and Drainage (IPTRID); and the Colombo Plan, an inter-governmental body which promotes the social and economic development of its member countries in the Asia-Pacific region. I commend and cherish the collaborative spirit of our partners and it is my hope that this will be further strengthened in the years ahead for the greater benefit of the people we serve.

The wind of positive change blowing across Africa must of necessity affect the agriculture sector. The most obvious reasons for such a change are the poor yields of many of our basic staples and the falling per caput food production, with the corresponding increases in food imports. One of the most critical challenges facing African agriculture today, especially in sub-Saharan Africa, is how to increase productivity to ensure year round availability of food for our people. In this regard, irrigation is certainly a key factor because of its crucial role in raising crop yields.

Perhaps to a gathering like this, of irrigation experts and economists, I need not mention that irrigation is fundamental to agricultural intensification. Nor should I add that agricultural development strategies emphasising irrigated agriculture have increased food production and stimulated economic growth in those countries where the Green Revolution occurred. But we all know that Africa is still waiting for a manifestation of its Green Revolution.

Water control and soil moisture management are critical for reliable food production. Yet in Africa, only some 12 million hectares, about 6 percent of the total cultivated land, are irrigated. This area could be increased considerably and irrigation could bring about increases in yield of over 400 percent. To do this, however, would require policy commitment on the part of governments, foreign capital to build infrastructure, as well as the active involvement of the private sector and farming communities.

As we know, until recently, irrigated agriculture was strongly and almost exclusively supported by the state in Africa. In the wake of Structural Adjustment Programmes, however, governments in the region can no longer afford to provide the generous support that was extended to irrigation projects, especially the large-scale ones. The rapid decline in public assistance to agricultural development has especially affected the irrigation sub-sector. We are also aware that the share of agriculture in total government expenditure in developing countries ranges from 0.015 percent to 23 percent. This figure is less than 10 percent in 90 percent of cases. Ironically, countries with high levels of undernourishment as in sub-Saharan Africa are also those with severe budgetary constraints. This points to the case of a larger flow of concessional development assistance to such countries to enable them to cope effectively with the challenge of food insecurity and undernutrition.

The total annual gross investment needs of agriculture in the developing countries (primary agriculture, storage, processing and support infrastructure) would be about US$180,400 million for the period up to 2015. A continuation of current annual investment rates until 2015 would be insufficient to achieve the World Food Summit (WFS) target of reducing by half the number of hungry people in the world by that date. The expected shortfall averages 12 percent for all developing regions and is 38 percent for sub-Saharan Africa.

What should be done in the face of such a situation? Distinguished participants, this is why you are here. We need to promote the emergence of new operators in the system and private irrigation enterprises appear to be the most appropriate. We know that some privately developed and managed irrigation schemes in most sub-Saharan countries are performing well and go to support the fact that there is business potential for the involvement of the private sector in the irrigation sub-sector. While they may have the advantage of being less of a drain on dwindling per capita public funds, we should not overlook the serious constraints that confront many small-scale irrigation operators, namely insecure land tenure systems, poor water quality, and lack of access to effective agricultural support services, including access to credit. Efforts should be continued to address these impediments.

A very strong defence of irrigation development is necessary if it is to compete favourably with other alternatives for attention. Perhaps you may wish to examine the following factors, which can contribute to this defence and may lead to a second generation of water projects being more successful than the previous ones:

- the macro-economic climate has improved within the last 20 years and financial returns to the agricultural sector are expected to increase following the various reforms;
- expensive internationally designed and constructed schemes are becoming unnecessary as local engineering capacity improves and simple appropriate technology becomes better known;
- advances in both agricultural science and engineering are continuing to be made, which can improve the efficiency of water use and increase the returns from irrigation;
- private-sector investment across a range of types from small-scale individual pump schemes such as we have in Nigeria to large-scale private estates in the case of Zambia coffee and wheat or Swaziland sugar, show that productive irrigation is possible;
- finally, irrigation does pay, for private investment has provided all financing for about 20 percent of the total area currently irrigated worldwide.

Among the four critical preconditions required to close the gap between food production and consumption in Africa, namely: good governance of the macro-economy, high-quality technical support and trained managers and farmers, water development ranks high among the lot. The responsibility for achieving these preconditions falls on both the national governments and the international community, which is expected to assist African governments to achieve food security. Inadequacies of market systems, lack of storage facilities, poor management of agricultural produce and absence of affordable credit schemes have contributed to failure in the past. These constraints must be eliminated through sound government macro-economic policies. But the needed expansion of irrigation must be based on lessons learnt from past experiences. You are here to find ways to make this happen.

In addition, governments in Africa, particularly those in sub-Saharan Africa, will have to critically review and reform their national water resources development and irrigation policies and strategies to meet the objectives of food security and sustainable agricultural development. I would like to reaffirm FAO's commitment to assist African countries in this difficult but urgent task.

In conclusion, I wish to reiterate that FAO views irrigation as an indispensable tool for improvement of food security in Africa. We and our partners are, therefore, keenly interested in the outcome of this Seminar. I am hopeful that participants will live up to the high hopes of FAO and its partners and come up with practical and realistic recommendations, which will address all aspects of private irrigation and provide governments, technical agencies, donors and financial institutions with sound advice to promote the development of sustainable private-sector participation in irrigation expansion in Africa. This will contribute immensely to boost food production on the continent and assist in enhancing the food security situation and the quality of life of our peoples.

On this positive note, I wish all participants fruitful deliberations and a happy stay among the warm and friendly people of Ghana.

Tendances et perspectives de l'irrigation en Afrique sub-saharienne

Irrigation trends and prospects in sub-Saharan Africa

Moïse Sonou

Résumé

En Afrique sub-saharienne, il n'y a que 4 pourcent des terres arables sous irrigation et l'on y prélève moins de 2 pourcent de l'eau disponible pour tous les usages. En moyenne, 18 pourcent des superficies équipées pour l'irrigation ne sont pas du tout exploitées, et les taux d'utilisation varient généralement entre 50 pourcent et 80 pourcent. C'est dire qu'un potentiel considérable reste disponible pour l'intensification et l'expansion des terres irriguées. Ce potentiel pourrait être libéré moyennant des investissements soutenus dans le sous-secteur. Toutefois, pour être efficace, investir dans l'irrigation implique l'investissement dans toute une série d'activités connexes qui contribuent à la rentabilité de l'irrigation. La part actuelle de l'investissement privé dans l'irrigation au niveau mondial confirme cette rentabilité. Cependant, pour l'Afrique sub-saharienne, les perspectives seraient beaucoup plus favorables si l'assistance publique au développement et notamment les investissements directs étrangers (IDE) n'accusaient pas une tendance au déclin.

Abstract

Only 4 percent of arable land in sub-Saharan Africa is irrigated, using just 2 percent of the available water resources. Furthermore, 18 percent of the area equipped for irrigation is not utilised at all and the intensity of use varies between 50 percent and 80 percent. This highlights the huge potential available for intensifying and expanding irrigated area, provided that the investments required can be successfully mobilised. However, it must be noted that if investments in irrigation are to yield satisfactory returns, investments must also be made in a series of related activities. Current global figures for the amount of private investment in irrigation confirm that good returns can indeed be achieved. Prospects for sub-Saharan Africa would be far more favourable if public development assistance, particularly foreign direct investments, did not show declining trends.

1. Introduction

Dans le monde, l'irrigation couvrait 194 millions d'hectares en 1995/7. En Afrique, seuls 12,5 millions d'hectares sont irrigués sur un total de 202 millions de terres cultivées, soit 6,2 pourcent. La proportion de terres irriguées en Afrique au sud du Sahara est encore plus réduite, puisque seuls 5,2 millions d'hectares, soit 3,3 pourcent des terres cultivées, sont irrigués.

En moyenne, on estime que 18 pourcent de terres irriguées contribuent pour 40 pourcent à la production agricole mondiale. Les analyses récentes suggèrent que l'agriculture irriguée représentera 38 pourcent de l'augmentation des terres arables et plus de 70 pourcent de l'augmentation de la production céréalière entre 1995/7 et 2030 (FAO 2000). Pour sa part de cette évolution, l'Afrique sub-saharienne a besoin des grands et petits périmètres irrigués.

Il est vrai que la performance plutôt décevante de bon nombre de grands aménagements hydroagricoles initiés par l'Etat ne milite guère en leur faveur. L'examen de la situation mondiale indique que le privé a entièrement financé plus de 20 pourcent des superficies actuellement irriguées. Les leçons des expériences du passé doivent guider le futur.

L'avantage des petits périmètres est indéniable dans certaines conditions. La maturation des petits projets est beaucoup plus rapide et ils se prêtent mieux à une gestion individualisée ou par petits groupes où les décisions sont plus faciles à prendre, la gestion plus flexible et le coût initial en capital est plus faible. Les petits périmètres ne sont pas pour autant dénués de problèmes; l'économie d'échelle n'est pas toujours aussi évidente qu'on peut le croire; en cas de sécheresse sévère, les petits périmètres sont plus affectés.

Nous procédons ci-après à une description de la situation actuelle de l'irrigation en Afrique sub-saharienne. Enfin, nous traçons les grandes lignes des perspectives ouvertes à l'expansion de l'irrigation.

2. Situation actuelle de l'irrigation en Afrique sub-saharienne

2.1 Utilisation de l'eau en Afrique

La répartition régionale des ressources en eau en Afrique est présentée dans le tableau 1 et la répartition des prélèvements d'eau dans le tableau 2.

On notera que, par souci de comparaison, ces deux tableaux ainsi que les figures 1 et 2 ci-après englobent l'Afrique du Nord.

Tableau 1. Distribution régionale des ressources en eau.

Région	Superficie	Pluie	Ressources en eau renouvelable			
	1000 km^2	km^3/an	km^3/an	mm/an	% du total	% de la pluie
Nord	5 753	411	50	8,7	1,2	12,2
Région soudano-sahélienne	8 591	2 878	170	19,8	4,3	5,9
Golfe de Guinée	2 106	2 965	952	452,0	23,8	32,1
Centre	5 329	7 621	1 946	365,2	48,8	25,5
Est	2 916	2 364	259	88,8	6,5	11,0
Iles de l'océan indien	591	1 005	340	575,3	8,5	33,8
Sud	4 739	2 967	274	57,8	6,9	9,2
Total	30 025	20 211	3 991	132,9	100	19,7

Source: FAO 1995.

D'après le tableau 1, il est bien évident que les pays les plus arides, qui nécessiteraient les plus grands volumes d'eau pour l'agriculture, disposent des ressources les plus limitées.

Le tableau 2 montre la répartition des prélèvements en eau par région entre les trois grands secteurs consommateurs d'eau: l'agriculture, l'industrie et les villes. A l'échelle du continent, environ 85 pourcent des utilisations recensées sont destinées à l'agriculture (contre 69% en moyenne pour le monde) mais ce chiffre varie considérablement d'une région à l'autre. Ce sont les régions arides, où l'irrigation joue un rôle important, qui prélèvent le plus d'eau pour l'agriculture.

Tableau 2. Distribution régionale des prélèvements d'eau.

Région	Total ressources internes	Prélèvements par secteur					
		Agriculture	Villes	Industries	Total	en % du total	en % des ressources internes
	$x10^6m^3$/an	$X10^6m^3$/an	$x10^6m^3$/an	$x10^6m^3$/an	$x10^6m^3$/an	%	%
Nord	50 000	65 000 (85%)	5 500 (7%)	5 800 (8%)	76 300 (100%)	50,9	152,6
Région soudano-sahélienne	170 000	22 600 (7%)	1 200 (5%)	300 (1%)	24 100 (100%)	16,1	14,2
Golfe de Guinée	952 000	3 800 (62%)	1 600 (26%)	700 (12%)	6 100 (100%)	4,1	0,6
Centre	1 946 000	600 (43%)	600 (43%)	200 (14%)	1 400 (100%)	0,9	0,1
Est	259 000	5 400 (83%)	900 (14%)	200 (3%)	6 500 (100%)	4,3	2,5
Iles de l'océan indien	340 000	16 400 (99%)	200 (1%)	20 (-)	16 620 (100%)	11,1	4,9
Sud	274 000	14 100 (75%)	3 000 (16%)	1 800 (9%)	18 900 (100%)	12,6	6,9
Total	3 991 000	127 900 (85%)	13 000 (9%)	9 020 (6%)	149 920 (100%)	100,0	3,8

Source: FAO 1995.

Si d'une manière générale moins de 4 pourcent des ressources totales en eau sont utilisées, on constate de très grandes disparités entre région et entre pays au sein d'une région. De manière générale, ce sont bien évidemment les pays les plus arides qui exercent la pression la plus forte sur leurs ressources en eau. Dans l'ensemble, l'Afrique sub-saharienne prélève moins de 2 pourcent de l'ensemble des ressources en eau disponibles.

2.2 Potentiel d'irrigation

De par sa relation étroite avec les ressources en eau, le potentiel d'irrigation est aussi inégalement réparti entre les différentes régions. Il faut également noter qu'en raison de la non concordance entre les régions géographiques et les bassins hydrographiques, les transferts d'eaux des zones humides vers des zones plus arides permettent à ces dernières de bénéficier d'un potentiel d'irrigation nettement plus élevé que ne leur permettraient leurs ressources propres. C'est le cas des zones traversées par les fleuves internationaux tels que le Sénégal, le Niger et le Chari en Afrique de l'Ouest, le Nil et les fleuves Shebele et Juba en Afrique de l'Est, le Limpopo, l'Orange et le Zambèze en Afrique australe. C'est la raison pour laquelle on comptabilise le potentiel d'irrigation par bassins plutôt que par pays. Le tableau 3 présente les terres aptes à l'irrigation pour les grands bassins d'Afrique, dont le total s'élève à près de 49 millions d'hectares. Si outre la qualité des terres on tient compte des ressources en eau (auxquelles s'ajoutent d'autres considérations relatives aux possibilités économiques de mise en valeur des terres), ce total se réduit à 35,8 millions d'hectares, soit plus de trois fois la superficie actuellement irriguée.

Tableau 3. Potentiel d'irrigation et terres irrigables des principaux bassins au Sud du Sahara.

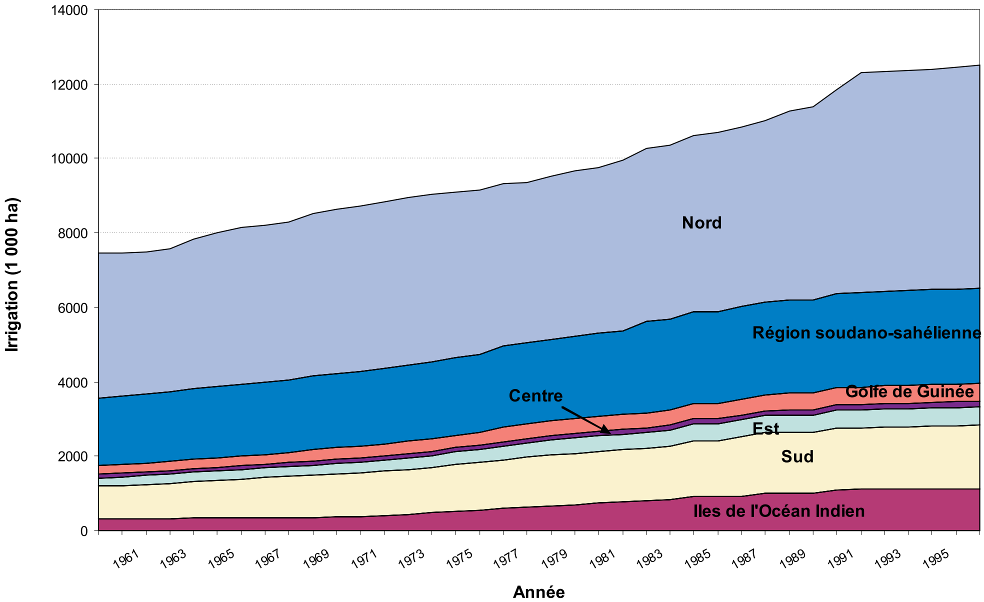
Principaux Fleuves	Superficie totale du bassin (ha)	Terres aptes à l'irrigation (ha)	Potentiel d'irrigation (ha)
Sénégal	48 318 100	3 645 800	420 000
Niger	227 394 600	28 943 400	2 816 510
Lac Tchad	238 163 500	36 524 600	1 163 200
Nil (potentiel égyptien exclus)	273 265 998	80 976 720	3 577 586
Vallée du Rift	63 759 300	13 946 700	844 010
Shebelli-Juba	81 042 700	25 847 900	351 460
Congo/Zaire	378 905 300	109 815 500	9 800 000
Zambèze	135 136 500	37 632 500	3 160 380
Okavango	32 319 200	6 612 100	208 060
Limpopo	40 186 400	9 736 100	295 400
Orange	89 636 800	14 140 500	390 000
Golfe de Guinée	213 497 000	45 902 400	5 947 750
Bassins côtiers du sud	257 172 200	57 601 100	5 319 560
Madagascar	58 704 000	14 497 400	1 500 000
Autres îles	934 600	105 500	34 990
Total	2 138 436 198	485 928 220	35 828 906

Source: FAO 1997.

2.3 Superficies irriguées

L'ensemble des superficies irriguées en Afrique s'élevait, au milieu des années 1990, à 12,2 millions d'hectares auxquels s'ajoutaient 2,1 millions d'hectares de bas-fonds cultivés et de cultures de décrue. On observe une distribution géographique très inégale de ces superficies. La figure 1 qui présente l'évolution des superficies irriguées depuis 1961 en Afrique montre bien les disparités régionales.

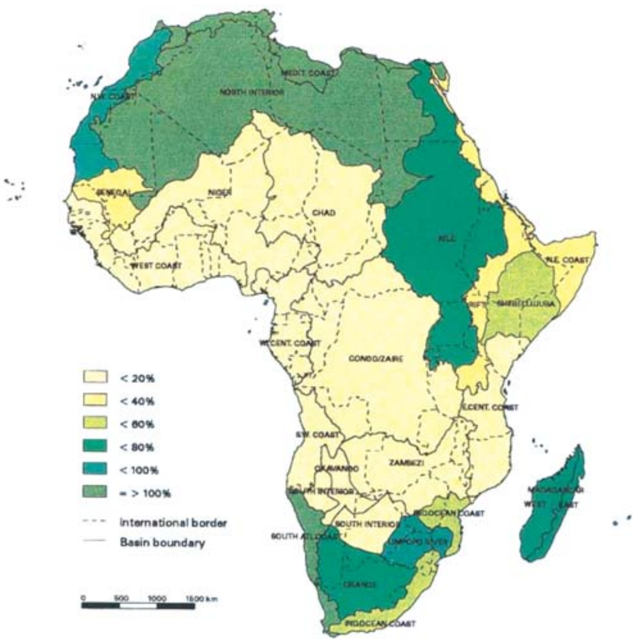
Figure 1. Evolution des superficies irriguées en Afrique 1961-1998.



Source: Faures et Sonou 2000.

La figure 2 représente, pour les grands bassins fluviaux, la part du potentiel d'irrigation déjà exploitée. Elle montre que globalement, en Afrique sub-saharienne, seule une très faible partie du potentiel est actuellement exploitée.

Figure 2. Irrigation en Afrique (en pour-cent du potentiel d'irrigation).



2.4 Techniques d'irrigation

L'irrigation gravitaire (ou de surface) domine nettement le panorama des techniques d'irrigation pratiquées en Afrique (90% des terres irriguées). On recense cependant plus d'un million d'hectares équipés en irrigation par aspersion, surtout dans les pays du Nord (Libye, Egypte, Maroc, Tunisie) ainsi qu'au Zimbabwe et en Afrique du Sud. Enfin, l'irrigation localisée est pratiquée dans 14 pays, mais elle ne représente qu'environ 1 pourcent des terres irriguées**.**

2.5 Cultures irriguées

Il est très difficile d'obtenir de bonnes estimations des cultures pratiquées sous irrigation. Le tableau 4 présente néanmoins la distribution des cultures irriguées pour environ 10,5 millions d'hectares (regroupées en six grandes classes) et donne une bonne image de leur distribution régionale. La culture la plus répandue est le riz, qui représente à lui seul près d'un tiers des spéculations. On observe cependant une grande disparité entre les régions. Cultivé principalement dans les marais et bas-fonds, le riz est majoritaire dans les zones humides du golfe de Guinée et de l'Est. Il est également très développé sur les plateaux de Madagascar. Parmi les autres céréales, le blé et le maïs sont cultivés et irrigués surtout en Afrique du Sud ainsi qu'au Soudan.

Tableau 4. Principales cultures irriguées (données partielles).

Région	Riz	Autres céréales	Maraîchage	Fourrages	Cultures industrielles	Arbori-Culture	Total
	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha
Nord	538 (11%)	2 221 (45%)	423 (9%)	1 207 (24%)	80 (2%)	459 (9%)	4 928 (100%)
Soudano-sahélienne	384 (22%)	839 (48%)	61 (3%)	4 (0%)	471 (27%)	1 (0%)	1 760 (100%)
Golfe de Guinée	993 (80%)	52 (4%)	168 (14%)	- (0%)	21 (2%)	6 (0%)	1 240 (100%)
Centre	21 (29%)	- (0%)	4 (6%)	- (0%)	42 (59%)	4 (6%)	71 (100%)
Est	173 (38%)	80 (18%)	158 (35%)	- (0%)	33 (7)	8 (2%)	452 (100%)
Iles de l'océan indien	880 (97%)	- (0%)	- (0%)	- (0%)	31 (3)	- (0%)	911 (100%)
Sud	147 (13%)	358 (32%)	42 (4%)	353 (31%)	198 (17%)	32 (3%)	1 130 (100%)
Total	3 136 (30%)	3 550 (34%)	856 (8%)	1 564 (15%)	876 (8%)	510 (5%)	10, 492 (100%)

Source: FAO 1995.

Les cultures industrielles irriguées sont quant à elles présentes surtout au Soudan et dans les pays du Sud, coton et oléagineux principalement, mais aussi la canne à sucre, le café, le cacao, le palmier, les bananes, le tabac et les fleurs.

Le tableau 4 indique clairement que l'irrigation est en majeure partie consacrée aux cultures céréalières (riz et autres céréales 64%) et c'est là où réside sa principale contribution à la sécurité alimentaire. C'est également là où le secteur privé intervient le moins.

Les cultures industrielles et horticoles (maraîchères, arboriculture et floriculture) quant à elles, représentent 21 pourcent des superficies irriguées. Elles bénéficient davantage des investissements privés, la production étant en partie orientée vers l'exportation.

2.6 Taux d'utilisation des superficies équipées

En Afrique, le taux moyen d'utilisation des superficies équipées pour l'irrigation varie sensiblement en fonction des conditions climatiques (lorsque des périodes de sécheresse affectent les ressources en eau destinées à l'irrigation), mais surtout en fonction des conditions socio-économiques des pays et des capacités d'organisation et de gestion. Si la majorité des pays ont un taux d'utilisation de plus de 80 pourcent, plusieurs d'entre eux montrent des performances nettement plus faibles, avec des taux d'utilisation qui ne dépassent pas 50 pourcent. En moyenne, on estime que 18 pourcent des superficies équipées pour l'irrigation ne sont pas exploitées. Il s'agit là d'un résultat relativement médiocre, qui s'explique en partie par le fait que des erreurs ont pu être commises dans l'aménagement et la mise en valeur mais surtout dans l'organisation et la gestion des périmètres irrigués.

2.7 Aspects économiques et financiers

Les coûts d'aménagement et de mise en valeur des terres par l'irrigation sont très variables d'un pays à l'autre et d'un type d'irrigation à l'autre. Ils peuvent aller de quelques centaines de dollars par hectare dans le cas de petits jardins maraîchers dans lesquels la main d'œuvre familiale représente l'investissement le plus important, à plus de US$25,000 par hectare pour les grands périmètres en zone enclavée. Ces coûts, qui sont les plus élevés du monde (en Asie, on estime entre US$1,000 et 2,000 le coût moyen à l'hectare des aménagements hydro-agricoles) rendent l'expansion de la grande irrigation publique très problématique. On verra dans la section relative aux perspectives futures que la tendance actuelle est de favoriser l'irrigation privée, souvent moins coûteuse et plus productive.

3. Tendances et perspectives pour l'irrigation en Afrique dans les prochaines décennies

La conception du rôle de l'irrigation vis-à-vis le développement rural, la production agricole et la sécurité alimentaire, est destinée à évoluer considérablement pour s'adapter à l'environnement mondial et aux tendances actuelles relatives à la gestion des ressources naturelles. La reconnaissance de la valeur économique de l'eau devient incontournable. Il faudra améliorer la productivité de chaque mètre cube d'eau et de chaque mètre carré de terre affectée à l'irrigation. La décentralisation des instances de décisions vers la base, vers les premiers acteurs s'accentuera. Les principaux facteurs de changement sont passés en revue ci-après et leur impact probable sur l'irrigation est discuté.

3.1 Aide et globalisation

La globalisation des activités économiques pourrait faire croire que le capital privé et le commerce remplaceraient graduellement l'aide comme source de financement du développement. Si l'on y prend garde, le niveau de pauvreté des populations sub-sahariennes pourrait les exclure, sinon faire d'eux les victimes de la mondialisation.

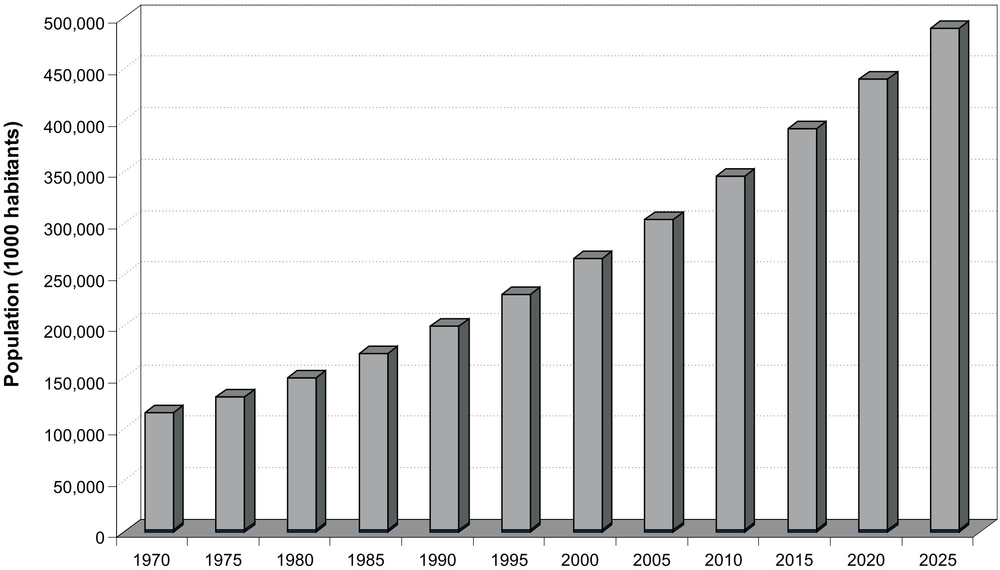
En effet, il est bien connu que la majorité des projets d'irrigation initiés par les gouvernements ont bénéficié de l'aide extérieure. Dans le secteur agricole y compris les forêts et les pêches, la proportion de l'aide reçue est passée de 20,2 pourcent en 1987/89 à 12,5 pourcent en 1996/98. Il y a trente ans, les prêts à l'agriculture représentaient 40 pourcent de l'enveloppe des prêts de la Banque Mondiale mais cette proportion est tombée à 10 pourcent en l'an 2000. Quant à l'aide extérieure destinée à l'Afrique, elle est passée de US$32 par personne en 1990 à US$18 en 1998.

D'ici à l'an 2015, l'on estime cependant qu'il faudra plus de US$180 milliards pour atteindre les objectifs du Sommet Mondial de l'Alimentation: réduire de moitié le nombre de sous-alimentés à travers le monde. Le rythme annuel d'investissement agricole actuellement observé est, en moyenne, inférieur de 12 pourcent aux prévisions pour l'ensemble des pays en développement, et de 38 pourcent pour l'Afrique sub-saharienne.

3.2 Croissance démographique, urbanisation et agriculture périurbaine

Les projections des Nations Unies indiquent que la population mondiale devrait passer de 6 milliards de personnes en l'an 2000 à 8 milliards en 2025. Plus de 80 pourcent de cette augmentation aura lieu dans les pays en développement (van Hofwegen and Svendsen 2000). La figure 3 montre l'évolution prévue en Afrique de l'Ouest jusqu'à 2025. Le défi consistera donc à produire assez de nourriture pour une population croissante et créer des emplois non agricoles tout en satisfaisant une demande croissante en eau de la part des autres secteurs d'utilisation (villes et industries). Actuellement, un habitant sur deux vit en zone urbaine.

Figure 3. Evolution de la population en Afrique de l'Ouest entre 1970 et 2025.

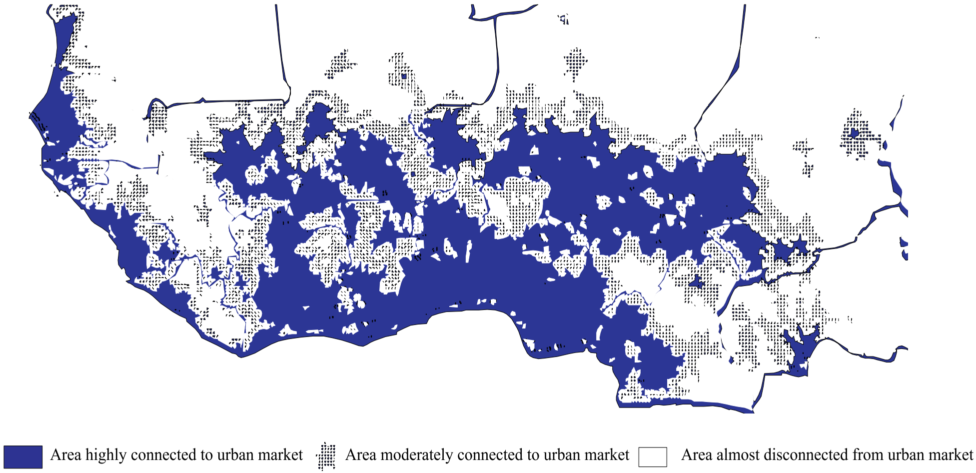


Source: FAO-IPTRID 1999.

Le développement croissant des marchés urbains exercera une influence positive sur la commercialisation des produits agricoles des zones périurbaines où devraient s'intensifier le maraîchage et d'autres cultures de rente. Ainsi, la carte de la figure 4 montre l'étendue des zones rurales qui seront connectées aux marchés urbains en 2025 en Afrique de l'Ouest.

En Afrique de l'Ouest où le taux d'urbanisation devrait atteindre 65 pourcent en 2025, chaque agriculteur en milieu rural devra produire pour les besoins alimentaires de 2,5 personnes (contre 1,6 personnes actuellement). Condition aggravante, la migration des campagnes vers les villes conduit souvent au chômage. Rapprocher la production agricole des villes, c'est rendre les produits plus accessibles aux consommateurs, toutes catégories confondues. En effet le coût du transport des produits représente dans certains pays plus de 50 pourcent, voire plus de 60 pourcent du prix au consommateur urbain (Sonou 2000). Cela appelle un développement conséquent des infrastructures routières, notamment dans les zones rurales.

Figure 4. Etendue des zones rurales ayant accès aux marchés urbains en 2025.



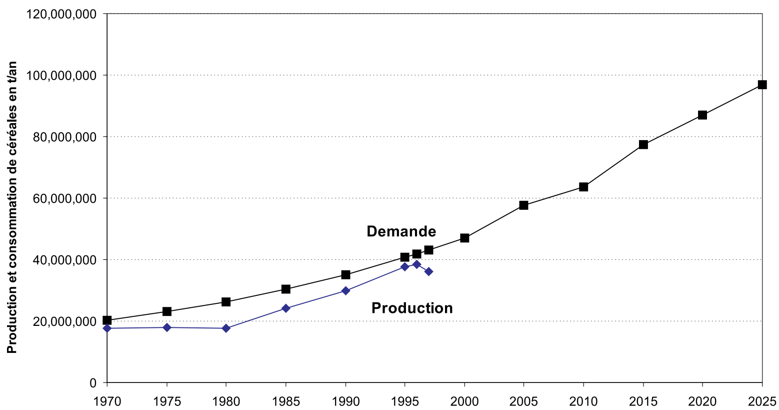
Source: OCDE, 1994, from FAO-IPTRID 1999.

3.3 Production agricole, sécurité alimentaire et revenus à l'exportation

Les prévisions indiquent que les exportations de nourriture des pays développés vers les pays en développement devraient croître de 140 pourcent entre 1993 et 2020.

Pour les pays qui ne peuvent générer suffisamment de biens ou services d'exportation pour pouvoir compenser leur déficit alimentaire par l'importation (beaucoup d'entre eux se situent en Afrique sub-saharienne), il est nécessaire de développer et renforcer les programmes de développement rural orientés vers une plus grande productivité (travail, terre, eau), tant en agriculture pluviale qu'en agriculture irriguée. L'irrigation a un rôle important à jouer comme promoteur de développement régional, comme moyen d'amélioration des conditions nutritionnelles des populations et pour combattre la pauvreté en zones rurales.

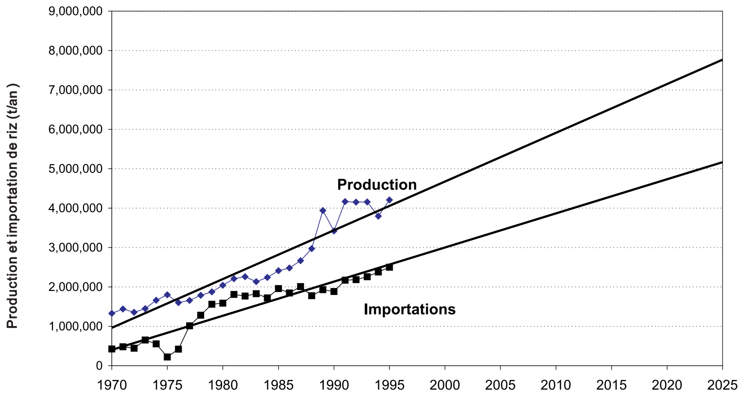
Figure 5. Production et demande en céréales en Afrique de l'Ouest 1970-2025.



Source: FAO-IPTRID 1999.

La figure 5 montre qu'en Afrique de l'Ouest la production céréalière suit la demande mais sans jamais la satisfaire, ce qui implique le recours systématique aux importations, notamment de riz et de blé. Depuis les années 1980, on assiste à une augmentation régulière du déficit de production céréalière dans la région. La situation du riz est préoccupante. En 1995, la région produisait seulement 63 pourcent du riz qu'elle consommait, alors qu'elle dispose de tout le potentiel nécessaire pour satisfaire ses besoins en riz (figure 6). Etant donné que le coût des importations pèse lourdement sur les balances commerciales des pays, ceux-ci seront tôt ou tard contraints à adopter une politique volontariste de promotion de la riziculture irriguée.

Figure 6. Production et importation de riz en Afrique de l'Ouest.



Source: FAO-IPTRID 1999.

Dans beaucoup de pays africains au Sud du Sahara, les produits agricoles destinés à l'exportation bénéficient de plus en plus de l'irrigation. Il en est ainsi notamment des fruits et fleurs. Les revenus à l'exportation permettent l'amélioration de la balance commerciale et à coup sûr facilitent l'importation des aliments qui ne sont pas produits localement. Sans ces exportations qui souvent proviennent du privé, il serait difficile de réduire la charge financière des importations agricoles et d'améliorer la sécurité alimentaire.

3.4 Transparence dans la gestion, dévolution et participation

La tendance globale à la décentralisation des processus de décision et des responsabilités de gestion dans tous les domaines aura probablement des conséquences importantes sur la façon dont seront gérés les grands périmètres irrigués. La gestion de l'eau qui prévalait jusqu'aux années 1990 dans les grands périmètres, à partir de structures lourdes et étatiques, sera remplacée par un service de l'eau contrôlé et/ou assuré par les irriguants; ceux-ci participant pleinement aux processus de prise des décisions relatives à la gestion de leurs périmètres. Cette transformation devrait s'accompagner d'une meilleure maîtrise des coûts de l'irrigation. A cette fin, il faudra développer les capacités de prise en charge de la gestion des périmètres irrigués par les nouveaux acteurs, les exploitants. Les problèmes liés au transfert de la gestion des périmètres aux usagers font spécifiquement l'objet du thème 3 de ce séminaire.

3.5 Environnement et santé

L'Afrique, comme les autres régions en développement, souffre de sérieux problèmes relatifs à l'impact de l'irrigation sur la santé et l'environnement. Malheureusement, très peu d'information quantitative est disponible à ce sujet pour les pays africains. La salinisation des terres est une réalité pour certains périmètres irrigués en régions arides. A l'exception de l'eutrophisation de certains réservoirs, la pollution de l'eau par l'agriculture n'est pas très importante en Afrique au Sud du Sahara étant donné le niveau relativement faible d'utilisation des engrais et des produits phytosanitaires. Ce sont les cultures maraîchères qui présentent les risques les plus élevés, tant pour ce qui est de la qualité des eaux d'irrigation (surtout à la périphérie et à l'intérieur des villes) que pour la pollution par usage inadéquat de fertilisants et de pesticides.

Les maladies transmises par l'eau, telles la schistosomiase et la malaria, sont des fléaux de première importance en Afrique. Environ 90 à 95 pourcent des décès dus à la malaria dans le monde sont concentrés en Afrique. Les données spécifiques relatives aux pays et liant la pratique de l'irrigation à la santé sont, une fois de plus, très souvent inexistantes ou incomplètes. Un sérieux effort est à faire pour améliorer le suivi des impacts environnementaux et sanitaires de l'irrigation en Afrique. Heureusement, des solutions techniques, économiques, sociales et environnementales existent qui permettent de corriger ou de prévenir les problèmes souvent associés à l'irrigation.

3.6 Les vrais obstacles à l'expansion de l'irrigation

Généralement, en termes de disponibilité en terres irrigables et en eaux, il n'y a pas d'obstacle à l'expansion de l'irrigation. Dans l'ensemble, l'Afrique sub-saharienne prélève moins de 2 pourcent de l'eau disponible. Les obstacles se retrouvent principalement dans:

- la lenteur de la mise au point et du transfert des nouvelles technologies d'irrigation à faible coût, lesquelles techniques devraient permettre, entre autres, économie de l'eau, économie d'énergie et économie de main d'œuvre;
- le manque de crédits d'investissement et de campagne;
- les politiques fiscales;
- le manque de motivation des agriculteurs à adopter les nouvelles technologies parce que (a) le coût n'en serait pas supportable, et (b) l'augmentation de la production butterait sur des problèmes d'accès au marché (étroitesse des marchés locaux, manque d'infrastructures de désenclavement des zones de production) et des problèmes de transformation, stockage, conservation et commercialisation;
- le manque d'accès aux intrants permettant de mieux valoriser l'eau (variétés de semences à haut rendement, engrais et pesticides, ces derniers devant être mis en balance avec la nutrition intégrée des plantes et la lutte intégrée contre les ennemis des plantes);
- le manque de formation aux techniques d'irrigation et à la gestion des périmètres;
- la baisse des investissements dans l'irrigation.

4. Investir dans l'irrigation

Comme suite aux programmes d'ajustement structurel, la plupart des gouvernements en Afrique sub-saharienne se trouvent obligés de réexaminer leurs politiques d'assistance financière directe à l'irrigation. Il faut rappeler ici que la part de l'agriculture dans les dépenses gouvernementales varie entre 0,015 pourcent et 23 pourcent, et reste inférieure à 10 pourcent dans 90 pourcent des pays en développement dont font partie les pays sub-sahariens. La nécessaire expansion de l'irrigation devra donc reposer, dans une large mesure, sur la participation des agriculteurs et sur les investissements privés.

De 1950 à 1993, 7 pourcent des prêts de la Banque Mondiale ont été attribués à l'irrigation, plus que dans tout autre sous-secteur (Jones 1995). A peu près dans la même période (1961/1963 à 1995/7), les superficies irriguées ont augmenté de 2 millions d'ha en Afrique sub-saharienne contre 70 millions d'ha en Asie. De 1990 à 1997, les prêts de la Banque Mondiale à l'irrigation sont tombés à près de 4 pourcent (DFID 2000). Voilà un déclin qui augure mal de l'expansion de l'irrigation attendue entre 1995/7 et 2030. Ce déclin touche à la fois les capitaux de premier investissement dans de nouveaux périmètres et les allocations pour les charges récurrentes et la réhabilitation.

L'Afrique au sud du Sahara éprouve ainsi beaucoup de difficultés à attirer les investissements directs étrangers (IDE). Pour toute l'Afrique, les IDE sont élevés à US$5.5 milliards en 1996, soit 1.5 pourcent des flux d'investissements mondiaux (BAD 1998).

La faiblesse du flux des IDE peut s'expliquer par la faible taille des marchés, l'état médiocre des infrastructures, l'incertitude politique, (la corruption et les régimes politiques restrictifs). Par ailleurs, les flux privés favorisent les économies hautement performantes, à forte capacité d'absorption des IDE.

Si dans un passé non lointain, les gouvernements assumaient tant bien que mal la responsabilité des besoins en capitaux pour le développement de l'irrigation, ils n'en peuvent plus de continuer seuls sur cette ligne. Aussi la participation des agriculteurs et du secteur privé est-elle devenue quasi inéluctable. Dans tous les cas, l'Etat continuera d'assumer les fonctions de réglementation et de création et maintien d'un environnement favorable au développement de l'irrigation. Ce nouveau partenariat pourrait prendre les formes suivantes:

- Le co-financement de l'irrigation: rôle de l'Etat, rôle des agriculteurs
    - Irrigation sociale: l'Etat répond à la demande des bénéficiaires en mettant en place de façon participative les infrastructures nécessaires à l'irrigation: les charges récurrentes étant la responsabilité des bénéficiaires.
    - L'Etat met en place des aménagements structurants permettant aux bénéficiaires de compléter par des investissements à leur portée.
- L'investissement entièrement privé dans l'irrigation
    - Le privé bénéficie, dans le cadre d'un programme de promotion de l'irrigation, d'une assistance de l'Etat ou d'organisations para-étatiques pour préparer les dossiers d'investissement et rechercher les sources d'investissement.
    - L'entreprise privée met en œuvre, entièrement à ses frais, l'infrastructure d'irrigation, la mise en valeur, la transformation, le stockage, la conservation et la commercialisation des produits.

Il convient de dire ici qu'il y a de très fortes indications de la rentabilité de l'irrigation. Nous en aurons l'illustration dans des études de cas présentés à ce séminaire. En effet, 20 pourcent des superficies actuellement irriguées à travers le monde ont été entièrement financées par l'investissement privé. La part du privé dans les 80 pourcent restants représente 50 pourcent du total des investissements. Mieux, on estime qu'il y a quelque 70 millions d'ha d'irrigation informelle privée qui échappent au contrôle des gouvernements et donc se trouvent souvent exclus des statistiques officielles, notamment en Afrique sub-saharienne.

5. Conclusions

Aujourd'hui il faut considérer que les cultures à haute valeur ajoutée, telle que l'horticulture, justifient pleinement l'apport de l'irrigation: le niveau élevé d'intrants et d'autres facteurs de production qu'exige l'horticulture nécessite que le producteur s'affranchisse des aléas climatiques. Le marché lui offre l'opportunité d'investir dans l'irrigation.

Les cultures céréalières constituent la majeure part de l'irrigation, et cela devrait continuer dans les décennies à venir. La production du riz devrait continuer à augmenter, mais à un rythme qui dépendra fort des dispositions que voudront prendre les pays pour la promotion de leurs capacités rizicoles. L'un des grands défis de la riziculture sera de prouver qu'il est possible de produire du riz en Afrique au sud du Sahara à des conditions économiques satisfaisantes pour les producteurs et pour les consommateurs.

L'irrigation jouera un rôle de plus en plus important à l'échelle mondiale. Elle permettra une agriculture intensive assurant 80 pourcent de toute la production agricole et 70 pourcent de la production céréalière. Son impact sur la productivité agricole aura des effets bénéfiques sur le revenu et l'emploi en milieu rural, la sécurité alimentaire et la réduction de la pauvreté.

En Afrique sub-saharienne, il n'y a que 4 pourcent des terres arables sous irrigation et l'on y prélève moins de 2 pourcent de l'eau disponible pour tous les usages. Cela laisse un potentiel considérable pour l'expansion de l'irrigation. Avec des investissements, ce potentiel pourrait être libéré. La part de l'investissement privé dans le développement actuel de l'irrigation à travers le monde témoigne de sa rentabilité.

Toutefois, pour être efficace, investir dans l'irrigation implique l'investissement dans toute une série d'activités connexes telles que les infrastructures de desserte, les pratiques culturales, les intrants (semences améliorées, engrais), le renforcement des capacités (ressources humaines) et le maintien d'un environnement favorable (politique macro-économique, législation et bonne gouvernance). C'est dire que l'Etat qui se désengage du secteur productif doit parallèlement renforcer ses actions de promotion et d'accompagnement des nouveaux opérateurs du sous-secteur de l'irrigation.

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Développement de l'irrigation privée en appui a la sécurité alimentaire en Afrique de l'Ouest

Private irrigation development in support of food security in West Africa

S. Bangoura

Résumé

Le développement de l'irrigation en Afrique de l'Ouest remonte aux années 40 avec la réalisation, par des entreprises européennes, de périmètres irrigués au long des principaux fleuves et dans des vallées intérieures, essentiellement pour la production de fruits et légumes tropicaux destinés aux marchés européens. Plus récemment, parallèlement au développement de l'irrigation publique, on observe le développement de nouvelles initiatives privées: depuis la petite irrigation informelle et des jardins maraîchers autour des zones urbaines et périurbaines jusqu'aux grands périmètres réalisés par des promoteurs privés. Cependant, le développement de l'irrigation privée en Afrique de l'Ouest est confronté à des contraintes de quatre ordres: coûts d'aménagement, aspects techniques, facteurs de production, et aspects juridiques et institutionnels. En se basant sur les expériences acquises à travers les projets du programme spécial pour la sécurité alimentaire de la FAO, cet article présente des recommandations en vue de promouvoir l'implication du secteur privée dans l'irrigation en Afrique de l'Ouest.

Abstract

Irrigation development in West Africa can be traced back to the 1940s with the construction of irrigation schemes by private companies from Europe, in the major river basins and also in the inland valleys for the production of tropical fruits and vegetables for the European markets. More recently, public sector irrigation development has been accompanied by a growing number of new initiatives by private entrepreneurs. These range from informal small-scale irrigation, largely practised in small gardens in urban and peri-urban areas, to large-scale irrigation schemes established by private entrepreneurs, for producing vegetables and fruits mainly for export. However, private irrigation development in West Africa is faced with constraints in four key areas: costs of development, technical aspects, production factors, and legal and institutional aspects. Based on the experiences gained through FAO's Special Programme for Food Security (SPFS) projects in West Africa, and the challenges facing the different countries, this paper makes recommendations for the promotion of private sector involvement in irrigation development in the region.

1. Introduction

Le développement de l'irrigation en Afrique de l'Ouest remonte à l'époque coloniale, et probablement vers le début des années 40 avec l'aménagement des grands périmètres rizicoles. Le développement de l'irrigation avait surtout été l'œuvre des grandes Sociétés coloniales et des planteurs privés européens, notamment français, anglais et portugais, dans les bassins fluviaux du Niger, du Sénégal et dans les petits bassins intérieurs (bas-fonds soudano-guinéens, forestiers) ainsi que dans les plaines littorales de la Guinée-Conakry, Guinée-Bissau, Gambie et du Sénégal (Casamance).

L'objectif visé par ces aménagements hydro-agricoles était essentiellement la production pour l'exportation des produits tropicaux (bananes, ananas, mangues) à haute valeur ajoutée vers les métropoles européennes et aussi pour la satisfaction des besoins alimentaires de base (riz) des colonies. Déjà en cette période, les terres les plus fertiles avaient été confisquées par l'administration coloniale et mises en valeur par les grandes Sociétés coloniales et par des planteurs privés européens résolument tournés vers le développement des cultures d'exportation. Ainsi plusieurs pays de l'Afrique de l'Ouest dont la Guinée-Conakry, deuxième producteur mondial de banane après les Antilles jusque vers 1962, et l'Office du Niger au Mali pour le riz, s'étaient hissés parmi les premiers exportateurs de produits agricoles tropicaux vers les métropoles européennes.

La priorité pour les grands aménagements hydro-agricoles s'est ainsi maintenue après les indépendances des pays. Dans la plupart des pays les gouvernements par le biais de sociétés d'Etats se sont substitués aux ''colons'' dans la réalisation et la gestion des aménagements hydro-agricoles.

La dégradation climatique observée à partir des années 1970 dans la plupart des pays africains, en particulier dans la zone sahélienne, et la pression démographique ont fortement milité en faveur de l'adoption de l'irrigation comme une option prioritaire d'intensification et de sécurisation de la production agricole. Ainsi, des ressources financières et humaines relativement importantes ont été mobilisées en faveur des projets d'irrigation.

Ainsi, dans la plupart des pays d'Afrique de l'Ouest, le développement de l'irrigation s'est considérablement renforcé sous l'égide des pouvoirs publics au cours de la décennie de 70 à 80. Parallèlement aux efforts déployés par les gouvernements pour le développement de l'irrigation comme moyen d'atténuation de la sécheresse, des initiatives privées se sont également développées çà et là, surtout pour les cultures horticoles et fruitières, notamment autour des zones urbaines et périurbaines.

Dans certains pays de la sous-région, l'engouement des entrepreneurs privés pour l'agriculture irriguée a été facilité d'une part, grâce aux réformes des législations foncières entreprises par les différents Etats (il y a lieu cependant de signaler que ces réformes foncières restent inachevées dans la plupart des pays) et d'autre part, grâce aux mesures d'ajustement structurelles engagées par les différents pays, ainsi qu'aux possibilités d'exportation offertes par le développement des infrastructures de transport.

2. Concept de l'irrigation privée

L'irrigation privée peut être définie comme une activité d'initiative privée dans laquelle l'essentiel des investissements sont supportés par l'initiateur, qui prend également sous sa responsabilité les décisions relatives à la production et à la commercialisation. Dans ce contexte, il faut également citer le cas des périmètres irrigués dont la gestion a été transférée aux exploitants privés. La recherche du profit conduit les investisseurs privés à cibler les cultures à haute valeur ajoutée comme des cultures maraîchères et fruitières. Cette orientation des investissements privés a été, dans le passé, mal comprise par les décideurs politiques qui n'arrivaient pas à apprécier les liens avec la politique de sécurité alimentaire prônée par les différents Etats. C'est ce qui expliquerait en partie le peu d'intérêt des pouvoirs publics face au développement de l'irrigation privée. Cependant on constate, dans presque tous les pays de la sous-région, un développement spontané de l'irrigation privée sans appui significatif des Etats. L'irrigation privée, ne devrait-il être perçue comme une activité complémentaire de l'action des services publics pour atteindre certains objectifs prioritaires de développement: réduction de la pauvreté, sécurité alimentaire, création d'emploi, amélioration de la balance commerciale et économie de devises fortes?
En pratique on retrouve deux types d'irrigation privée en Afrique de l'Ouest;

- La petite irrigation privée "informelle", largement pratiquée dans les petits jardins maraîchers des périmètres urbains et périurbains. Il est malheureusement rare de trouver des données fiables sur ce type d'irrigation dans les statistiques dressées par les services publics. Ce type d'irrigation est pratiqué par une large frange des populations notamment urbaine et périurbaine; les femmes et les jeunes sont particulièrement actifs dans cette activité.

- L'irrigation privée des moyens et grands périmètres de bas-fonds et plaines alluviales, pratiquée par des entrepreneurs privés ayant à leur disposition des moyens financiers et matériels appréciables. Les cultures de contre-saison constituées par les légumes divers et les fruits sont les principales spéculations pratiquées. On peut également retenir dans cette catégorie les petites exploitations familiales orientées vers la culture des céréales.

3. Potentiel d'irrigation en Afrique

Selon la FAO (1997), le potentiel d'irrigation pour les grands bassins d'Afrique est de l'ordre de 600 millions d'hectares; en prenant en compte la qualité des terres, les ressources en eau, et les possibilités économiques de mise en valeur, ce potentiel serait réduit à 42,5 millions d'hectares. L'ensemble des superficies irriguées en Afrique serait de l'ordre de 14,3 millions d'hectares (tableau 1).

Tableau 1. Potentiel d'irrigation et terres irrigables des principaux fleuves d'Afrique.

Principaux fleuves	Superficie totale du bassin (ha)	Terres aptes à l'irrigation (ha)	Potentiel d'irrigation (ha)
Sénégal	48 318 100	3 645 800	420 000
Niger	227 394 600	28 943 400	2 816 510
Lac Tchad	238 163 500	36 524 600	1 163 200
Nil	311 236 900	92 019 000	8 000 000
Vallée du Rift	63 759 300	13 946 700	844 010
Shebelli-Juba	81 042 700	25 847 900	351 460
Congo/Zaire	378 905 300	109 815 500	9 800 000
Zambèze	135 136 500	37 632 500	3 160 380
Okavango	32 319 200	6 612 100	208 060
Limpopo	40 186 400	9 736 100	295 400
Orange	89 636 800	14 140 500	390 000
Bassins endoréiques (déserts)	645 028 900	63 747 500	125 000
Bassins côtiers du nord	207 584 800	36 242 000	2 128 050
Golfe de Guinée	213 497 000	45 902 400	5 947 750
Bassins côtiers du sud	257 172 200	57 601 100	5 319 560
Madagascar	58 704 000	14 497 400	1 500 000
Autres îles	934 600	105 500	34 990
Total	3 029 020 800	596 960 000	42 504 370

Réalisations en irrigation privée en Afrique de l'Ouest

D'une manière générale, les réalisations d'irrigation privée en Afrique de l'Ouest se concentrent dans le secteur horticole et fruitier, et dans une moindre mesure dans la riziculture et les autres céréales. Les résultats obtenus dans le domaine de l'irrigation privée sont nettement en deçà des possibilités réelles au vu du potentiel de terres irrigables disponibles dans les différents pays de la sous-région. Dans le tableau 2, des chiffres partiels disponibles sur les superficies et les cultures sous irrigation privée sont donnés à titre indicatif pour quelques pays de la sous-région. Selon les résultats présentés dans ce tableau, les taux de mise en valeur du potentiel d'irrigation par le secteur privé sont très faibles (inférieurs à 5%) dans les différents pays.

Tableau 2. Superficies sous irrigation privée (données partielles).

Pays	Superficie irriguée (ha)	Principales cultures	Techniques d'irrigation	Potentiel de développement (ha)
Mali	4500	légumes et fruits	puisards, pompage	560 000
Sénégal	5000	légumes, fruits, riz	puisards, puits modernes, pompage, irrigation gravitaire	349 000
Burkina Faso	4000	légumes et fruits	puisards, puits modernes, pompage, irrigation gravitaire	165 000
Guinée-Conakry	2500	riz, légumes, fruits	irrigation gravitaire, pompage, aspersion, puisard	364 000
Bénin	1730	légumes, fruits	irrigation gravitaire, pompage, aspersion	300 000
Ghana	> 5000	légumes, fruits	puisards, aspersion, irrigation gravitaire	346 000

N.B. (1) Les chiffres sur les superficies irriguées ne prennent en compte que les périmètres sous irrigation privée.
(2) Tableau préparé par l'auteur sur la base des informations recueillies à partir des documents cités dans la bibliographie.

4. Contraintes au développement de l'irrigation privée

Les contraintes au développement de l'irrigation privée en Afrique sont essentiellement de quatre ordres: les coûts d'aménagement, les aspects techniques, les facteurs de production, et les aspects juridiques et institutionnels.

S'agissant des coûts d'aménagement, la principale difficulté réside dans le financement des aménagements structurants que représentent les ouvrages principaux (barrages, canaux principaux, digues de protection, pistes d'accès etc.) par l'irriguant privé, compte tenu du fait que l'investissement doit être techniquement et financièrement supportable par le privé. Le financement des infrastructures structurantes par l'Etat devrait être pris en compte dans les plans stratégiques de développement du sous-secteur de l'irrigation. Une politique d'appui de l'Etat dans la préparation et la répartition des investissements permettrait d'atténuer ces contraintes.

Les contraintes d'ordre technique ont trait aux options technologiques optimales à choisir (typologie d'irrigation, technologies appropriées d'irrigation etc.) relatives à la gestion technique, économique et environnementale des périmètres aménagés.

L'environnement économique et social peu favorable rend l'accès aux facteurs de production difficile. En effet, l'accès au crédit et les taux d'intérêt élevés imposés par les institutions de crédit sont parmi les contraintes les plus importantes auxquelles font face les entrepreneurs privés agricoles.

Les contraintes d'ordre juridiques et institutionnelles à lever sont principalement les suivantes:

- La clarification de la législation foncière et la mise en œuvres des textes d'application sont des actions qui pourraient sécuriser les investisseurs privés. En effet le cadre institutionnel existant dans les différents pays se caractérise par le poids encore trop important de l'Etat dans le financement et la gestion des aménagements hydro-agricoles. Des groupements associatifs sont faibles et insuffisamment organisés et des structures d'appui pour le développement de l'irrigation privée sont à créer ou à renforcer.
- Les institutions financières existantes s'intéressent très peu au secteur agricole, vu les risques et le caractère peu attractif du crédit aux petits producteurs. L'investissement en faveur de l'irrigation connaît une tendance à la baisse depuis plus d'une décennie. Les structures de commercialisation et les débouchés pour les produits agricoles sont insuffisants et peu structurés.

5. Axes stratégiques de développement de l'irrigation privée

Les options stratégiques prioritaires de développement de l'irrigation privée sont fonction des politiques et stratégies définies par les différents Etats. Cependant, en règle générale, on retrouve les principes de base suivants:

- L'amélioration de l'environnement institutionnel et juridique du sous-secteur de l'irrigation. Dans ce contexte, les actions prioritaires à engager pour le développement de l'irrigation privée sont: la clarification des rôles et missions des différents acteurs, le désengagement progressif des Etats du financement intégral, de la mise en œuvre et de la gestion des aménagements hydro-agricoles, le soutien à l'émergence d'un secteur privé dynamique, les réformes foncières et les codes de l'eau, et la mise en place de codes d'investissement suffisamment attractifs.
- Il est tout aussi important d'améliorer les techniques de mobilisation et de gestion de l'eau, et de promouvoir des technologies d'irrigation techniquement et économiquement fiables.
- L'amélioration de l'environnement économique et social permettra de faciliter l'accès au crédit; la performance des institutions de crédit sera également accrue. L'amélioration des services financiers comportera, par exemple, des mesures susceptibles de favoriser la mobilisation de l'épargne rurale et l'accroissement de l'offre de services adaptés aux besoins des agriculteurs.

- Le renforcement des capacités techniques et de gestion des différents intervenants (groupements associatifs, services publics, entrepreneurs privés, ONG, etc.) permettra une appropriation réelle des techniques et technologies d'irrigation par les différents acteurs de développement.

- L'amélioration du circuit de transport et de commercialisation, la promotion de petites industries de transformation et de conservation des produits agricoles sont des actions prioritaires à considérer.

6. Enjeux et perspectives de développement de l'irrigation privée

La croissance démographique galopante qui caractérise les pays africains en général et en particulier les zones urbaines, a pour corollaire l'augmentation des besoins alimentaires des populations, il se trouve que ces besoins ne peuvent être satisfaits avec les niveaux de production actuels.

Les restructurations des politiques sectorielles agricoles, dans le contexte général des réformes économiques entreprises par les Etats, doivent nécessairement prendre en compte le sous-secteur de l'irrigation, compte tenu de ses impacts sur la sécurisation de l'agriculture, sur l'augmentation des rendements des cultures et des revenus des producteurs, sur la création d'emploi, et sur la réduction des importations alimentaires de base et de la balance commerciale.

Dans le contexte de la restructuration du sous-secteur de l'irrigation, les stratégies et plans d'actions doivent clairement proposer les mesures d'allégement du poids financier des interventions de l'Etat dans la réalisation et la maintenance des infrastructures d'aménagements hydro-agricoles ainsi que le transfert adapté des périmètres aménagés par les services publics aux groupements associatifs et aux entrepreneurs privés. Le passage d'une irrigation financée entièrement par l'Etat vers des projets d'irrigation financés et gérés par des groupes d'individus privés ou des associations d'agriculteurs apparaît comme une solution adaptée au contexte actuel d'ajustement des économies des pays en voie de développement.

La promotion de nouvelles technologies d'irrigation peu coûteuses (pompes de petite et moyenne capacités, pompes à pédales, systèmes de goutte-à-goutte du type familial, etc.) pour l'irrigation à petite échelle est une alternative viable pour les pays à faible revenu.

Au regard du potentiel de terres aménageables existant et de la complémentarité nécessaire entre les secteurs public et privé pour le développement du sous-secteur de l'irrigation, la promotion de l'irrigation privée est perçue comme une perspective d'avenir susceptible de contribuer grandement à la réduction de la pauvreté et à la sécurité alimentaire des populations.

7. Conclusion et recommandations

Le développement du sous-secteur de l'irrigation en Afrique en général et en Afrique de l'Ouest en particulier, au cours des 20 dernières années démontre à suffisance que l'irrigation est une alternative durable de sécurisation de la production agricole et d'augmentation des rendements des cultures et des revenus des producteurs.

La tendance à la baisse constatée de l'investissement dans le secteur agricole à partir de 1980, milite en faveur d'un allégement du poids financier de l'Etat dans les aménagements hydro-agricoles accompagné d'une prise de responsabilité plus poussée des agriculteurs et des entrepreneurs privés dans le financement de leurs activités d'irrigation que par le passé.

Les projets d'irrigation privée en Afrique doivent s'inscrire dans la politique globale de sécurité alimentaire prônée par les différents pays, de lutte contre la pauvreté et de la promotion des investissements dans le sous-secteur de l'irrigation, tout en assurant une prise de responsabilité plus grande des investissements par les bénéficiaires.

Dans le souci de soutenir le développement de l'irrigation privée en Afrique de l'Ouest, les mesures ci-après doivent être prises en compte:

- Poursuivre la politique de recentrage de l'Etat vers ses fonctions pérennes de planification et de contrôle et promouvoir le secteur privé dans le sous-secteur de l'irrigation.

- Renforcer la participation des bénéficiaires des infrastructures collectives au financement des investissements, et inciter les entrepreneurs privés à investir dans l'irrigation.
- Adopter une politique souple de recapitalisation du secteur agricole en général et celui de la petite irrigation en particulier.
- Améliorer les outils législatifs et juridiques en vue de drainer les investissements privés vers le sous-secteur de l'irrigation.
- Promouvoir les techniques et technologies d'irrigation à moindre coût.
- Appuyer l'émergence d'interprofessions dynamiques et structurées pour améliorer la commercialisation des produits agricoles.
- Capitaliser les expériences et les informations existantes sur l'irrigation privée.

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Socio-economic impact of smallholder irrigation development in Zimbabwe: A case study of five successful irrigation schemes

L'impact socio-économique du développement de la petite irrigation au Zimbabwe: Une étude de cinq périmètres irrigués performants

Kennedy Mudima

Abstract

An analysis is given of the impacts of five small irrigation systems in Zimbabwe. The systems range in size from 9 to 92 ha, and have fewer than 100 farmers. Most are farmer-managed, but one is managed by farmers jointly with a government agency. The assessment of impacts takes account of a broad set of aspects, including direct production benefits and various secondary benefits such as employment generation, stimulation of the local economy, and environmental protection. The performance of the systems is found satisfactory in all respects. The cost to government of providing added production capacity through smallholder irrigation is compared with the cost of government's drought relief programmes, and it is concluded that the costs (capital and operational) of providing irrigation are substantially less than the cost of providing drought relief assistance. Lists of conclusions and recommendations are provided, with the general themes that small-holder irrigation systems represent a good investment for government; that farmer-managed systems are effective and reduce pressures on government budgets; that farmers should be involved in planning new schemes; and that training packages and study tours are valuable tools to prepare new entrants to irrigated farming.

Résumé

Cet article examine les impacts de cinq petits périmètres irrigués au Zimbabwe, de 9 à 92 ha et ayant moins de 100 exploitants chacun. Quatre d'entre eux sont gérés par les exploitants eux-mêmes ; le cinquième est géré conjointement avec une organisation de l'Etat. L'analyse des impacts prendre en compte les bénéfices directs de la production ainsi que divers bénéfices secondaires tels la création d'emplois, la stimulation de l'économie locale et la protection de l'environnement. Les performances des périmètres se révèlent satisfaisantes a tous les égards. Les coûts que doit supporter le gouvernement pour augmenter la capacité de production par la promotion de la petite irrigation sont comparés aux coûts des programmes d'assistance contre la sécheresse ; on montre que les coûts (investissements initiaux et charges récurrentes) lies à l'irrigation sont beaucoup moins élevés. Des recommandations et conclusions présentées montrent que : la petite irrigation représente un bon investissement pour l'Etat ; les périmètres auto-gérés sont performants et ils réduisent les charges de l'Etat ; les exploitants doivent être impliqués dans la réalisation de nouveaux périmètres ; la formation et les voyages d'étude sont des outils précieux pour sensibiliser et préparer les exploitants pour qui l'agriculture irriguée est une nouvelle occupation.

1. Introduction

This paper summarises the results of a socio-economic impact assessment carried out on five successful smallholder irrigation schemes in Zimbabwe (FAO 2000). The paper starts by giving a very brief general overview and background on the agricultural sector of Zimbabwe to enable the discussion on smallholder irrigation which follows to be taken and understood in the right perspective. This is then followed by a summary of the findings and recommendations from the socio-economic impact evaluation.

The results of the socio-economic impact evaluation show that smallholder irrigation can certainly be economically and financially viable and can result in increased productivity, improved incomes and nutrition, employment creation, food security and drought relief savings for governments. Smallholder irrigation development can be used as a key drought mitigation measure and as a vehicle for the long-term agricultural and macro-economic development of a country.

2. Zimbabwe: Background information

2.1 Introduction

Zimbabwe is a landlocked country in the Southern Africa region, with an area of over 390,000 km^2, bordered by Zambia, Mozambique, South Africa, Botswana and Namibia. It is situated between about 15 and 22 degrees south latitude and about 26 and 34 degrees east longitude. Climatic conditions are largely sub-tropical with one rainy season, between November and March. Rainfall reliability decreases from north to south and also from east to west. Only 37 percent of the country receives rainfall considered adequate for agriculture.

2.2 Agricultural sector

Agriculture is the mainstay of the economy of Zimbabwe. Although the agricultural sector contributes only about 18 percent of the country's Gross Domestic Product (GDP), it is the country's largest foreign currency earner and about 40 percent of the country's exports are of agricultural origin (Agritex 1999). About 70 percent of the population are directly dependent on it for formal employment and agriculture provide about 60 percent of raw materials to industry (Agritex 1999). Recent experiences, especially the periods during and immediately after the severe droughts of 1986/87, 1991/92 and 1993/94, have shown that the performance of the country's economy is directly related to the performance of the agricultural sector. The economy performs well when agriculture is thriving.

The agricultural sector has a dualistic nature made up of a fairly advanced large-scale commercial sub-sector and a smallholder sub-sector which is poor, less developed and still needs a lot of support. For the purposes of relating climate, soils and topography Zimbabwe is divided into five Agro-ecological zones or Natural Regions (NRs). NRs I, II and III are areas of higher agricultural potential and cover about 35 percent of the land area. NRs IV and V comprise the remaining 65 percent of land area, and these are areas of poor soils, low and erratic rainfall and hence of poor agricultural potential. The commercial sub-sector occupies about 12 million hectares and 56 percent of this is located in NRs I, II and III. The small-scale sub-sector occupies 16.3 million hectares, 75 percent of which lies in low potential Agro-ecological zones IV and V. Therefore dryland farming in the majority of the smallholder sub-sector is unsuccessful. Experience has shown that farmers in these areas on average obtain a good harvest once every 4 to 5 years

2.3 The Zimbabwean irrigation sub sector: A brief overview

At independence in 1980 the new government of Zimbabwe recognised the role of irrigation in agricultural development, especially in improving the production of the smallholder farmers. The government increased its efforts to promote irrigation development in this sector, which had been neglected by the previous colonial government. In about 1983, steps were taken to develop new smallholder irrigation schemes and rehabilitate all the irrigation schemes, which were damaged during the Liberation War.

Zimbabwe has made tremendous strides in smallholder irrigation since 1980. From about 57 malfunctioning schemes covering 2,500 ha in 1980, over 180 formal[1] irrigation schemes have been developed over the years in communal, resettlement and smallscale purchase areas, bringing the total area under smallholder irrigation today to about 12,000 ha. In all, 155,500 ha are under irrigation, and therefore the area under smallholders is about 8.5 percent of the total irrigated area as shown in Table 1. Due to its informal nature micro-scale or garden irrigation in "dambos" or wetlands is not normally included in official estimates of the total irrigation command area. However, it is estimated that about 30,000 ha is under micro-scale irrigation in the country, mainly in the "dambos" or wetlands.

[1] That is those schemes that were initiated and financed by government.

Table 1. Current status of irrigation development in Zimbabwe.

Sector	Area under irrigation (ha)	As % of total area under irrigation
Large-scale commercial farms	126,000	81
Government farms	13,500	8.5
Outgrower schemes[a]	3,000	2
Smallholder (including small-scale purchase areas)	13,000	8.5
Total	155,500	100

[a]Outgrower schemes refer to a group of individual plot holders adjacent and linked to a core estate. The outgrowers irrigate a crop independently but on behalf of the main estate. The plot holders depend on the main estate for provision of irrigation water, transport, managerial, technical and marketing services.

Source: AGRITEX estimates, 1999.

Smallholder irrigation schemes in Zimbabwe are of two basic categories: supplementary (“part--time” irrigation) schemes and full production (“full-time” irrigation) schemes. In the first category the irrigated plot size per household is typically 0.1–0.5 ha and the farmers combine irrigation with dryland farming activities. Income derived from irrigation is used to supplement income from dryland production. In “full-time” irrigation schemes plot sizes are typically 0.5–2 ha per household. Such plot sizes are meant to provide full-time occupation with irrigation. Irrigation farmers on such schemes are not expected to be engaged also in dryland agriculture.

The main water sources for smallholder schemes have been water stored in medium-sized and large dams. Other important sources has been river flow, deep motorised bore-holes, sand abstraction systems, shallow wells and springs. Irrigation technologies in use in this sub-sector include surface irrigation, which comprises 68 percent of the schemes, and sprinkler irrigation, which makes up 32 percent of the schemes. In terms of area, 89 percent of the area is under surface irrigation and 11 percent is sprinkler irrigated. Localised irrigation[2] is not yet in use the smallholder irrigation sub-sector.

In terms of management, there are three broad types of smallholder schemes: government-managed, farmer-managed and jointly managed schemes. Government-managed schemes are developed and maintained by the Department of Agricultural Technical and Extension Services (AGRITEX). In the new schemes there tend to be a shift away from this practice and towards farmer-managed projects. Farmer-managed schemes are developed by the government but owned and managed by the farmers’ Irrigation Management Committees (IMCs) with minimal government interventions in terms of management. For jointly-managed schemes the farmers and government share the financial responsibility for operation and maintenance. For such schemes, the government is usually responsible for the headworks (i.e., dam or weir, pumping station and conveyance system up to field edge), while farmers take responsibility for the infield infrastructure. In terms of scheme numbers, 50 percent of the smallholder schemes are farmer-managed, 32 percent are government-managed and 18 percent are jointly managed. However, in terms of area, the government is still managing a larger hectarage, as most of the farmer-managed schemes tend to be small.

3. Socio-economic impact of selected smallholder irrigation schemes in Zimbabwe

In an attempt to contribute to a better understanding of the smallholder irrigation sub-sector in Zimbabwe, a socio-economic performance evaluation was carried out on five selected smallholder irrigation schemes. The schemes were known to be doing well although in varying degrees. The objective of pre-selecting the good schemes was to find out what factors make good schemes perform well.

[2] Drip irrigation is being piloted in the smallholder sub-sector under the FAO Special Programme for Food Security (SPFS).

3.1 The schemes

Table 2 presents some of the important features of the five schemes studied. The studied schemes varied in size from 9 ha to 92 ha. Three of the schemes are under sprinkler irrigation and two are under surface irrigation. Two of the schemes are located in resettlement areas and the other three are in communal areas. All schemes except Murara are within 150 km from a major town. The schemes at Murara and Mzinyathini were initiated by government in its attempts to provide the farmers with a source of self-sustenance. The farmers did not actually request this development. At Chitora, Hama Mavhaire and Wenimbi the farmers identified the project and approached the government for help. The farmers made financial contributions for the development of infield works. In the other two schemes farmers did not participate or contribute during planning and implementation. All the schemes are farmer-managed except Hama Mavhaire, which is jointly managed by government and the farmers.

Table 2. Major features of the selected schemes.

Name of scheme	District	NR	Size (ha)	Plot size (ha)	Major crops grown	Cropping intensity (%)	Type of management	Irrigation system
Chitora	Mutoko	III	9	0.5	vegetables	± 300	Farmers	Drag-hose sprinkler
Hama Mavhaire	Mvuma	IV	92	1.0	vegetables and food crops	± 200	Joint Government and Farmers	Semi-portable sprinkler
Murara	Mutoko	IV	18	0.5	vegetables	± 200	Farmers	Surface irrigation
Mzinyathini	Umzingwane	IV	32	0.4	food crops; some vegetables	± 200	Farmers	Surface irrigation
Wenimbi	Marondera	III	34	1.55	food crops; some vegetables	± 150	Farmers	Drag-hose sprinkler

The impacts of the smallholder schemes were examined in relation to several aspects, as described in the following paragraphs.

3.2 Agricultural performance

3.2.1 Crop yields

The evaluation revealed that crop yields can go up many-fold with irrigation. For example at Chitora during the 1997/98 season groundnuts yields were recorded to be 4 t/ha, as compared to 0.7–1 t/ha obtained under dryland. Maize yields were 6 t/ha in Murara, compared to l–2 t/ha obtained under dryland. Table 3 presents the yields of selected crops under irrigation as compared to dryland at the different schemes studied.

Table 3. Average yields for selected crops at the different irrigation schemes during the 1997/1998 season.

Scheme	Maize	Green maize[a]	Wheat	Tomatoes	Beans	Groundnuts
Chitora	–	40,000	–	40	–	4
Hama Mavhaire	7	35,000	–	–	3	3
Murara	6	35,000	–	28	2	–
Mzinyathini	7	–	–	20	–	2
Wenimbi	7	37,000	–	30	–	–
Average dryland yields	1.5	–	–	–	–	0.7 – 1

[a] Yield for green maize is given in cobs.
Note: — crop not grown on this scheme.
Source: AGRITEX and farmers' estimates, 1999.

3.2.2 Cropping patterns

The evaluation of the successful irrigation schemes showed that under irrigation high cropping intensities are practised (Table 2). Table 4 indicates the general cropping patterns practised at the five schemes. Crops unknown to communal farmers, like baby corn, cucumbers, carrots, butternuts, green pepper, peas and potatoes can now be grown. The cropping pattern is normally dominated by vegetables and high-value crops, so that the farmers can generate enough income to operate and maintain the irrigation schemes. The production of high-value crops for both local and export markets by some of these schemes means that they are now participating in the mainstream economy. The cropping pattern in most cases is a compromise between subsistence requirements, availability of sound agronomic rotations, roads infrastructure, proximity to markets and marketing demand.

Table 4. Crops grown at the different schemes.

Scheme	Crops
Chitora	Cucumber, green mealies, potatoes, beans, green pepper, butternut, groundnuts, onion, rape, carrots, tomatoes.
Hama Mavhaire	Green mealies, peas, beans, groundnuts, grain maize.
Murara	Tomatoes, potatoes, green mealies, beans, onion, rape.
Mzinyathini	Maize, groundnuts, sugar beans, wheat, cabbage, rape, tomatoes
Wenimbi	Tomatoes, green maize, grain maize, leafy vegetables

Source: AGRITEX 1999.

3.3 Incomes derived from the irrigation schemes

The evaluation of the case studies has indicated that smallholder irrigation schemes can be reliable sources of income. Farmer incomes derived from the schemes are shown in Table 5. At the time of study individual farmers in these schemes were getting monthly incomes as high as Z$5,833 per farmer per month from plots of just 1 ha, while dryland incomes can be as low as Z$1,000 per month per farmer from an average 6 ha plot size. The incomes were higher than the minimum wage of Z$1,400 per month which is paid for unskilled labour in the Zimbabwean industry and the minimum wage of Z$600 per month which is paid for unskilled labour in the agricultural industry of Zimbabwe. From a social point of view a farmer in an irrigation scheme is certainly much better off than labourers in urban industries who are faced with a lot of other demands like rent, water and electricity charges on their incomes. This gives every reason for the government to channel more resources to small-holder irrigation development.

Table 5. Net incomes derived from the irrigation schemes during the 1997/1998 season.

Scheme	Plot size (ha)	Average annual family income (Z$)	Income per ha (Z$)	Average income per farmer per month (Z$)
Chitora	0.5	60,000	120,000	5,000
Hama Mavhaire	1.0	70,000	70,000	5,833
Murara	0.5	25,000	50,000	2,083
Mzinyathini	0.4	20,000	50,000	1,667
Wenimbi	1.55	79,000	50,968	6,583

Note: US$1= Z$33 (December 1998).
Source: AGRITEX extension staff and farmers. 1999.

3.4 Financial and economic analysis

To evaluate further the viability of the irrigation schemes, a financial and economic analysis was conducted on all five projects to judge their impacts on the farmers and the government in addition to their impact from the point of view of society. The analysis follows the “time adjusted cash flow approach" which assumes that every transaction falls at the end of the accounting period (end of year in this case). This means the initial investment is considered to have taken place during the first year of the project. A constant price approach was also adopted, thus expressing the costs and benefits in real terms. The results of the analysis are shown in Table 6 where the Financial Internal Rate of Return (FIRR), Net Present Value (NPV) and Economic Internal Rate of Return (EIRR) are used as the financial and economic indicators. From Table 6 it transpires that all the irrigation schemes studied are financially and economically viable based solely on the indicators. The viability of these schemes can be attributed to the high incomes derived by the farmers who grow high-value horticultural crops.

Table 6. Results of the financial and economic analyses of the irrigation schemes.

Scheme	Financial analysis[1]		Economic analysis[2]
	FIRR(%)	NPV (Z$)	EIRR(%)
Chitora	85[3]	230,947	90
Hama Mavhaire	17	1,985,548	17
Murara	45[3]	635,058	50
Mzinyathini	24	62,524	19
Wenimbi	68[3]	410,965	71

[1]The discount rate used for the financial analysis was 9.75 percent.
[2]The opportunity cost of capital used for the economic analysis was 8.5 percent.
[3]The very high FIRR is attributed to the negligible cost of head works (because of either direct abstraction from a river or already existing dam), and high percentage of horticultural crops in the cropping programme. The schemes have a reasonable access to markets.

Care should be taken in the interpretation of the financial and economic analysis figures presented in Table 6. The results reveal very useful information on the performance of the individual irrigation schemes but a direct comparison cannot be made between the schemes due to the different conditions on each scheme.

3.5 Employment generation

Irrigation is one way of generating employment in rural areas. All the five schemes studied were found to hire labour additional to that provided by the irrigating households to assist in land preparation, planting, weeding and harvesting. For example, at a typical viable small-holder irrigation scheme 1 ha of irrigated tomatoes will require 120 labour days for planting, weeding, harvesting and marketing over a period of three months. At a rate of Z$30 per labour day, this translates into Z$3,600 per hectare for one crop only. Successful schemes can practise a cropping intensity as high as 250 percent. This means in one year a 1-ha plot will require Z$9,000 for hired labour. Taking, for example, a successful scheme like Hama Mavhaire (92 ha), this scheme will employ about 115 people permanently for one year at the agricultural minimum wage of Z$600 per month. Payment is normally in kind and cash. For example at Chitora it was found that a labourer hired in the scheme was paid Z$20 per day plus vegetables to take home. The irrigation schemes which grow high-value horticultural crops employ much more labour than the schemes which concentrate on grain crops.

The availability of employment in the irrigation schemes is also important in terms of reduction of rural to urban migration. It is important to appreciate that a reduction in migration is in fact a saving for the urban municipalities in terms of an avoided cost of providing services like housing, water, sewerage, education and health to potential migrants.

3.6 Food security

According to the findings of FAO (1997) Zimbabwe's food situation is characterised by food security at national level but food insecurity at micro level. The major area of concern is the availability of food at household level. The five irrigation schemes were found to act as sources of food security for the participants and the surrounding communities through increased productivity, stable production and increased incomes. Some of the schemes like Murara and Hama Mavhaire are located in harsh climatic regions where people cannot grow enough to feed themselves because of unfavourable weather conditions. The farmers participating in the irrigation schemes never run out of food, unlike their dryland counterparts. The payment of hired labour in kind by most schemes also ensures food security and better nutrition.

3.7 Drought relief savings

The Government of Zimbabwe (GOZ) has spent large amounts of money since 1980 on drought relief. Irrigation development can contribute towards drought savings. The importance of irrigation in drought relief savings can be better illustrated by a comparative analysis of the cost of a drought relief programme and the investment required in irrigation to obtain a similar relief.

Consider 1,000 families living in NR V, where rainfall is erratic, unreliable and inadequate for any meaningful dryland cultivation. The aim of the drought relief programme is to supply at least 550 kg annually to each family of six persons. If these families were placed on a drought relief programme they would require 550 tonnes of maize per annum. The government expenditure in 1998 to purchase this quantity of maize, at Z$2,400 per tonne, would be Z$1.32 million. The estimated transport cost would be Z$110,000 and the administrative cost would amount to another Z$200,000, making a total annual drought relief cost of Z$1.63 million.

The question now is, can small-holder irrigation schemes produce the equivalent of drought relief and at what cost? If an average yield of 6 t/ha is assumed for maize in the smallholder schemes, 92 ha would be needed to produce 550 tonnes annually. The total cost of developing 92 ha at Z$70,000 per hectare in 1998 was Z$6.44 million. The annual financial equivalent (which is obtained by multiplying the investment cost by the capital recovery factor for 20 years at a 9.75% discount rate) is Z$0.74 million. The production cost for maize produced on 92 ha is about Z$0.37 million. This means the total annual cost of producing maize is Z$1.11 million.

From the above analysis the cost of irrigation is Z$0.52 million less than the cost of drought relief. Furthermore, the experience with drought relief is that it does not get to people who need it most. In fact, under normal circumstances, a complete drought relief package includes other commodities such as beans which if included can double the cost of drought relief, thereby making irrigation much more attractive.

Clearly smallholder irrigation is important as a development strategy since it results in government savings and ensures access to food by smallholder farmers. Farmers enjoy the human dignity of producing their own food instead of continuous food hand-outs from the government.

3.8 Acquisition of assets

The evaluation of the schemes showed that their participants acquired various assets. This was clearly illustrated by Chitora irrigation scheme. The participants who used to live with their parents before the scheme now have brick walled houses of their own. They are all married and own various household assets, electrical goods and farm implements. The farmers confirmed that their standard of living had indeed improved. At Hama Mavhaire about 29 percent of the plot holders were reported to have bought between one and four head of cattle from the proceeds of the scheme. About 65 had bought at least a donkey, 13 percent had put a brick under asbestos or corrugated iron sheet house, and 105 had installed a solar panel (Agritex 1999). At Wenimbi, farmers have managed to buy a second-hand five tonne truck to transport their produce to the market. Three farmers on this scheme had managed each to buy a small car. The conclusion that can be drawn from these observations on the five schemes is that well performing smallholder irrigation schemes can permit accumulation of wealth by the participants.

3.9 Entrepreneurial skills

The irrigation schemes have afforded the farmers an opportunity to operate on a commercial basis. Most of the schemes have had their participants acquiring entrepreneurial skills. This is evidenced by the ability of the farmers to do their own budgeting, keep record books and manage their own affairs. These skills are most evident in farmer-managed schemes. Farmers have to search for marketing information, organise cropping programmes which fit the markets, and organise transport to such markets. They are also capable of negotiating contracts, although they still need assistance in this aspect.

3.10 Backward and forward linkages

The increased demand for inputs from local dealers, necessitated by the growing of horticultural crops in most schemes is an example of the backward linkages offered by the smallholder irrigation schemes. All the five schemes studied provide some degree of demand for inputs in their areas. Transport, which is hired for marketing by schemes such as Chitora, Hama Mavhaire and Murara is another example. The fact that most schemes go for more than 150 percent cropping intensity means that most input suppliers and transporters are in business all year around. This is different from input suppliers and transporters who service dryland farmers, who experience brisk business only in summer.

The demand for scheme produce by some vegetable canning and grain processing private companies in Zimbabwe such as National Foods, Hortico, Olivine and Interfresh is an example of the forward linkages offered by irrigation schemes. By offering such produce, the schemes create businesses and employment in the companies they supply and contribute to increased labour

The establishment of the irrigation schemes has resulted in the provision of infrastructure around which other economic activities take effect. The electrification of the pumping station at Hama Mavhaire, for example, has resulted in the nearby shopping centre being also electrified. A study of the scheme found that before the scheme there was only one general dealer shop, one bottle store and one diesel-powered grinding mill. Now there are four general dealer shops, two bottle stores, one hardware store, one butchery and five electrically driven grinding mills. At Chitora before the scheme the nearest shopping centre was at Mutoko, 60 km away. However after the establishment of Chitora irrigation scheme and two other adjacent schemes, a vibrant business centre namely Corner store was established only 16 km from the scheme as a result of the increased economic activities brought about by the irrigation schemes.

3.11 Conservation of natural resources

The irrigation schemes evaluated were seen to contribute in a way to the conservation of natural resources. While the dryland farmers adjacent to Murara irrigation scheme were engaged in gold panning to earn a living, the irrigators were not. Irrigation offers full-time employment such that the farmers are distracted from engaging in environmentally destructive activities like gold panning.[3] The irrigation farmers also use the irrigation schemes as sources of income for further investment in resource management. This was clearly illustrated again by the farmers from Murara, who are planting trees and woodlots making use of extra income derived from irrigation.

3.12 Economic development

The fact that the irrigation schemes result in the increase in incomes for the farmers means that the schemes are promoting economic development of the nation, which is measured by the well-being of the people. The changes which occur to the people, such as improved houses for farmers, better nutrition, self-reliance, improved assets etc., are part of economic development. The high Economic Rates of Return obtained for Chitora (90%), Murara (50 percent), and Wenimbi (71 percent) show that some irrigation projects can significantly contribute towards increasing national income.

4. Summary of findings

The successes of smallholder irrigation development are many and varied. Some of these are quantifiable while others are not. The major findings of the socio-economic evaluation of the five successful irrigation schemes can be summarised as follows:

[3] Gold panning is a process whereby people illegally dig deeper channels on the river banks. The process is very dangerous for both people and the environment. During the digging process the channels usually collapse resulting in injuries or even deaths of the panners. The process also results in the formation of gullies, soil degradation and subsequent siltation of rivers.

- Smallholder irrigation can be indeed financially and economically viable if it is planned, implemented and managed in the right way. The major determining factors for viability in small-holder irrigation include planning and construction, type of scheme management, type of technology, appropriateness of design, institutional support, cropping programmes, availability of markets, marketing strategies, and commitment of the farmers.
- Crop yields and farmer incomes under small-holder irrigation can increase many fold with irrigation.
- Crops hitherto unknown to communal farmers, e.g., baby corn, peas, potatoes, okra, paprika etc., can now be grown under irrigation.
- Smallholder irrigators are now able to grow high-value crops both for the local and export markets, thus effectively participating in the main stream economy.
- In times of severe droughts smallholder irrigation schemes act as a source of food security at the household level.
- In areas of very low rainfall farmers practising irrigation enjoy the human dignity of producing their own food instead of depending on continuous drought relief hand-outs from the government. In addition drought relief programmes are difficult and expensive for the government to implement, in terms of both logistics and resources.
- Smallholder irrigation development has made it possible for other rural infrastructure to be developed in areas which would otherwise have remained without roads, telephones, electricity, schools, or shops.
- Smallholder irrigators have developed a commercial mentality and acquired various entrepreneurial skills.
- Farmers in successful irrigation schemes have acquired personal assets (improved housing, farm implements, furniture, electrical appliances) and their standard of living has improved substantially.
- Irrigation schemes provide an alternative source of employment to the rural people, thereby discouraging rural to urban migration.

5. Recommendations

Smallholder irrigation should be expanded through the construction of new schemes and the rehabilitation of existing ones. The evaluation of existing viable smallholder irrigation schemes in Zimbabwe led to the following recommendations:

- Develop farmer-managed irrigation schemes. In addition to being more successful, they remove the financial burden of operation and maintenance from government.
- Farmers should participate in all project phases from planning to implementation, management and evaluation.
- A bottom-up approach should be followed in smallholder irrigation development, treating farmers as “owners” rather than “beneficiaries” of a project.
- If farmers are expected to participate in the development of a project they should be in a position to make well-informed decisions. They should be informed from the beginning of what is expected of them and what impact this development will have on their lives. Training, including tours of schemes in operation and discussions with the users of these schemes on the different aspects of irrigation development, is indispensable.

- Government should find a way to transfer gradually the management of irrigation schemes to the farmers. Only technically sound schemes should be transferred and farmers should be trained and supported to overcome the transitional period.
- Training of farmers in water management, irrigated crop production, and marketing as well as general management and operation and maintenance are considered as necessary.
- In the absence of credit for inputs, it is important to help farmers with inputs during the first season so that they can build a cash flow base.
- Institutional support through technical and extension services should be strengthened to support the farmers effectively.
- Continuous monitoring and evaluation of irrigation schemes jointly with farmers is necessary, to provide feedback to the planners and to assist the farmers to improve their performance.
- An integrated rural development approach should be followed for any irrigation development.

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Développement de la petite irrigation privée en Afrique de l'Ouest: Leçons tirées des projets financés par la Banque mondiale

Development of small-scale private irrigation in West Africa: Lessons drawn from World Bank financed projects

F. Gadelle

Résumé

Si les périmètres irrigués, grands ou petits, aménagés par l'Etat en Afrique de l'Ouest ont en grande partie échoué, l'irrigation individuelle s'est développée, surtout pour les fruits et légumes. La Banque mondiale appuie des projets de promotion de l'irrigation privée au Burkina Faso, Mali, Mauritanie et Niger. Cet article présente les enseignements tirés de ces projets portant sur: (a) la nécessité de bien définir le rôle de l'Etat, oscillant entre absence de contrôle et micro-contrôle, (b) le besoin d'améliorer les équipements pour pouvoir exploiter les eaux profondes et économiser l'eau d'irrigation, et de développer des motopompes moins coûteuses, (c) le financement des investissements, (d) l'assistance technique à la mise en valeur et à la gestion des exploitations ainsi qu'aux opérations post-récolte, (e) la prise en compte des dimensions environnementales et sociales, (f) la viabilité et durabilité de projets après l'arrêt de soutien externe, et (g) les limites objectives posées au développement de la petite irrigation en Afrique de l'Ouest par la rareté relative des ressources en eau dans la région.

Abstract

While government-sponsored irrigation schemes in West Africa, be they large or small-scale, have largely failed, the development of individual irrigation has made considerable strides, especially for vegetable and fruit production. The World Bank presently supports private irrigation promotion projects in Burkina Faso, Mali, Mauritania and Niger. Drawing on lessons learnt from these projects, the paper discusses: (a) the need to clearly define the role of governments, wavering between lack of control and micro-management, (b) the need for improvements to equipment to allow use of deeper aquifers and save water as well as the development of less costly motorized pumps, (c) financing of investments, (d) technical assistance for the operation and management of farms and for post-harvest operations, (e) the need to include environmental and social dimensions, (f) the long-term viability and sustainability of projects after the end of external financing, and (g) the relative scarcity of water resources in West Africa, which limits the expansion of private small-scale irrigation in the region.

1. Nécessité de développer l'irrigation privée en Afrique de l'Ouest

1.1 Besoins de la région en produits provenant de l'agriculture irriguée

Même si l'autosuffisance alimentaire est probablement un objectif irréaliste, l'Afrique de l'Ouest a besoin de produire des céréales, des fruits et des légumes, sans même parler d'autres produits agricoles (oléagineux, sucre, coton, fourrages, etc.). Le tableau 1 montre que les importations alimentaires de l'Afrique de l'Ouest portent surtout sur le blé, difficile à produire localement pour des raisons climatiques, et le riz qui doit être produit sous irrigation dans la plupart des pays de la région. D'après les prévisions pour 2025, les importations de riz croîtront jusqu'à 5 millions de tonnes si la production n'augmente pas plus vite que par le passé. Cela implique d'irriguer près d'un million d'hectares supplémentaires même si des progrès importants peuvent être faits sur la production de riz pluvial et sur les rendements des périmètres existants. Aux besoins pour l'irrigation des céréales, s'ajoutent ceux pour la production de sucre et de fruits et légumes. Ces derniers seuls atteindraient 30 millions de tonnes en 2025, ce qui nécessiterait d'irriguer 1,5 à 2,0 millions d'hectares.

Tableau 1. Production et importations de céréales, fruits et légumes en Afrique de l’Ouest (en milliers de tonnes) – Année 1999.

Produits	Production	Importations	Approvisionnement
	Céréales		
Blé	122	3 196	3 074
Riz usiné	4 835	4 132	7 173
Autres céréales	31 418	331	31 770
Total céréales	36 375	6 795	32 157
	Fruits et légumes		
Fruits (sauf melons)	15 290		13 068
Légumes et melons	11 406		10 499
Total fruits et légumes	26 696	(345)	23 567

N.B. Les chiffres d’importations et de production ne prennent pas en compte les pertes.
Source : FAO/IPTRID, 1999, actualisé.

1.2 Résultats actuels du développement de l’irrigation

Bien qu’ayant toujours fait partie des priorités des gouvernements, l’irrigation dans la région n’a pas rencontré un grand succès. Les surfaces cultivées sous irrigation officielle sont restées marginales et les productions issues de ces surfaces ont peu contribué à la satisfaction des besoins des populations. En effet, moins de 10 pourcent d’un potentiel irrigable global estimé à plus de 10 millions d’hectares en Afrique de l’Ouest sont effectivement irrigués aujourd’hui. Cet échec relatif des politiques d’irrigation passées est encore plus sévère si l’on considère que la plupart des grands périmètres ont été financés par l’aide extérieure à des coûts très élevés, parfois au prix d’un endettement croissant des Etats.

En effet, peu avant et après les indépendances, l’Etat a financé de grands et moyens aménagements pour la culture du riz, de la canne à sucre ou des céréales de crue et décrue contrôlée. Ces aménagements étaient le plus souvent gérés par l’administration ou des sociétés para-étatiques. Vu leurs résultats médiocres, leur développement a été fortement freiné depuis une quinzaine d’années. Les investissements se limitent le plus souvent à leur réhabilitation, sauf pour l’Office du Niger au Mali où les extensions ont recommencé récemment à la suite du succès des premières réhabilitations, succès dû à des conditions favorables rendant les aménagements peu coûteux (irrigation gravitaire, investissements de base déjà existants, grandes étendues de terres à faible micro-relief). Le transfert des périmètres à des associations d’usagers ou leur privatisation est en cours malgré de nombreuses difficultés pour financer le gros entretien et le renouvellement des équipements de pompage.

Au début des années 70, pour pallier les effets de la sécheresse, les gouvernements ont suscité la création de périmètres villageois, d’abord dans la vallée du Sénégal puis dans la vallée du Niger au Mali. Ces aménagements villageois, souvent mal construits, avaient surtout un but social: les surfaces données à chaque attributaire lui permettent seulement de survivre mais pas de se développer. Beaucoup de ces périmètres fonctionnent mal faute d’entretien des infrastructures et de renouvellement des motopompes.

Depuis une vingtaine d’années, on a commencé à mettre en valeur les bas-fonds où les sols sont plus fertiles et mieux alimentés en eau. Il est encore trop tôt pour savoir si ces aménagements, le plus souvent réalisés avec la participation des populations, sont plus durables que les autres.

1.3 Raisons de l’engouement pour l’irrigation privée

Pendant que les aménagements d’origine étatique n’obtenaient pas de résultats probants, l’irrigation d’initiative “privée,[1]” c’est à dire individuelle le plus souvent, s’est développée dans trois directions principales:

[1]En fait, les terres ne sont jamais cultivées collectivement. Même dans les grands aménagements, la terre est attribuée individuellement aux exploitants. La distinction « public-privé» provient plutôt du financement des investissements, avec participation importante de l ’état dans le premier cas. Elle provient aussi de ce que les irriguants privés sont libres de choisir les cultures, la manière de les pratiquer et de commercialiser les produits.

- De nombreux petits maraîchers assurent l'approvisionnement des villes et même des pays voisins à partir des ceintures péri-urbaines ou de zones traditionnelles de production comme le pays Dogon au Mali ou la région de Galmi au Niger, toutes deux spécialisées dans la production d'oignons. Le Nigeria constitue un cas à part dans la mesure où les producteurs dans les vallées du Nord (fadamas) ont profité de subventions sur les carburants pour accroître leurs surfaces irriguées de céréales et maraîchage.
- Des investisseurs d'origine urbaine se sont lancés dans la production de fruits en "grandes" plantations autour des villes et de riz dans la vallée du Sénégal. Ils ont été très peu aidés, au moins officiellement, bien qu'ils aient souvent bénéficié de passe-droits (taxes non payées, emprunts non remboursés, etc.).
- Des investisseurs, parfois étrangers, ont lancé des grandes exploitations pour les bananes, les ananas…, tournées vers l'exportation. Ils sortent du cadre de ce document.

La prise de conscience que les aménagements « privés » avaient permis de satisfaire la plupart des besoins en maraîchage et en fruits, voire même d'exporter des produits à haute valeur ajoutée, a conduit les gouvernements et les bailleurs de fonds à vouloir appuyer les petites initiatives privées. Cette idée a été confortée par plusieurs arguments:

- L'aide extérieure, qui a jusqu'ici financé la plus grande part des coûts d'investissement (et de réhabilitation) dans les périmètres, va devenir de plus en plus rare car elle va être affectée à d'autres besoins: santé, appuis aux réformes institutionnelles, etc.
- L'appui aux irrigations privées se limite à un appui à l'investissement initial; en cas d'échec, le risque est supporté par l'investisseur et il n'est pas besoin de réhabilitation ou d'aide au fonctionnement; l'appui à l'investissement devrait être moins coûteux à l'hectare que pour les grands aménagements (il n'y a pas d'économies d'échelle en irrigation).
- Les agriculteurs africains sont plus individualistes que ce qu'ont pensé leurs dirigeants et les bailleurs de fonds en privilégiant l'esprit communautaire. Même dans les aménagements dits villageois, les tensions sociales gênent la perception des redevances d'irrigation.

1.4 Nouvelles stratégies de développement de l'irrigation

Le développement de l'irrigation privée se fait dans le cadre de nouvelles stratégies nationales qui s'inscrivent dans une politique globale de développement rural et de gestion des ressources en eau (FAO 1995, FAO 1999a). Celles-ci ont en commun (Gouvernement du Mali 1999, Gouvernement de la Mauritanie 1997, FAO 1999b pour le Sénégal, FAO 1999c pour la Côte d'Ivoire, FAO 2001a et FAO 2001b pour le Niger) de: (i) redéfinir les rôles respectifs de l'Etat et des autres intervenants (secteur public, organisations paysannes, société civile), (ii) faire participer les agriculteurs à la conception, au financement, à la réalisation et à la gestion des aménagements, (iii) privilégier les aménagements individuels ou pour petits groupes, y inclus dans les bas-fonds, au détriment des moyens et grands périmètres jugés trop coûteux et peu performants, (iv) prendre en compte les solutions alternatives (production pluviale, importations) sans préjugés, priorité étant donnée à la rentabilité financière et économique des productions, (v) inclure des préoccupations d'impact environnemental et de justice sociale dans la conception des aménagements, (vi) faire payer par les bénéficiaires la totalité des coûts d'entretien et de gestion ainsi que le remboursement partiel des coûts d'investissement, (vii) éliminer les obstacles réglementaires (formalités administratives, etc.) et financiers (taxes, monopoles...) aussi bien aux investissements d'irrigation qu'à l'aval et l'amont, (viii) supprimer les contraintes économiques (financement des investissements et de la mise en valeur, prise en compte des activités en amont et en aval de la production), et (ix) promouvoir une recherche sur l'irrigation orientée par la demande des paysans ou des aménagistes.

1.5 Projets à la base du présent document

Il s'est révélé difficile d'appliquer les stratégies définies ci-dessus dans le cas de la promotion de l'irrigation privée, dans la mesure où celle-ci était très mal connue car les études antérieures sur le développement de l'irrigation s'étaient limitées aux seuls aménagements aidés par l'état En outre, l'idée d'utiliser des fonds publics pour promouvoir des activités individuelles a souvent heurté des décideurs politiques. Les premiers projets qui ont été financés dans ce domaine ont donc eu un caractère pilote aussi bien sur le plan technique qu'institutionnel. La Banque mondiale, en particulier, a appuyé quatre projets ayant pour objectif unique ou important la promotion de l'irrigation privée:

- le projet pilote de promotion de l'irrigation privée au Niger, PPIP, dont une deuxième phase, PPIP 2, est en cours de préparation (Banque mondiale 1995 et 2001);
- le projet pilote de promotion de l'irrigation privée au Mali, PPIP (Banque mondiale 1997);
- le projet pilote de promotion de l'irrigation privée et des activités connexes au Burkina Faso, (Banque mondiale 1999);
- le programme de développement intégré de l'agriculture irriguée en Mauritanie, PDIAIM, qui prévoit, entre autres activités, d'appuyer le développement de l'irrigation privée pour la riziculture et la diversification (Banque mondiale 1999).

D'autres projets financés par la Banque mondiale, en particulier celui du Nord Nigeria (National Fadama Development Project), ont bien inclus des activités réussies de promotion de la petite irrigation mais cela avait été plutôt considéré comme une alternative à des petits aménagements collectifs.[2] Parmi les autres bailleurs de fonds ayant aidé la petite irrigation, on peut citer:

- La France a aidé le développement agricole des grandes irrigations privées en Mauritanie en appuyant financièrement et techniquement une organisation de producteurs (AGETA,[3]) dans ses activités de vulgarisation et en finançant des « infrastructures structurantes » qui facilitent l'implantation d'irriguants privés;
- L'Union européenne finance des petits irriguants au Niger (Projet d'appui à la sécurité alimentaire par la petite irrigation, ASAPI, en cours de démarrage dans la basse vallée de la Tarka et la région de Zinder); au Mali, après avoir financé des périmètres villageois, elle finance plutôt des périmètres « familiaux » dans la région de Mopti (Projet de valorisation des ressources en eau de surface de la 5ème région du Mali, VRES, 1998);
- L'USAID a financé un projet de diffusion des pompes à pédales au Sénégal (terminé en 1998, Hyman 1996) et continue d'en financer au Mali (Hyman 1998) et au Bénin (ATI 1999); par ailleurs, l'USAID a un financement pour la grande exploitation privée à l'Office du Niger au Mali;
- La BAD et le FIDA appuient des projets de développement de la petite irrigation, entre autres au Mali, au Ghana, en Côte d'Ivoire et au Tchad.

Sauf pour la France en Mauritanie et l'USAID à l'Office du Niger, ces projets promeuvent la petite irrigation plutôt que l'irrigation privée en tant que telle. Cependant, certains enseignements peuvent être tirés de ces projets pour le développement futur de l'irrigation privée en Afrique de l'Ouest.

1.6 Organisation du présent document

Les projets de développement de l'irrigation privée, en particulier ceux financés par la Banque mondiale, ont mis en évidence des problèmes et des solutions concernant l'organisation institutionnelle, les techniques et équipements à promouvoir, l'appui à la mise en valeur, le financement des aménagements ainsi que l'impact environnemental et social des projets d'appui à la promotion de l'irrigation privée. Rappelons ici que l'irrigation privée se définit comme une activité d'initiative privée dans laquelle l'essentiel des coûts est supporté par le promoteur qui est seul responsable des décisions relatives à la production et à la commercialisation: la recherche du profit est donc l'objectif fondamental et non des objectifs publics (autosuffisance alimentaire, équilibre de la balance commerciale…). Le présent document examine donc les solutions adoptées dans chacun des quatre projets du Burkina Faso,

[2] La Banque mondiale va financer un projet de développement de l'irrigation privée à l'Office du Niger au Mali mais cela va se faire dans un contexte très différent.

[3] Association Générale des Groupements d'Exploitants et Eleveurs pour l'Etude et l'Emploi des Techniques Améliorées Agricoles et Animales.

du Mali, de la Mauritanie et du Niger pour résoudre les différents problèmes évoqués ci-dessus. Les leçons tirées de ces projets permettent ainsi de proposer de nouvelles pistes pour rendre l’irrigation privée à la fois plus profitable et plus durable.

2. Organisation institutionnelle des projets

L’organisation institutionnelle des projets de promotion de l’irrigation privée est assez variable selon les Etats. Deux points sont majeurs: la gestion du projet et le contrôle par l’Etat.

2.1 Gestion du projet

- Au Burkina Faso et au Niger, la gestion des projets de promotion de l’irrigation privée a été confiée à des associations de droit privé créées pendant la préparation des projets, APIPAC (Association pour la promotion de l’irrigation privée et des activités connexes) au Burkina Faso et ANPIP (Association nigérienne de promotion de l’irrigation privée) au Niger, composées de personnes physiques et morales ayant des activités dans l’irrigation. Ces associations ont mis en place des agences internes (UTP, Unité technique de projet, et ANPIP) chargées de gérer le projet financé par la Banque mondiale (plus quelques petits projets annexes financés par d’autres bailleurs de fonds). Les problèmes majeurs de ces associations sont leur rôle dans la gestion des projets et leurs ressources après la fin des projets:

  - Actuellement, les associations jouent un faible rôle dans la gestion de leurs agences bien que leurs présidents doivent signer les contrats importants; le directeur de l ’agence est peu contrôlé et agit plutôt comme un chef de projet classique.

  - Seul, le Burkina Faso a commencé à s’atteler au problème de la survie de l’association après le projet en prévoyant des cotisations, bien qu’encore très insuffisantes. Au Niger, l’ANPIP en est seulement à élaborer un plan stratégique. L’alourdissement des frais de gestion des projets que gèrent ces associations ne facilitera pas leur durabilité sauf si elles abandonnent certaines activités secondaires par rapport à leur but principal de promotion de l’irrigation privée.

  - Au Mali, le projet était intégré dans une structure de type holding, l’APROFA (Agence pour la promotion des filières agricoles), qui gérait également un projet de promotion des exportations, PAVCOPA (Projet d’appui à la valorisation des produits agricoles). Devant leurs mauvais résultats, les deux projets ont été fusionnés en un seul projet APROFA, géré par un conseil d’administration composé de personnes morales (Etat, chambre d’agriculture, sociétés de développement…). La durabilité de l’APROFA n’a pas encore été évoquée.

  - En Mauritanie, le projet est géré par un service de l’Etat, l’Unité de coordination du PDIAIM, UC-PDIAIM, rattachée au Ministère chargé du développement rural. La Société nationale de développement rural, SONADER, gère le volet grande irrigation ainsi que les tests et recherches en irrigation et drainage. La SONADER conseille également le Comité de subvention et l’UNCACEM (Union nationale des coopératives agricoles de crédit et d’épargne de Mauritanie) lors de l’instruction des dossiers des agriculteurs en vue de subventions et/ou de crédits.

2.2 Contrôle par l’Etat

Confier la gestion des projets à des associations de droit privé revient à faire gérer des fonds publics, empruntés par l’Etat, par des personnes privées dont la légitimité à les gérer est discutable. Après avoir envisagé de refuser ce type de gestion, les Etats l’ont finalement accepté moyennant un contrôle sur la gestion et l’utilisation des fonds:

- Au Niger, le contrôle a été confié à une Direction du Ministère du développement rural pendant la phase pilote; il sera confié à un Comité de suivi et d’orientation, CSO, pendant la 2ème phase. Ce CSO approuvera les programmes et budgets ainsi que les rapports d’exécution technique et financière. Il approuvera aussi les subventions aux agriculteurs. Au début de la phase pilote, le Gouvernement gérait le volet environnement du projet mais cette gestion a été inefficace et, maintenant, l'ensemble du projet est géré par l'ANPIP qui fait largement appel à des sous-traitants spécialisés.

- Au Mali, le Ministère suit le projet APROFA de manière analogue au Niger, c'est à dire d'assez loin.
- Au Burkina Faso, un Comité d'orientation et de suivi, COS, suit les programmes et les budgets. Une Unité de coordination financière, UCOF, dépendante du Ministère de l'Agriculture, suit l'exécution du projet au jour le jour. Elle vise les contrats d'un montant supérieur à un million FCFA (US$1400) passés par l'APIPAC; elle gère elle-même une partie des crédits du projet: environnement, suivi-évaluation, audits, achat des logiciels de gestion financière et des équipements (pour que ceux-ci restent propriété du Gouvernement Burkinabé et non de l'APIPAC). Cette micro-gestion s'est révélée lourde et finalement assez inefficace.

3. Problèmes et solutions techniques

3.1 Typologie de l'irrigation privée

La typologie des périmètres irrigués privés permet en gros de les classer en cinq types:

- la petite exploitation maraîchère irriguée manuellement par arrosoir, calebasse ou shadouf, parfois delou (système à traction animale d'origine arabe utilisé au Nord Niger); les tailles réelles d'exploitation (surfaces irriguées hors chemins et zones perdues) sont très petites, moins de 0,1 ha généralement, sauf dans le cas du délou où on arrive à un demi-hectare;
- l'exploitation maraîchère utilisant la pompe à pédales, de 0,2 à 0,4 ha;
- l'exploitation maraîchère utilisant une petite pompe à moteur deux temps (3 à 5 CV); sa surface se situe entre moins de 1 ha et 2 ha;
- l'exploitation maraîchère et fruitière utilisant une motopompe diesel, d'une taille supérieure (5 à 12 CV), jusqu'à cinq hectares, parfois plus pour les producteurs de bananes et d'ananas de Côte d'Ivoire ou du Ghana (20 à 25 CV pour l'aspersion ou le goutte à goutte sur une dizaine d'ha);
- l'exploitation rizicole mécanisée pouvant aller jusqu'à plusieurs centaines d'hectares qu'on trouve dans le delta du fleuve Sénégal, en Mauritanie et au Sénégal.

3.2 Contenu technique des projets de promotion de l'irrigation privée

Le contenu technique des projets de promotion de l'irrigation privée est variable selon les Etats:

<u>Taille des exploitations</u>: Les projets qui ont bénéficié d'un financement de la Banque mondiale appuient les exploitations de moins de 10 ha au Burkina Faso et au Niger, avec une nette orientation vers les exploitations de moins d'un hectare dans ce dernier pays où on utilise principalement des nappes souterraines. Au Mali, les petites exploitations faisaient déjà l'objet d'un appui de l'USAID avant l'arrivée du projet de la Banque mondiale qui s'intéresse donc aux exploitations plus grandes, principalement autour des villes. En Mauritanie, le projet PDIAIM s'intéresse aux exploitations de plus de cinq hectares, qu'elles soient collectives (périmètres villageois) ou privées.[4] Il faut signaler que le VRES au Mali appuie des exploitations « de groupe » où les agriculteurs se regroupent pour réaliser eux-mêmes les investissements autres que les études techniques et l'achat des groupes motopompes.

<u>Tests d'équipements et de technologies pour l'irrigation</u>: Les projets financés par la Banque mondiale ont tous un volet destiné à financer des tests et la diffusion d'équipements et technologies nouveaux:

[4] Lors de la préparation du projet, on a estimé que le potentiel pour la petite irrigation serait trop faible pour justifier l'intervention sur ce seul créneau d'une ONG spécialisée et on avait envisagé de combiner la diffusion de pompes à pédales avec celle de presses à huile et de foyers améliorés. Ce volet a été finalement abandonné.

- En Mauritanie, le PDIAIM (PDIAIM 1999) finance des tests sur des améliorations aux systèmes de pompage, l'introduction de nouvelles technologies d'irrigation (aspersion et goutte à goutte), l'amélioration du drainage (les sols sont salés dans le delta);
- Au Mali, au Burkina et au Niger, les projets de promotion de l'irrigation privée financent l'introduction de technologies et équipements divers après des tests (DIWI 1998).

Autres tests: Les projets du Burkina Faso et du Niger financeront aussi des tests et la diffusion d'équipements de stockage, conservation, transformation et commercialisation des produits maraîchers et fruitiers. Au Mali, ce volet est pris en compte par le projet PAVCOPA financé parallèlement à celui de promotion de l'irrigation privée. En Mauritanie, le PDIAIM a un volet diversification mais plus orienté vers la commercialisation pour l'exportation, au moins au stade de la conception du projet.

Diffusion: La diffusion des équipements a été couplée aux tests et confiée à des opérateurs privés spécialisés, après consultation au Niger (un pour les techniques manuelles et un pour les techniques motorisées) et au Burkina Faso (un pour les techniques manuelles mais on va élargir les tests aux techniques motorisées). Ces opérateurs avaient une grande expérience, en particulier dans la diffusion des petits équipements. Celle-ci s'appuie sur le choix et la formation d'artisans expérimentés et désireux de commercialiser des équipements nouveaux. Ces artisans installent ou vendent eux-mêmes les équipements (forages et pompes à pédales), l'opérateur se limitant à la formation et au suivi technique des artisans ainsi qu'à des démonstrations, des publicités à la radio et la télévision, des participations aux foires agricoles…

Formation: La plupart des projets ont inclus un volet formation des agriculteurs mais aussi des artisans, vendeurs de matériel et bureaux d'études. Jusqu'ici, ce volet s'est surtout limité à la formation des agriculteurs à l'entretien des motopompes. Les formations des autres intervenants n'ont pas fait l'objet de plans de formation ni de beaucoup de réalisations effectives.

3.3 Améliorations techniques en cours de diffusion ou en tests

Des améliorations techniques ont été testées et favorablement accueillies dans certains pays où elles sont déjà en cours de diffusion. Ces améliorations et les progrès restant à faire sont les suivants:

Captage des ressources en eaux souterraines: le forage manuel jusqu'à 10 m de profondeur, à moins de US$ 100, est bien adapté aux terrains sableux. Le forage à la lance est aussi possible bien qu'un peu plus cher. D'autres améliorations doivent encore être testées: forages au vibro-bailer, au battage et à la micro-tarière pour plus grandes profondeurs, puits collecteurs (sans doute trop chers), utilisation des eaux de puits profonds.

Irrigation des micro-périmètres: Jusqu'à 0,4 ha, la pompe à pédales modifiée par l'ONG EWW (EnterpriseWorks Worldwide) au Niger (Pompe Gajera) s'est montrée supérieure aux autres modèles tout en coûtant seulement US$50-60. Pour les agriculteurs qui ne veulent pas pédaler en public, la pompe à main rend le même service mais coûte deux fois plus cher. Des modèles pour forages jusqu'à 15 m de profondeur sont en cours de semi-diffusion mais leur débit est évidemment moindre pour un coût plus élevé (US$170 au Niger). Les solutions utilisant les animaux ne semblent pas reproductibles en dehors de leur zone d'origine.

Irrigation des parcelles plus grandes: Au-delà de 0,5-0,6 ha, il faut passer à la motopompe. Le logiciel PumpSelect (Van't Hof 2001) permet, à partir d'une base de données sur les équipements, de déterminer les motopompes les plus adaptées. Des progrès (Banque mondiale 2001) restent à faire pour: (i) introduire des motopompes d'origine asiatique beaucoup moins coûteuses; (ii) améliorer les performances des moteurs existants; et (iii) former les agriculteurs et les réparateurs à l'entretien des motopompes pour augmenter leur durée de vie. L'utilisation d'autres carburants à partir d'huiles et de résidus végétaux ou des énergies renouvelables (vent, soleil, chutes d'eau) ne semble pas très prometteuse dans les conditions de l'Afrique de l'Ouest bien que des tests doivent être poursuivis dans ces domaines. Pour l'exploitation des nappes profondes, un groupe immergé alimenté en électricité par un groupe électrogène ou le réseau est coûteux. Pour les puits, des solutions simples existent: pompe posée sur une plate-forme ou entraînement de la pompe par courroie depuis un moteur de surface.

Le transport de l'eau en sols sableux peut être effectué par conduites enterrées en plastique de type assainissement, solution mieux adaptée aux petites exploitations que les canaux revêtus de béton ou de maçonnerie; cette amélioration peut être progressive, l'agriculteur remplaçant les canaux en terre par des conduites en fonction de ses moyens.

Pour l'application de l'eau, *l'aspersion* est mal adaptée (pertes en eau par évaporation des gouttelettes, coûts élevés de l'énergie) sauf en zone humide (irrigation des bananes ou de l'ananas) ou en grande culture (canne à sucre) où la main d'œuvre devient un problème. De grands espoirs sont fondés sur le développement de l'irrigation localisée, en particulier celui des micro-kits de 25 m^2 pour jardins familiaux et mini-kits à basse pression de 500 m^2 de surface alimentés en eau à partir de pompes à pédales (Chapin 1999; Netafim 1999).

Pour les grandes exploitations, on connaît bien la riziculture où, en dehors de l'agronomie, les progrès restent plutôt à réaliser dans l'utilisation de stations de pompage mieux adaptées. On connaît beaucoup moins bien l'irrigation des grandes cultures autres que la banane et l'ananas, en particulier les fruits et légumes pour la diversification. L'irrigation en billons de grande longueur est médiocrement pratiquée; l'aspersion s'est révélée trop coûteuse au Sourou au Burkina Faso et à Diré au Mali; l'irrigation localisée est encore très expérimentale. Il y a là tout un domaine pour la recherche.

3.4 Préparation des dossiers de projets d'irrigations

Les grands exploitants demandent un appui aux études destinées à les aider à trouver des crédits bancaires. Au Burkina Faso, au Mali et en Mauritanie, on fait appel à des bureaux d'études privés classiques. Leur choix se fait par les agriculteurs sur la base de listes de bureaux agréés en Mauritanie, par appel à des bureaux choisis au niveau régional après consultation par le projet au Burkina Faso, après consultation au cas par cas par le projet au Mali.

En Mauritanie, le coût des études est subventionné par le projet à 100 pourcent pour les petits agriculteurs, à 80 pourcent pour les exploitants individuels. Au Mali, les études sont subventionnées à 75 pourcent après une visite préliminaire facturée forfaitairement à 3 000 FCFA par le projet. Au Burkina Faso, la subvention est aussi de 75 pourcent.

Les termes de référence des études doivent être techniquement suffisants, adaptés au contexte de la petite exploitation et acceptables par le crédit bancaire si nécessaire:

- En Mauritanie existent des termes de référence types adaptés à la réhabilitation ou la construction nouvelle de périmètres de plus de cinq hectares avec un crédit bancaire à la clé. Ces études font la part belle à la préparation de variantes entre lesquelles l'agriculteur doit choisir en fonction de ses moyens et de la subvention ou du crédit qu'il peut espérer.
- Au Burkina Faso, les premiers dossiers concernant des propriétés de plusieurs hectares ont fait l'objet d'études légères, bien adaptées aux moyennes exploitations et aux petites activités connexes.
- Au Mali, les études ont suivi une méthodologie pour grand périmètre, inadaptée aux petites exploitations et, surtout, à celles qui ne peuvent pas accéder au crédit bancaire.
- Au Niger, le projet a suscité la création de petits bureaux d'études locaux, au statut de groupement d'intérêt économique, GIE, qui se font payer les études et la surveillance des travaux (périmètres de moins de 2 ha) par les agriculteurs pour un prix modique (10 000 FCFA/ha pour les études, 10 % du montant des travaux pour la surveillance). Ces bureaux, formés de jeunes diplômés, complètent leurs revenus par des prestations pour le PPIP (suivi de tests sur exploitations) ou des ONG à des tarifs très bas (20 000 FCFA/jour). Ils viennent de se diversifier avec la création de boutiques d'intrants pour cultures maraîchères et fruitières. Deux GIE existent déjà et quatre autres sont prévus dans un avenir proche.

4. Financement des investissements

Le développement de l'irrigation privée se heurte au financement des investissements et, à un moindre degré, à celui du crédit de campagne (Doucet 1998). Dans beaucoup de pays, le crédit aux agriculteurs individuels a été abandonné car trop difficile et trop coûteux à recouvrer: envoyer en voiture un agent d'une banque récupérer une petite somme peut être plus cher que la somme recouvrée. En outre, même s'il existe un marché privé de la terre, une banque qui saisit une terre agricole, caution habituelle du crédit agricole en pays développés, la vend très mal en Afrique de l'Ouest, voire pas du tout. Diverses solutions de remplacement ont donc été préconisées avec plus ou moins de succès.

4.1 Financement des agriculteurs

Crédit fournisseur: Au Burkina Faso, au Mali et au Niger, les fabricants de pompes à pédales acceptent un paiement initial de 20 à 50 pourcent de la valeur de la pompe avec paiement du reste après la récolte. En cas de non-paiement, le fabricant reprend sa pompe et ne rembourse rien à l'agriculteur défaillant. Cette forme de crédit traditionnel est très pratique car elle ne fait pas intervenir les projets mais elle est limitée par les capacités financières des fournisseurs.

Crédit bancaire classique:

- En Mauritanie, l'Union nationale des coopératives agricoles de crédit et d'épargne de Mauritanie (UNCACEM) consent des crédits aux irriguants individuels mais il s'agit le plus souvent de gros agriculteurs; le taux de crédit devrait atteindre celui du marché dans quelques années, soit 19 pourcent par an. L'UNCACEM a été très ferme dans sa politique de remboursement au point qu'elle n'a plus que 400 membres (dont quelques coopératives de petits agriculteurs sur périmètres publics ou villageois). Le projet a trouvé peu de clients.

- Au Mali, la Caisse nationale de crédit agricole, CNCA, prête encore aux agriculteurs privés à un taux voisin de 13 pourcent par an mais demande un titre foncier urbain en gage. Du coup, les clients sont rares. La CNCA n'a pas d'activités dans beaucoup de régions, ce qui a conduit le projet VRES à donner les motopompes aux petits groupes qu'il appuie.

- Au Niger, il n'existe pratiquement plus de crédit aux agriculteurs par le système bancaire.

- Au Burkina Faso, les banques prêtent encore aux agriculteurs mais exigent des garanties; la petite taille du pays rend la récupération des prêts moins coûteuse; en outre, il existe une tradition de remboursement des prêts au Burkina Faso, plus que dans d'autres pays.

Crédit local: C'est la solution choisie au Niger pour la 2ème phase du futur projet de promotion de l'irrigation privée, PPIP 2 (aucun système de crédit n'a été prévu durant la phase pilote sauf pour des petites opérations hors projet Banque mondiale). Les caisses populaires d'épargne et de crédit, CPEC, devraient accorder des prêts aux agriculteurs pour les investissements ainsi que des crédits de campagne. Les conditions d'une saine gestion de ce crédit local l'amènent à prêter à des conditions peu attractives, aux environs de 25 pourcent par an. Sans doute, les agriculteurs n'emprunteront que pour des investissements suffisamment importants comme les motopompes.

Subvention: Celle-ci est souvent prévue pour les infrastructures de base qui permettent le développement de l'irrigation privée: barrages de retenue, grands chenaux et digues…Pour les investissements dans l'exploitation, la subvention se justifie moins sauf si on considère l'intérêt général: économies d'eau justifiant une subvention pour les investissements dans le goutte à goutte en Tunisie, environnement justifiant une subvention au drainage... Dans les projets de promotion de l'irrigation privée, les subventions sont variables selon les pays:

- Au Burkina Faso, on a prévu des subventions théoriquement variables selon les types d'investissement. En fait, elles sont plutôt réservées aux innovations techniques.

- Au Niger, le projet pilote n'a pas accordé de subventions aux agriculteurs. En 2ème phase, on envisage des subventions mais le système est encore discuté (cf. plus loin).

- Au Mali, aucune subvention n'est prévue sauf pour les obtentions de titres fonciers financées à 50 pourcent et les études financées à 75 pourcent par l'APROFA.

- En Mauritanie, la subvention sera variable selon la catégorie d'agriculteurs: 50 pourcent du coût des travaux et 100 pourcent du coût des études et de la surveillance pour les petits exploitants (moins de 2 ha), 20 pourcent du coût des travaux et 80 pourcent du coût des études et de la surveillance pour les moyens exploitants (moins de 40 ha), pas de subvention pour les exploitants de plus de 40 ha.

4.2 Refinancement ou garantie des crédits

Les organismes de crédit demandent souvent soit une ligne de crédit spécifique, s'ils manquent de liquidités, cas fréquent chez les caisses de crédit mutuel, soit un fonds de garantie destiné à les couvrir, au moins partiellement, contre les risques de non-remboursement. Avec une ligne de crédit, la banque est incitée à utiliser les crédits mis à sa disposition. Cette solution est donc dangereuse sauf si on exige que la banque utilise une partie de ses fonds propres. Par exemple, la mutuelle de Gaya au Niger affiche un taux de remboursement à échéance de plus de 90 pourcent sur les prêts sur fonds propres et de moins de 80 pourcent sur les prêts faits sur une ligne de crédit. L'inconvénient du fonds de garantie est aussi que la banque est incitée à prêter sans risque. C'est pourquoi le fonds de garantie porte sur moins de 100 pourcent du montant des prêts, généralement 50 pourcent.

Les solutions choisies dans les différents projets financés par la Banque mondiale sont variables selon l'histoire du crédit dans le pays:

- En Mauritanie, la Banque mondiale (Banque mondiale 1999) a financé une ligne de crédit rétrocédée par l'Etat à l'UNCACEM, qui doit progressivement relever ses taux jusqu'au niveau du marché. Les prêts sont accompagnés de subventions dont les pourcentages sont variables suivant la taille de l'exploitation (moins de 40 ha), son statut (petite exploitation dans un périmètre villageois ou exploitation privée) et les catégories de prêts (riziculture, diversification…).
- Au Mali, la CNCA a refusé toute ligne de crédit qu' « elle serait obligée d'utiliser, y compris pour des prêts non justifiés ». Il est vrai qu'elle dispose de fonds propres importants.
- Au Burkina Faso, le projet (Banque mondiale 1999) comporte un fonds de garantie à 50 pourcent qui est financé par la contrepartie burkinabé au projet APIPAC.
- Au Niger, la Banque mondiale n'a pas accepté de financer une ligne de crédit, faute de confiance dans le système bancaire et de contrôle possible de celui-ci.[5] Il est envisagé que la Banque mondiale fasse un don de 70 à 80 pourcent du coût de l'équipement aux caisses populaires d'épargne et de crédit, CPEC. Celles-ci prêteraient ces fonds aux agriculteurs après accord d'un comité des prêts au niveau national. Etant donné que la plupart des prêts seront inférieurs à 250.000 FCFA (US$ 350), les agriculteurs seraient invités à se regrouper pour réduire les coûts de transaction. Le système, non encore testé, semble plutôt adapté aux grandes exploitations qu'aux agriculteurs ayant besoin d'une pompe à pédales. De nombreux problèmes restent d'ailleurs à résoudre: possibilités d'achats au Nigeria où les agriculteurs se procurent la majorité de leurs motopompes, propriété des fonds donnés par la Banque mondiale (des Caisses comme le voudrait la durabilité du système ou des agriculteurs emprunteurs comme le propose la Banque mondiale), besoin de comptes bancaires pour verser les fonds de la Banque mondiale dans un pays où les banques ont très peu d'agences….

5. Appui aux volets autres que les investissements d'irrigation

L'apport de l'irrigation n'est pas suffisant. Les cultures irriguées doivent être profitables, ce qui implique de les commercialiser à un prix rémunérateur malgré le caractère périssable de beaucoup de fruits et légumes. Deux volets sont donc primordiaux pour le succès des projets de développement de l'irrigation privée: l'appui à la mise en valeur, y compris la gestion des exploitations, et l'appui à l'utilisation

[5] Le budget de l'Etat ne lui permet pas de financer une ligne de crédit; des discussions sont en cours avec d'autres bailleurs de fonds pour, éventuellement, trouver une ligne de crédit, plus simple que le système proposé. On a aussi envisagé d'ouvrir un crédit bancaire aux fabricants de pompes à pédales qui font déjà crédit à leurs acheteurs, ceci pour accélérer la diffusion de ces pompes. Cela ne règle cependant pas le problème du crédit à l'achat de motopompes, crucial dans les conditions du Niger.

des produits par le stockage, la conservation, la transformation et la commercialisation. Ces appuis varient selon les besoins des exploitations qui ne sont pas les mêmes pour une micro-exploitation tournée vers l'auto-consommation et le marché local (jardin féminin) ou une « grande » exploitation tournée vers le marché européen (producteurs de mangues séchées au Burkina Faso). De même, les traditions maraîchères et fruitières du Mali et du Burkina Faso les conduisent à prévoir des solutions plus avancées techniquement que celles recommandables en Mauritanie et au Niger qui n'ont pas une grande expérience de la production maraîchère diversifiée.

5.1 Appui à la mise en valeur

L'appui à la mise en valeur, y inclus la gestion de l'irrigation et l'entretien des infrastructures hydrauliques, se fait par l'intermédiaire de divers organismes:

- En Mauritanie, l'appui à la riziculture est confié à la SONADER qui est encouragée à sous-traiter une partie de ses activités à des ONG ou bureaux d'études (surtout pour l'appui à l'organisation des producteurs). L'unité de coordination du PDIAIM, UC-PDIAIM, gère l'appui à la diversification ; elle a engagé un assistant technique vulgarisateur et se fait aider par des missions de consultants internationaux.
- Au Mali, les services de l'Etat devaient assurer l'appui technique dans le cadre d'un projet de vulgarisation agricole financé par la Banque mondiale; ce projet s'est terminé sans apport particulier aux irriguants. On envisage maintenant l'appui par un opérateur privé à des paysans pilotes pour mettre au point un certain nombre de techniques. La fusion avec le projet PAVCOPA améliore les perspectives.
- Au Burkina Faso, l'APIPAC a sélectionné au niveau de chaque zone des bureaux d'études chargés d'apporter un appui technique aux agriculteurs; l'expérience en est à son démarrage.
- Au Niger, l'appui technique des agents de l'Etat devait être assuré par le projet de vulgarisation agricole qui s'est terminé avant le démarrage du PPIP. L'appui à la mise en valeur s'est donc limité à des formations sur l'entretien des motopompes, les GIE cités plus haut appuyant seulement l'investissement. Pour la 2ème phase, on envisage d'élargir les compétences des GIE à l'appui à la gestion technique et financière des exploitations. Les agriculteurs prendraient en charge, de façon progressive, les coûts des prestations de service de ces centres de gestion.

5.2 Intégration avec l'aval (et l'amont) de la filière

Dans les quatre pays, les projets sont intégrés avec l'aval de la filière mais sous des formes variables:

- En Mauritanie, l'UC-PDIAIM gère le volet de diversification des cultures, principalement pour l'exportation; les composantes de ce volet sont principalement orientées vers l'agronomie (tests de nouvelles cultures) et la commercialisation.
- Au Mali, le projet de promotion de l'irrigation est maintenant intégré dans le projet APROFA qui s'occupe de commercialiser tous les produits agricoles, y compris ceux produits sans irrigation; ses préoccupations vont également aux tests et à la commercialisation de nouvelles cultures.
- Au Burkina Faso, un volet d'appui aux activités connexes (stockage, transformation et commercialisation) a été confié à une société privée qui doit procéder à des tests d'équipements et de nouvelles technologies. Le projet finance aussi des tests sur le compostage et la lutte intégrée ; en parallèle, le Canada finance l'étude d'une plate forme de tests et démonstrations sur les techniques de conservation et transformation des produits.
- Au Niger, la phase pilote ne prévoyait pas de volet pour l'aval de la production et seuls ont été diffusés des hangars traditionnels améliorés pour le stockage des oignons. Pour la 2ème phase, on a prévu d'insister sur les activités à petite échelle de stockage, conservation, transformation et commercialisation locale des produits ainsi que sur le

compostage et la lutte intégrée. Il faut signaler qu'un projet de Promotion des exportations agro-pastorales, PEAP, aussi financé par la Banque mondiale, prévoit l'appui aux exportations à grande échelle.

6. Intégration des dimensions environnementales et sociales

6.1 Intégration de la dimension environnementale

Tous les projets prévoient un volet de suivi et d'atténuation de l'impact environnemental dû aux irrigations, principalement sur les eaux (épuisement des nappes et pollution des petits aquifères souterrains) et sur les sols (salinisation et sodisation, très marqués seulement dans le delta du Sénégal). Le suivi des grands aquifères sédimentaires est plus facile que celui des petites nappes isolées des zones de socle. Une méthodologie pour ce dernier suivi, faisant intervenir les irriguants, est encore à mettre au point. Au Niger s'ajoute un volet de protection contre les érosions hydriques et éoliennes. En effet, beaucoup de sites de petite irrigation sont attaqués par des dunes ou des oueds. La plupart des projets prévoient aussi des volets pour la lutte intégrée (IPM) et la sensibilisation aux risques associés à l'utilisation des engrais et pesticides. Le PPIP 2 du Niger prévoit même une sensibilisation des consommateurs à ces risques.

6.2 Intégration de la dimension sociale

La promotion de l'irrigation privée s'adresse à des agriculteurs qui ne sont pas très pauvres puisqu'ils sont capables d'investir. Seul le projet de 2ème phase du PPIP du Niger prévoit explicitement la prise en compte des besoins des pauvres et des femmes mais ce volet est plutôt théorique. L'appui aux femmes se fera plutôt en favorisant les activités post-récolte dont elles s'occupent le plus souvent.

6.3 Problèmes fonciers

Les rapports d'évaluation ont tous insisté sur les problèmes fonciers que rencontreraient les irriguants potentiels. En fait, les solutions proposées ont été variables selon les pays:

- En Mauritanie, les prêts et subventions ne sont accordés que sur le vu d'une autorisation d'exploiter officielle. Le PDIAIM n'appuie pas l'obtention de titres mais il finance un schéma directeur et un plan d'occupation des sols pour une zone de la vallée du fleuve Sénégal;
- Au Mali, l'APROFA subventionnait l'obtention des titres fonciers (plan topographique, formalités administratives et taxes); ce volet a été détourné dans la mesure où certains bénéficiaires de ces subventions n'ont pas investi dans l'irrigation;
- Au Burkina Faso, la DIPAC (Projet Pilote de Développement de l'Irrigation Privée et des Activités Connexes) appuie les propriétaires potentiels mais sans subvention;
- Au Niger, le projet a aidé à régler des litiges fonciers; il faut signaler que la loi au Niger reconnaît la propriété coutumière à l'égal de la propriété avec titre foncier.

Dans l'ensemble, sauf en Mauritanie, les problèmes fonciers rencontrés par les non-autochtones d'un village pour obtenir des terres ressortent plus du social que du juridique. Avant d'obtenir une terre, il faut un accord traditionnel qui peut être formalisé mais ce n'est pas indispensable, surtout au Niger qui reconnaît le système traditionnel de tenure des terres. Les difficultés arrivent lorsque: (i) la coutume interdit le prêt de terres à longue durée et/ou interdit les plantations d'arbres sur les terres accordées traditionnellement; et (ii) les candidats à une terre essaient de passer outre le système traditionnel.

6.4 Suivi-évaluation

Tous les projets ont un service de suivi-évaluation. Les premières propositions pour son rôle étaient irréalistes dans la mesure où elles envisageaient de suivre l'ensemble des irriguants. C'est d'autant plus difficile que la vente des pompes à pédales (ou l'installation de forages manuels) se fait dans le cadre de relations de fournisseur privé à client privé sans intervention du projet. On s'oriente maintenant vers des études par sondages sur l'impact des projets sur l'agriculture irriguée.

7. Rentabilité et diffusion des irrigations privées

7.1 Rentabilité financière

La rentabilité financière de la riziculture irriguée est faible et ce n'est qu'après des acrobaties financières (entre autres, non-remboursement des prêts) que les riziculteurs du delta du fleuve Sénégal peuvent la continuer. La seule voie possible est la réduction des coûts d'investissement et de fonctionnement ainsi que la production du riz de qualité supérieure.

Dans le cas des cultures maraîchères et fruitières, la rentabilité financière des équipements proposés est en général très bonne même si elle est variable selon les documents et les pays:

- Plus de 50 pourcent pour les pompes à pédales par rapport à l'exhaure traditionnelle; la surface cultivée par exploitant double au Niger (de 0,1 à 0,2 ha, Banque mondiale 2001) et augmente de 40 pourcent au Sénégal (de 0,33 à 0,46 ha, Hyman 1996);
- Plus de 50 pourcent pour les petites motopompes par rapport à l'exhaure traditionnelle (Banque mondiale 2001) à condition que la parcelle irriguée soit assez grande, au moins 0,6 à 0,7 ha;[6] au-dessous de cette surface, il vaut mieux prendre deux pompes à pédales.
- Elevée pour les canalisations en plastique en comptabilisant la valeur de la diminution des pertes en eau dans les réseaux (Banque mondiale 2001).

La rentabilité des forages est évidemment très grande par rapport aux puits en béton puisqu'ils coûtent cinq fois moins cher au mètre linéaire. Par rapport aux puits traditionnels qui s'effondrent chaque année, ils durent beaucoup plus longtemps et, surtout, ils évitent de transformer le champ en une suite de cratères entourés des déblais des puits effondrés.

La rentabilité de l'irrigation localisée est inconnue car on ne dispose d'aucun élément sur les résultats techniques et financiers ou sur l'acceptabilité de cette technique. L'aspersion n'a pas donné de résultats probants sauf en grandes exploitations dans la zone humide.

7.2 Potentiel théorique de l'irrigation privée

La quasi-totalité des exploitations privées utilise des eaux de surface ou des eaux souterraines à faible profondeur. L'exploitation des eaux souterraines profondes est trop coûteuse sauf subventions de l'énergie de pompage. Les besoins en eau des cultures sont en effet trois fois plus élevés en Afrique de l'Ouest qu'en Afrique du Nord d'où des coûts de pompage beaucoup supérieurs. Le potentiel pour la petite irrigation restera donc assez limité si on n'oublie pas que:

- Les exploitations utilisant les eaux de surface doivent être situées près de celles-ci, à la différence des grands périmètres qui peuvent utiliser des terres jusqu'à plusieurs dizaines de kilomètres de la ressource en eau;
- A la différence des deltas asiatiques, le débit des nappes superficielles est généralement très faible dans les zones de socle qui recouvrent la majeure partie des pays de l'Afrique de l'Ouest.

Le potentiel peut être augmenté par: (i) la construction de retenues d'eau où on peut pratiquer l'irrigation par pompage sur leurs bords, (ii) le creusement de forages profonds dans les zones où la nappe est artésienne ou semi-artésienne, et (iii) comme dans la vallée du Sénégal, la construction de chenaux partant des cours d'eau le long desquels peuvent s'installer des irriguants privés. Dans ces trois cas, un mécanisme de financement adapté, comprenant une importante part de subvention, doit permettre de financer les infrastructures de base: barrages, forages profonds, chenaux.

[6] Beaucoup d'agriculteurs appuyés par des projets financés par l'Union européenne au Niger n'ont pas pu rembourser le crédit pour l'achat d'une motopompe ; certains sont même revenus à la pompe à pédales.

7.3 Résultats de diffusion

La diffusion des techniques d'irrigation manuelle est restée limitée malgré leur rentabilité financière évidente: on a toujours vendu moins de 500 pompes à pédales par an au Mali et au Sénégal, ce qui représente au plus 200 ha par an. Des surfaces analogues sont attendues au Niger. Pourquoi ces faibles performances?

- Les zones où la nappe est suffisamment proche ou celles où l'eau de surface est facilement accessible sont limitées et souvent difficiles d'accès; les possibilités de vendre les produits maraîchers sont alors faibles;
- Les pompes à pédales ont une durée de vie très longue car les réparations sont peu coûteuses. Le marché de renouvellement est donc faible, d'autant que certains agriculteurs enrichis passent à la motopompe lorsqu'il faudra remplacer leur pompe à pédales;
- Pédaler en position surélevée est parfois mal accepté socialement par certains agriculteurs ou agricultrices; la diffusion des pompes à main, deux fois plus chères pour le même service, montre que cet argument n'est pas sans fondement;
- Enfin, les professionnels dirigeant les diverses associations d'irriguants sont, en général, des agriculteurs qui ont réussi et ont donc dépassé le stade de la pompe à pédales qu'ils ne promeuvent pas beaucoup auprès de leurs membres.

Le potentiel des autres techniques est théoriquement limité par leur prix, soit unitaire (une motopompe coûte au moins US$300 sauf si on l'importe de Chine), soit à l'hectare (l'irrigation localisée revient à plus de 5000 $/ha). Le crédit serait donc indispensable pour les voir se développer rapidement, sauf pour les conduites enterrées qui peuvent être installées petit à petit en fonction des moyens de l'agriculteur. Il faut cependant corriger cette impression: au Niger, il existerait environ 20, 000 petites motopompes, ce qui implique un marché de renouvellement de 5000 pompes par an; les divers projets de développement en fournissent moins du quart et les agriculteurs sont donc capables de trouver les ressources propres nécessaires pour acheter le reste.

8. Conclusions sur le développement de la petite irrigation privée

L'expérience des quelques projets de développement de la petite irrigation privée, c'est à dire individuelle ou en petits groupes volontaires, a permis d'obtenir un certain nombre d'enseignements:

- L'irrigation privée est irremplaçable pour le développement des cultures à haute valeur ajoutée destinées au marché, qu'il soit local ou d'exportation; à ce titre, elle mérite d'être appuyée par des projets de développement;
- La gestion d'un projet d'appui à l'irrigation privée par une association privée, même si celle-ci est faiblement organisée, n'est pas plus mauvaise qu'une gestion par un service étatique; au contraire, le contrôle de l'Etat peut s'exercer sans influencer la gestion quotidienne du projet;
- Il est facile de promouvoir les technologies simples (forages manuels, pompes à pédales…) sans faire appel au crédit à condition d'utiliser la méthodologie des ONG qui ont lancé la diffusion des pompes à pédales en Afrique (IDE et EWW, anciennement ATI, cf. Egan 1997):
  - On ne doit vendre qu'un produit éprouvé techniquement avec une masse critique pour le nombre d'équipements à vendre;
  - Le coût de l'équipement doit être abordable et ne doit pas être directement subventionné pour que la vente continue après le projet;
  - L'équipement doit être vendu prioritairement à des agriculteurs individuels ou à des petits groupes;
  - On doit utiliser les constructeurs locaux et travailler avec le secteur privé chargé aussi de fournir un service d'entretien et après-vente;

- Un opérateur spécialisé doit coordonner le démarrage de la diffusion et faire de la publicité.

- L'expérience du projet financé par l'USAID de diffusion des pompes à pédales au Sénégal montre bien qu'on peut arriver à un projet durable: trois ans après la fin du projet, les artisans continuent à vendre environ 200 pompes par an, moins qu'au plus fort du projet (486 pompes en 1995, Hyman 1996), mais les fabricants qui restent y trouvent leur compte;[7]

- Malgré le relatif succès de la diffusion des technologies et équipements simples, les surfaces concernées resteront faibles, de l'ordre de moins de 500 ha par an et par pays pour les pompes à pédales, moins de 10 ha par an pour un pays où on vendrait annuellement 4000 kits de 25 m^2 de goutte à goutte ; en revanche, le développement profitera à un grand nombre de personnes (4000 kits de micro-irrigation permettent de diversifier l'alimentation de 4000 familles);

- Il reste à explorer plus sérieusement la réduction des coûts d'investissement : importations d'équipements de pays du sud-est asiatique, fabrication locale de pièces détachées…

- Il est difficile de promouvoir l'irrigation privée à plus grande échelle sans système de crédit mais celui-ci n'est pas simple à mettre en place car toujours très coûteux pour l'emprunteur si on veut que le système soit durable. Il faudrait aussi connaître les circuits de financement qui ont permis le développement de l'irrigation privée jusqu'ici;

- L'appui à la mise en valeur est indispensable. Les structures de vulgarisation étatiques ne savent pas répondre à la demande diversifiée d'agriculteurs techniquement avancés. Les services payants en sont encore au stade expérimental. L'expérience des GIE au Niger est la plus intéressante à cet égard mais ceux-ci sont encore fragiles et limités à l'appui à la mise en place des équipements d'irrigation;

- Les opérations post-récolte doivent faire l'objet d'une recherche plus active, en particulier pour tout ce qui reste au niveau artisanal, susceptible de créer des revenus locaux, en particulier pour les femmes.

L'exemple de la phase pilote du Projet de promotion de l'irrigation privée au Niger et, surtout, l'expérience du projet USAID de promotion de pompes à pédales au Sénégal, montrent bien qu'on peut promouvoir la petite irrigation dans des conditions durables en Afrique de l'Ouest. Il reste à élargir cette expérience sans en attendre de miracles pour un développement rapide mais plutôt pour un développement touchant un maximum de personnes.

[7] Il serait utile d'évaluer l'expérience sénégalaise quelques années après la fin du projet financé par l'USAID. En particulier, il serait intéressant de connaître les raisons du déclin du nombre de pompes à pédales vendues annuellement et si les agriculteurs s'enrichissent pour passer à un stade supérieur.

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Affordable small-scale drip irrigation in Africa: Potential role of the private sector

L'irrigation goutte-à-goutte à faible coût en Afrique: Rôle du secteur privé

N. H. van Leeuwen

Abstract

The paper describes various low-cost drip irrigation kits that are offered for sale by manufacturers. Some difficulties or shortcomings in the presentations of information about these kits are discussed. The users' requirements are summarised, and advantages and disadvantages of drip technologies are described, with particular attention to the question of filtration needs. In the final section the author summarises pre-conditions for the successful and sustainable introduction of these types of equipment in African circumstances.

Résumé

Une description de divers matériel d'irrigation goutte-à-goutte à faible coût disponible sur le marché est présentée. Des difficultés et des insuffisances liées à la présentation d'information sur ce matériel sont mises en lumière. Les avantages et inconvénients de ces kits vis-à-vis les besoins des usagers sont abordés avec une attention particulière aux questions liées au filtrage. Enfin, l'auteur liste les pré-conditions pour réussir l'introduction de ce type de matériel en Afrique.

1. Introduction

With the objectives of reducing water losses and increasing the efficiency of irrigation, technologies have been developed to conduct water through pipes to the fields, to apply the water in small quantities, directly to the plant root area and to avoid wetting of large soil areas at the surface. Jar irrigation and irrigation through sub-surface porous clay pipes have been applied with success for many years. In both cases, the slow exudation of water through the porous baked clay provides a steady supply of water to the roots of the plant that develop preferably in the wetted area around the jar or the pipe.

Following the introduction of plastics in irrigation equipment, started some 50 years ago, a number of different localised irrigation systems have been developed and they continue to be improved. Drip irrigation systems that do not wet large areas of the soil surface are the most efficient. In addition to the irrigation water efficiency, drip irrigation systems require less labour, allow efficient application of fertilisers, and result in fewer occurrences of diseases and pests, and consequently higher quality products. In general, however, these systems are considered to be relatively expensive and to require a high level of technology.

Irrigation schemes in developing countries suffer from very low water efficiency, resulting in waterlogging and salinity problems. Also water scarcity is a problem in many developing countries in Africa. Most readily available water resources have been mobilised already for irrigation and a large part of the expansion of the irrigated area should come from the development by small-holder farmers of small local water resources such as small reservoirs and shallow groundwater. The optimal use of these limited resources is essential. The adoption of small-scale low-cost drip irrigation technologies by small-holder farmers in Africa has great potential and could be one of the solutions for increasing food production, increasing farmers' incomes and improving food security.

2. Appropriate drip irrigation systems

Generally, small-holder farmers in most countries in arid and semi-arid regions of Africa depend on one rain-fed cereal crop (millet, sorghum, maize) grown during the rainy season. In addition in many villages groups of women and young men grow vegetables on small plots of land in order to improve the family diet, or for sale at local or urban markets.

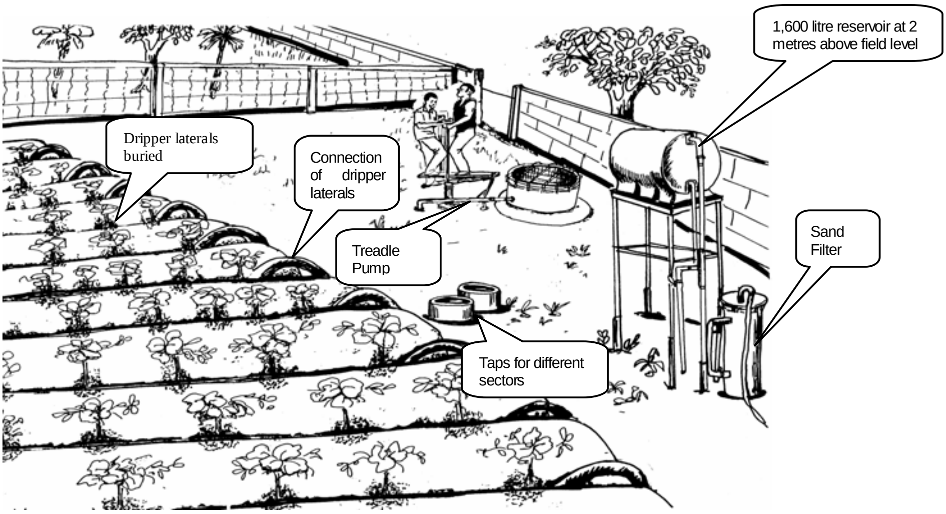
Urban and peri-urban agriculture is growing fast around all major cities. With the increase of urban population and consequent rising demand for fruits and vegetables, irrigated agriculture will need to expand rapidly in the future. However, water resources are limited and irrigation is very labour-demanding because in many urban and peri-urban gardens, the irrigation water is carried by hand from the well, reservoir or river to the fields.

The use of drip systems would allow making optimum use of valuable water resources, and farmers in rural as well as in urban areas would be able to grow more crops per drop, per m^2 and per hour of work. In order to be adoptable by smallholder farmers, drip systems should be affordable, which means that they should:

- have low investment cost: in view of the smallholder farmer's income level, the investment cost for the equipment and supplies should be as low as possible;
- have low operation and maintenance costs;
- be easy to install and to operate by farmers without particular technical training;
- be cost-effective: the investment should be earned back in one season.

Different organisations and companies[1] propose systems that correspond more or less to the above requirements. These systems have a number of features in common.

Figure 1. Layout of a small-scale drip-irrigation system (Keita–Van Leeuwen).



- ***Water supply***. Most of the small-scale systems are supplied with water from a bucket, drum or other water container that is installed in the field close to the cultivated area. Depending on the dripper laterals, these reservoirs are installed on a stand or on a platform at 1 to 2.5 meters above field level. Dripper laterals can be connected directly to the water reservoir itself or to a main distribution pipe. In some cases it is assumed that the irrigation water is supplied by an existing pressurised water supply system, in which case no reservoir is installed.

[1]Chapin Watermatics Inc., International Development Enterprises (IDE), NETAFIM, Aquatec.

- ***Water quality control***. All systems have some kind of filtering of the irrigation water in order to avoid the clogging of the drippers by impurities. Such a filter is sometimes limited to a piece of cloth that filters the water where it enters the reservoir. Other systems are provided with a disk or screen filter. The need for a more secure filtering with a sand filter for those locations where the water is very dirty is mentioned by a number of suppliers.

- ***Water distribution.*** Several systems propose laterals that have drippers built-in at specific distances (such as 30, 45, 75 cm). Others have low-density polyethylene laterals on which drippers can be fixed at the desired spacing. Several lines of plants can be irrigated if microtubes are fixed to one lateral. Sometimes the drippers are reduced to a simple hole in the lateral.

- ***Cost.*** Investment cost for most of the systems is relatively low. The cost of the kits that are proposed varies between US$5 and US$100 per unit (depending on the area covered). These costs exclude any equipment for the mobilisation of water (boreholes, wells, pumps, canals, etc.) as well as the cost of the reservoir (buckets, drums, etc).

The information provided by suppliers varies from one system to the other and makes it difficult to proceed with a comparison. The general impression that is given in all the documentation is that these drip irrigation kits are cheap, do not require much water and are not labour-demanding. The reality can be somehow different.

3. Low-cost drip irrigation kits

While there is no doubt about the merit of low-cost small-scale drip kits, there is in most cases an over-simplification in the presentation. There are serious risks that users are confronted with unexpected problems and, not finding easy solutions, they may quickly abandon the drip system and return to their traditional watering methods with cans.

- ***Potential irrigated areas***. The area covered by the proposed drip irrigation kits varies between 25 and 500 m^2. This area is generally based on the length of the dripper laterals and the distance between the lines. Consequently the same kit can cover an area of 500 m^2 or 2000m^2, if the distances between the drip lines are increased from 0.75m to 3.00 m. A comparison between different systems should consequently not be based on the area covered but on the length of drip line provided in the kit. The distance between the drip lines should depend mainly on the optimal distance between the rows of plants, which varies from one crop to another. The area actually covered by the system will influence strongly the amount of water that is needed.

- ***Investment cost.*** The different kits are offered for prices that vary from US$5 to US$100. Independently of the actual areas covered by these systems, as discussed above, the cost per hectare would amount to some US$2,000. Not included are the costs of the water point, the pump, the sand-filter (if required) and the connecting pipes. Taking into account all these additional elements, the total cost of a complete set of equipment for small-scale drip-irrigation may vary between US$5,000 and US$7,500 per ha.

- ***Crop water requirements.*** Some of the kits are accompanied by indications that with two buckets or two drums of water a day a farmer can irrigate a given area. The actual amount of water supplied to the crops varies between 1.6 and 9 mm/day. Several kits give indications that in warm climates more water could be needed. None of the kits mentions that the water required depends also on the crop that is grown as well as on the development stage of that crop. The effect of plant population or plant density on the crop water requirements is similar to that of the percentage of ground cover (Doorenbos and Pruitt 1992). When the topsoil is kept relatively dry, evaporation from the soil surface is sharply reduced and ET crop will be less for low population crops than for high population crops. During the early stage of a crop a high population planting would normally require somewhat more water than a low density planting, due to quicker development of full ground cover. In irrigated agriculture, plant population has been considered to be of little importance in terms of total water needs. In general, water requirements will depend on the total area covered. Since drip irrigation does not allow visual control of the amount of water that is applied to each plant, farmers will need assistance to determine the quantity of water required and how to make sure that this quantity is applied.

- ***Water mobilisation.*** The documentation on drip irrigation kits gives the impression that the mobilisation of irrigation water is not really a main problem. By providing just two buckets of water (of 20 litres each) in the morning and in the afternoon the water requirements would be covered. In fact this would just amount to 2 mm/day, and in certain circumstances the plants may require 8 mm/day, corresponding to eight trips from the water sources with two buckets of 20 l each. When it gets to filling a 200-l drum several times a day, there is clearly need to pump water into the system. In most cases individual farmers would be able to use a pump; however the cost of the pump, the dug-well and connecting pipes should be added to the investment cost the same as the cost of the buckets or drums. The labour cost for pumping the water should be added to the operations cost.

- ***Filters.*** For some of the bucket kits, the filtering of the water is done by a piece of cloth. Most kits have filters; some very simple screen filters, others more sophisticated screen filters, without however mentioning the actual performance of these filters. Sand or gravel filters are mentioned as they could be used to treat more heavily charged water. The documentation does not mention any specific filtering requirements for the different types of drip lines. It only mentions that some of the systems are easy to clean. The information received, after specific request, from one of the suppliers of driplines, has given clear indications with regard to the actual filtering requirements. These filtering requirements (from 125 to 80 microns) also depend on the actual discharge of the drippers: with a higher discharge (higher water pressure) the level of filtration can be reduced.

- ***Fertigation.*** The application, through the drip system, of nutrients dissolved in water is called fertigation. Since the fertiliser reaches the root zone directly, fertigation is the most efficient way of application of fertilisers. The increased production will allow a better valorisation of the investment made by the farmer in the drip-irrigation equipment. Only one supplier mentions the possibility of fertigation in its documentation. Farmers will need advice on the advantages of fertigation and should be trained in the selection of the liquid fertiliser and the procedures for its application through the drip system.

- ***Flexibility.*** Most of the kits are supposed to be used on flat land and rectangular fields, and include drip tapes that have fixed distances between the drippers. These systems present problems when used on sloping land, or when farmers need to irrigate crops that require a different spacing.

- ***Advice and training.*** In order to make successful use of the drip irrigation system; farmers will need advice and training. Part of the training and advice, dealing specifically with the irrigation system as such, could possibly be part of the package that the farmer purchases from the supplier. This package could also include trouble-shooting services during the first season. Other advice and assistance dealing with the selection of crop varieties, disease and pest control, marketing, etc., should be provided by specialised government services.

Most of the above-mentioned issues can be dealt with without too many problems. The quality of the water and the selection of the type of drip lines however will require special attention.

4. Physical water quality

Many decisions during the planning stage of a drip system have to focus on the issue of water quality. In particular, the physical quality of the irrigation water is the main factor that should be taken into account when selecting the water filter(s) and the type of drip lines and eventually the drippers to use. This is valid for large-scale projects where farmers have access to high-level technical expertise and have resources to adjust the equipment as and when required. This is, however,

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essential for smallholder farmers who, in case of major problems, will have no choice other than abandoning the system, as they do not have access to remedial solutions.

The physical water quality will be very different from one place to another. Depending on the source of water, it can also vary considerably during the season and even from one season to another. If water samples are available, it is not always easy to get these examined in a simple and quick way. The easiest way out would be to use always a drip system that, independently of the water quality, will present fewer clogging risks and can be easily cleaned. This would exclude drip lines with pre-manufactured drippers such as T-Tape and the Chapin Tape. The advantage of these drip lines is that their cost is much lower.[2] Driplines with pre-manufactured drippers can be installed without any additional costs. LDPE dripline pipes need micro-tubes or drippers at additional costs almost equal to the cost of the pipe itself. Driplines with pre-manufactured drippers also assure a more homogeneous distribution of water, are easy to use and require no maintenance. Since they are buried there is less risk for damage and the water efficiency is higher.

If the water is very clean, a simple screen filter for security purposes will be sufficient. If the water is charged with mineral particles there will be two options:

- Install only a security filter and use surface dripper lines that can easily be controlled and cleaned whenever needed; or
- Install the appropriate filter in addition to the security filter and use sub-surface drip lines with pre-manufactured drippers.

The following filters (FAO Irrigation Equipment Supply Database) are generally used to clean water for drip-irrigation systems.

Gravel or sand filters.[3] These filters, also called media filters, are closed cylindrical tanks that contain a gravel of 1.5–3.5 mm grain size or a basalt sand filter bed. Where the irrigation water source is an open reservoir, they are installed at the beginning of the head control of the system. Water entering the tank from the top passes through the gravel bed, which traps the large particles of unbroken organic matter, mostly algae, and the water exits through the outlet at the bottom of the tank. They are equipped with the necessary inlet, outlet and drain valves, and a back-flushing arrangement. The filter body is epoxy coated metal, minimum 8.0 bars PN, and is 50–180 cm high and 40–100 cm in diameter. They are available in threaded connection sizes of 1–8 in.

Disk type filters. These are cylindrical, made of reinforced plastic, horizontal in-line or vertical angle-shaped. The filtering elements consist of stacks of grooved plastic rings with multiple intersections, providing a three-dimensional filtration of high level. They are very effective in removing all kinds of impurities of inorganic and organic origin, algae included. The degree of filtration can range from 40 to 600 mesh (400–25 microns). They are available in all sizes (¾–6 in), PN 8.0 bars, with threaded joints. They are placed at the end of the control unit before the main pipeline.

Screen type filters. These are used for final filtration, as a safeguard for either moderate quality-water or following a primary filtration with gravel or hydrocyclone filters. They are installed at the end of the head control before the main pipeline. They are made of epoxy coated metal or high engineering plastics in various cylindrical shapes (horizontal on-line, vertical angle, etc.), and are equipped with interchangeable perforated filtering elements, inlet, outlet and drain valves and pressure inspection gauges. They can withstand a working pressure (PN) of 8.0 bars. The degree of filtration ranges from 60 to 200 mesh (75 microns). They are available in sizes of ¾ - 4 in. Smaller sizes are made of reinforced plastic.

If it does not exist already, an easy-to-use water testing device should be developed. Since most of the small-scale drip-irrigation systems will work under low pressure with corresponding low discharge of the drippers, the highest required level of filtration should be adopted. Farmers should also be trained in proper operation and maintenance of the filters.

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[2] In Project GCP/RAF/340/JPN (Burkina Faso) actual cost (CIF) of T-Tape is 40 percent of 16 mm low-density poly-ethylene tube with drippers.

[3] Sand filters have been manufactured locally in Burkina Faso by project GCP/RAF/340/JPN and were using four layers of sand from 1 mm to 4.5 mm. This filter appeared to be insufficient for water charged with loam.

5. Sustainable introduction of small-scale low-cost drip irrigation in Africa

From a long-term perspective, irrigation development should be based on two guiding principles: the generalisation of private irrigation and the professionalisation of the actors operating in the irrigation sector (Soumaila 2001). In order to follow these guiding principles, irrigation should be:

- essentially initiated and managed by the operators themselves;
- low-cost, oriented towards water management and low water use;
- providing a good cost-benefit ratio;
- sustainable and respecting the environment.

Several distributors of small-scale drip-irrigation kits are working in the same direction by trying to assemble their irrigation kits at country level and to set up national distribution networks. In emergency cases, the kits can be assembled elsewhere and shipped in containers. It is, however, much cheaper to ship supplies in large quantities and assemble the kits locally. The assembling of such kits is, in fact, very simple and could even be further decentralised to the local distributors of irrigation supplies in smaller cities. The main advantage of such decentralisation is that, it opens the possibility to customise the equipment.

In view of the many variables, such as water quality, soil texture, crops and cultivation methods, shape and slope of the farmer’s field, technical capacity and financial resources of the farmer, etc., there is a need for an individual approach to select the most appropriate set-up for each drip irrigation system. Since the design of the system is closely related to the local availability of materials, it would be most appropriate if the supplier of the equipment could provide assistance to individual farmers for the design of small-scale drip irrigation systems. This assistance should not be limited to the design of the system but should also include advice on irrigation practices. Such an individual approach will also allow setting up a system that can evolve in time. Local distributors of irrigation equipment will have special interest in selling systems that work correctly, as this will increase their business in the future.

Clear and simple guidelines, covering all aspects of small-scale drip irrigation, should be prepared for these local distributors of irrigation equipment, to make them capable of providing such services to farmers. Short training courses on design and operation of small-scale drip irrigation systems should also be organised for interested equipment distributors at national level.

It is further recommended that experiences with small-scale drip irrigation in sub-Saharan Africa be collected and analysed to draw lessons for the expansion of this type of irrigation. In particular, experiences with the adoption of these new irrigation technologies by women farmers should be shared with a large public. Many women farmers are cultivating small irrigated plots and they have the largest constraints in terms of labour availability, and generally limited access to new technologies and to credit. Finally, methodologies for simple and quick analysis of water quality should be identified and made available to the professionals.

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Development of urban and peri-urban agriculture in West Africa

Développement de l'agriculture urbaine et périurbaine en Afrique de l'ouest

Boubacar Barry

Abstract

Urban agriculture is an important source of income and nutrition for urban populations. Horticulture, mainly vegetable production, has expanded in and around West African cities as an informal activity practised by poor and landless city dwellers. The broad diversity of crop species allows year-round production, employment and income. Growers have realised that intensive horticulture can be practised on small plots, using water and land resources efficiently. Urban and peri-urban agriculture has a potential to provide productive jobs for the urban unemployed, while contributing significantly to the food provision of Africa's cities. In Accra an estimated 3 percent of the labour force is engaged in urban farming and urban farmers supply 90 percent of vegetable supplies. Urban agriculture is developed in areas that generally have a precarious status and whose development or distribution may depend on the unilateral ideas of municipal authorities or specific urban management institutions. Land under the authority of these institutions is used without formal authority but with varying tolerance, not always backed by rationality. Despite success and growing importance, peri-urban irrigation is still subject to numerous constraints, including insufficient access to clean water, uncertainty about land tenure, inadequate know-how, increasing pressure and marketing difficulties.

Résumé

L'agriculture urbaine est une importante source de revenu et de la nutrition pour les populations urbaines. La production des fruits et légumes s'est répandue autour des villes ouest-africaines. Il s'agit d'une activité informelle pratiquée par les citadins pauvres et sans terres. La production d'une gamme de cultures très variées offre aux exploitants l'emploi et des revenus tout au long de l'année. Le maraîchage se pratique de manière intensive sur des petites parcelles mais avec une efficiente utilisation des ressources en eau et en terre. L'agriculture urbaine et périurbaine offre une possible réponse au problème de chômage urbain tout en contribuant à la sécurité alimentaire des villes africaines. A Accra on estime que ce secteur occupe environ 3 pourcent de la main d'œuvre et fournit 90 pourcent des légumes. Mais l'agriculture urbaine et périurbaine se développe dans des zones dont l'attribution et la mise en valeur dépendent des décisions unilatérales des autorités locales. Les terres sous leur contrôle sont exploitées sans autorisation formelle avec plus ou moins de tolérance. Malgré sa réussite agrandissante, l'agriculture périurbaine est toujours soumise à de nombreuses contraintes : incertain accès à l'eau, insécurité foncière, connaissances limitées, et difficultés d'écoulement des produits.

1. Introduction

Africa, which has for a long time been the least urbanised region in the world, is now undergoing an urban explosion. In the West African humid forest zone more people live in cities than rural areas. In approximately 20 years, two out of three West Africans will live in urban centres. This represents an immense challenge for food security, sanitation and poverty alleviation especially as the per capita food supply is still decreasing and the number of undernourished people living in cities is on the rise. Natural demographic growth and population migration are the sources of this poorly organised urban growth, which entails economic, social and environmental problems.

The 1980s have been referred to repeatedly as a decade of crisis for African development. None of the factors underlying this "crisis" are new: declining terms of trade, declining per capita production of food crops, increasing foreign indebtedness, environmental degradation and continued high rates of migration by the young from rural to urban areas. Two major catastrophic droughts through much of sub-Saharan Africa, combined with conflicts and political turmoil during the decade, have led to the decline of much of the formal, modern sector of Africa's economy, with a resulting decline in the standard of living for both urban and rural people.

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In apparent reaction to the increasing urban population, intensive peri-urban and urban farming systems, both with their distinct characteristics and interactions, have emerged and are expected by some experts to assume great importance in the years ahead.

Poor people in the cities are constantly faced with the problem of how to survive at the household or micro-level amidst economic decline and the lack of job opportunities. "Rather than return to the countryside, much of this urban population has resorted to any means at their disposal to survive in the city. The various survival mechanisms of the urban poor have come to be called the 'informal sector', so named by the International Labour Organisation's investigation of employment conditions in African economies in the 1970s." (Maxwell and Zziwa 1992).

Urban agricultural production is often included in the informal sector, because cultivation and livestock rearing within urban sectors were generally forbidden during the colonial period. This hostile attitude by the authorities toward urban farming has usually continued after independence. Nevertheless, urban agriculture has been an integral part of African cities from the beginning of their development, as pointed out by Rakodi (1988). This fits also well with the perception of urban migrants, who view the city as their farm (Aronson 1978), as it becomes part of their extended geographic sphere, while the rural home often remains home, despite their living in the city.

Some authors emphasise the adaptation of urban agriculture to certain characteristics of urban life in transition: a break between rural production and urban consumption that is marked by the need to supply less expensive European-type market products such as green beans, green peppers, tomatoes, etc. The most commonly produced goods are high-value perishable products like vegetables and fruits, as well as small livestock, poultry, fish, and snack food. Thus Bamako, capital of Mali, would be self-sufficient in vegetables because of urban market gardeners.

The same applies to essential provisions for the city of Lomé, where competition of other origins exists: neighbouring villages, and importation of specific products from Burkina Faso, Niger, Mali, and Europe. Urban agriculture would then be generating income and employment in an urban environment through a network of interdependent activities connected to it. These peripheral activities are found in the artisan production sector (blacksmiths, masons, carpenters, etc.), as well as in the service sector (transportation of fertilisers, phytosanitary products and seeds, repair of motor pumps, etc.) and marketing sectors.

2. Urban and peri-urban agriculture: A source of income and nutrition.

Three fundamental observations concerning urban agriculture are noted by Maxwell and Zziwa (1992):

1. Urban agriculture is an important component of household survival strategies for the urban poor.
2. Urban agriculture has provided livelihoods and food to an increasing number of urban and peri-urban residents.
3. Urban and peri-urban agriculture have a potential to provide productive jobs for the urban unemployed, while contributing significantly to the food provision of Africa's cities.

According to Amuzu and Leitman (1991), in Accra an estimated 3 percent of the city's labour force are engaged in urban farming, and 90 percent of the city's vegetable supplies are supplied by urban farmers.

Urban agriculture is an important source of income and nutrition for urban populations. As the share of wages in income has fallen drastically under the effects of structural adjustment programmes, increased engagement in farming in urban and peri-urban areas has been the most visible response to the crisis.

Horticulture, mainly vegetable production, has expanded in and around West African cities as an informal activity practised by poor and landless city dwellers. The broad diversity of horticultural crop species allows year-round production, employment and income. Growers have realised that intensive horticulture can be practised on small plots making efficient use of water and land resources. Real efficiencies are being made by productive use of under-utilised resources such as vacant land and unemployed labour.

Vegetable cash crops are often produced by experienced farmers and marketed directly or by short chains without much processing. In the case of leaf vegetables, harvesting and sales must take place daily. They provide a quick return to meet a family's day cash requirement for purchasing food. Leafy vegetables are particularly perishable and post-harvest losses can be reduced significantly when production is located close to consumers.

Short production cycles and rapid adjustment to market demand and climatic conditions result in a surprisingly high, regular income to peri-urban farmers as well as to market entrepreneurs. Some urban and peri-urban growers are moving more and more into intensive production of high value-added produce, rather than basic foodstuffs; such activities can become major sources of income for more sophisticated members of the population who have investment capacity.

The pervasive economic importance of peri-urban irrigation has created at all production levels an investment incentive for private economic operators. Under the pressure of economic and political powers and encouraged by international organisations, various actions have taken place in an attempt to help organise this new production sector. NGOs are getting involved more and more. This movement is supported by the credit institutions that are lending to individuals and also on a group basis.

3. Constraints

Despite its success and growing importance, peri-urban irrigation is still subject to numerous constraints. Among them are insufficient access to clean water, uncertainty about land tenure, level of know-how, increasing pressure and marketing difficulties.

3.1 Land

Historically, urban farming in African cities has been a major activity in African cities since pre-colonial days. According to Winters (1983), in hot, often humid regions such as tropical Africa, the problem of storing food compounded the problem of transporting it. The fact that urbanisation was so independent of trade was one more reason for cities to be self-sufficient in food. Urban farming in contemporary African cities is largely unrecognised, unassisted and in some cases outlawed because of the supposed hazards associated with it.

Agricultural activities have influenced and determined urban land-use and the morphology of cities in Africa. Cities such as Kumasi, Ghana, and the Yoruba towns of western Nigeria were surrounded by a zone of intensive farming in which the majority of residents worked every day (Winters 1983).

According to Mougeot (1994), urban farming will likely continue to expand because of the current conditions prevailing in African countries. These conditions include rapid urbanisation, ineffective agricultural policies, crippled domestic food distribution, constrained government spending, removal of subsidies, soaring inflation, rising unemployment, natural disasters and civil strife.

Urban agriculture is developed in areas that, generally, have a precarious status and whose development or distribution in the town often depends on the unilateral ideas of municipal authorities or specific urban management institutions. Land under the authority of these legal institutions is used without formal authority but with a varying tolerance, which is not always backed by rationality. Thus, the market gardens that have long been tolerated in Bamako incited some people to grow grains (millet, corn, etc.) on interstitial strips in the towns with successful results. Since 1989, the authorities have prohibited this practice since the high stalks created a bush that served as refuge to thieves (Diallo 1993). The most often cited example of this occurred in Bafoussan, Cameroon, during the 1970s, when the mayor arranged for the corn to be cut in order to clean up the town.

Land is often free in the interstitial areas. However, complex rental systems have often been developed through the succession of occupants or the informal involvement of administrations in the activity. Leasing is also common between land-owners and producers (Lomé, Lagos). In the latter case, the profitability of using this land for housing projects, not at all comparable to the profitability of urban agriculture, determines the risk of the activity.

The status of the activity varies, in contradiction to a premature classification in the informal sector, which, nevertheless, remains the most current. In Zaire, the government has promoted it to an official project, supported by outside funding. In Nigeria, the government has considered urban agriculture so important that it has made all inputs tax-exempt (fertilisers, seeds, etc.). For the majority, however, urban agriculture is simply an activity that is tolerated.

3.2 Need for inputs

The intensification of agriculture in and around the cities requires inputs such as fertilisers, biocides, labour, and water. The most expensive inputs in terms of direct costs and possible environmental impact are fertilisers and pesticides. This makes it worthwhile to look at alternatives (waste recycling, integrated pest management).

Waste recycling for urban and peri-urban agriculture is a potentially powerful, locally responsive approach to addressing waste disposal problems in African cities. The concept is not new to Africa, but to promote it on a large scale requires fundamental changes in planning Africa's urban areas, as well as change in attitudes of city governments, decision-makers, and urban planers. Change demands a commitment by them to include urban cultivation and organic waste recycling as an integral part of the built environment.

3.3 Water

Agriculture requires water, which may be obtained directly from rainfall (rainfed farming), or indirectly from a variety of sources such as rivers and streams, wells, rainwater harvesting, piped water and wastewater (irrigated farming). Water is essential for urban agriculture. For this activity, often considered to be on the borderline of profitability, access to low-cost quality water in the city raises enormous difficulties. The use of traditional wells is currently practised in many towns located far from rivers. Lacking a simple solution, some stopgap measures, like using polluted water form the sewage systems, expose the producer as well as the consumer to potential danger. One could mention, as an example, the use of wastewater to irrigate crops in Cambérène and Yoff (Dakar, Senegal) as well as in some areas of Lomé.

In Dakar, about 100,000 cubic meters of domestic wastewater is evacuated daily. Use of this resource could prove interesting because of some advantages like availability of more water and reduction of agricultural inputs such as fertilisers. However, because a large number of farmers use this untreated urban domestic wastewater either as the only source for irrigation or to supplement shallow wells, a potential danger for contamination exists.

The speed and unplanned nature of urban growth generates water problems and closely related sanitary problems, and most cities have an irregular water supply. As in peri-urban areas, irrigation is often proposed as an efficient and lasting way of using land. According to Livingston (1987), in vegetable production for example, competition for water can become a key factor influencing the viability of agriculture in cities.

3.4 Health

The practice of reusing waste in food cultivation in Africa is not new. Most African countries have traditionally utilised various types of materials to maintain and improve the productivity, tilth and fertility of agricultural soils. The indigenous kitchen gardens, compounds and community gardening systems of West Africa have made extensive use of organic materials. Promoting the reuse of waste in urban cultivation on a large scale, in areas with high population concentrations, raises the issue of health.

The issue of health is critical in urban and peri-urban agriculture. Urban solid waste in African cities contains large quantities of pathogens due to the presence of human excreta. Application in farming of such untreated waste can pose significant health risks both to those who have direct contact with it, and also to the general public who are affected through the food chain links (Furedy et al. 1997).

4. Conclusions

The combined effect of increasing population size and shrinking land availability demands increased food production. This can only be achieved through a more intensive management of resources in all aspects of food production. Urban and peri-urban agriculture should be included in such an approach, to be encouraged and guided by the authorities.

Urban farming has been taken up by the urban poor as a survival strategy, and more food is being produced in the urban and peri-urban sphere as a result. Encouragement and enlargement of such private enterprise by the authorities through the organised and proper use of treated urban wastewater could benefit both the urban poor at the micro- and household levels, and the urban food situation at the macro level.

Urban and peri-urban production systems need development support because projections estimate that within less than 30 years, half of the world's population will live in urban areas. Measures to boost agricultural production play a very important role in achieving development policy goals by reducing food insecurity, and increasing income and employment opportunities.

Urban and peri-urban agriculture offer partial solutions to several problems created by rapid urban growth in the developing world and especially in West Africa. Increased production through the application of efficient technologies to urban and peri-urban agriculture decreases food prices and increases consumption. If vegetable production systems are prominent among peri-urban and urban agricultural enterprises, people's consumption of them will increase. This means access to food and a way to overcome malnutrition for the poorest segment of the population, a source of income and high-quality food at low cost and possibility of savings for a large majority of people.

Urban farming is a competitive economic activity providing new jobs to many in the city, especially for people with limited mobility, low skill and little capital, including women and children. However, the benefits of urban agriculture extend beyond better nutrition, poverty reduction and jobs for the poor. Agricultural methods make the most out of scarce land, water and other natural resources, and often make use of wastes and industrial by-products as well. From the environmental and economic point of view waste reduction is interesting.

Urban areas have to be considered as vast nutrient sinks and only immense fertiliser imports and/or recycling of nutrients will sustain the food supply from the urban production areas. Therefore, in addition to agro-industrial byproducts (poultry manure, sawmill dust, brewery refuse), household refuse need to be valorised and considered either as an alternative or additional nutrients source. However, care has to be taken because of waste contamination by pathogens and agro-chemicals.

Peri-urban and urban vegetables will play a multiple role in achieving development policy goals (food security and malnutrition, job opportunities and poverty alleviation, support of women). When formulating future development plans, it is important that urban-rural linkages are fully understood; neither urban nor rural development should be treated in isolation. In view of the large gap in data on food and related nutrient-flows between rural, peri-urban and urban areas, studies must be conducted to minimise peri-urban nutrient depletion and to maximise environmentally sound land management. Decision support systems for city planners could be designed as one result. A network of approaches involving all stakeholders of urban development and peri-urban agriculture would be appropriate. As well, it would be a good idea to compare several African cities within the network and benefit from their experiences.

The informal private sector of urban and peri-urban farming should not be taken over by the government, although the treatment of urban wastewater and its subsequent use in urban agriculture does require government planning, investment and extension services. Participatory development in urban and peri-urban farming may enable proper integration between central planning of wastewater treatment and its use by private farmers. Special legislation for use of urban and peri-urban for farming purposes should be made as flexible as possible.

Municipalities in the Netherlands, for example, allow certain municipal areas, divided in small plots, to be farmed by interested individuals without their becoming owners of the land. Temporary permits are given and a small yearly fee has to be paid. Yearly extension of such permits in urban and peri-urban Africa could be made conditional on proper use of the wastewater and compliance with public health requirements.

The occurrence of severe drought will undoubtedly cause a decrease in the level of food production under rainfed agriculture. The resultant decline in locally produced food needs to be compensated for, frequently by supply from existing reserves or imports, in order to maintain food availability and consumption at a secure level.

One of the characteristic aspects of urban development is the widespread availability of piped water, a sewage system and the resultant production of urban wastewater. Because water is in the short run even more critical than food for human survival, governments have usually planned to maintain the piped water supplies to cities from secure water resources which can be used even during times of drought. Hence, the output of urban wastewater will also continue during meteorological drought. This rather stable production of urban wastewater should be perceived by planners as a real asset not to be wasted!

Four reasons can be given for the importance of urban wastewater treatment and purification in Africa:

1. Urban wastewater needs to be contained and purified for reasons of public health.
2. Raw urban sewage should not be permitted to flow freely on the surface, polluting streams, surface water and groundwater resources.
3. Treated wastewater can be used successfully and safely, at or near its urban source, in urban and peri-urban farming to produce food without the need for chemical fertilisers.
4. Urban wastewater will be available even during periods of drought, enabling urban and peri-urban food production to continue and thereby increasing urban food security.

Since urban sewage treatment requires government planning and supervision, it seems reasonable to suggest the need for agricultural extension education, legislation, and supervision concerning the agricultural use of the treated wastewater by individual urban farmers, in view of possible health hazards. However, a detailed World Bank report about wastewater irrigation in developing countries (Shuval et al. 1986), concluded that public health positions have often been overly conservative. The report recommends the use of low-cost stabilisation ponds, considered to be a robust method of wastewater treatment well suited to the needs of developing countries. “In fact, as we have already pointed out, 20-day stabilisation ponds can remove almost all bacteria and viruses and can produce an effluent suitable for unrestricted irrigation of vegetables” (Shuval et al. 1986).

Despite the official neglect from the colonial period to the present day, it is clearly apparent across contemporary Africa that urban farming is widespread and it is becoming a permanent feature of the landscapes of many cities. Proof of its persistence and stability is reflected in the acreage and land farmed within and around the built-up space of African cities and by the number of urban residents engaged in urban agriculture. A number of African countries have recognised the importance of urban farming and have taken steps to incorporate urban agriculture in their city plans.

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Gender analysis for improved irrigation performance

L'analyse genre pour l'amélioration des performances de l'irrigation

Barbara van Koppen

Abstract

The paper aims to improve gender analysis in agriculture in order to enhance its practical relevance for the design of irrigation policy and interventions, by moving on from simple statements of the importance of gender, and developing a set of nine statements that cover detailed aspects of gendered roles, rights and relationships. The discussion emphasises the need to identify the farm decision-maker, and the gender of that person. Farm decision-making is distinguished from merely working on the farm; and from other roles such as household headship, and land ownership. The final sections of the paper address the development of a Gender Performance Indicator for use in irrigation systems. The use of the indicator is illustrated by an example from Burkina Faso, which also shows how neglect of these principles reduced the benefits of initial stages of this project.

Résumé

Cet article vise à améliorer l'analyse genre en agriculture par la démonstration de son importance pratique pour la conception des politiques et interventions d'irrigation. Au lieu de simples assertions sur l'importance du genre, l'article propose neuf principes qui permettent d'analyser, de manière détaillée, les aspects genre dans des rôles, droits et devoirs liés à l'agriculture irriguée. La discussion souligne la nécessité d'identifier non seulement la personne qui prend des décisions au niveau de la parcelle agricole mais aussi le genre de cette personne. La responsabilité pour la prise de décision n'est pas assimilée au simple fait de travailler la terre. Le rôle du décideur au niveau de la parcelle agricole est également distingué d'autres rôles comme chef de famille et propriétaire de la parcelle. Enfin, l'article aborde le problème du développement d'un indicateur de performance genre susceptible d'utilisation dans le domaine de l'irrigation. L'application de cet indicateur à un projet d'irrigation au Burkina Faso illustre la réduction des bénéfices entraînée par la non prise en compte de ces principes lors de l'élaboration du projet.

1. Introduction

Today, it is widely acknowledged that "Women play an important role in agriculture and irrigation in sub-Saharan Africa and should be reached better by both the public and private sectors." However, it often stops at that point. The consensus is not easily translated into action. One explanation for this gap between intentions and action is that the statement is too general to be of much practical use. Especially for the introduction of new irrigation technologies, gender generalities are rather fruitless. Below, we nuance the above statement and elaborate nine new statements on gender and irrigation that are probably better guides for effective action.

(i) Women farm decision-makers differ from women unpaid family labourers

Gender debates tend to focus on differences between all men and all women. If differences between women (or between men) are highlighted, these are differences according to class, ethnic groups, age, culture, etc. However, especially for irrigation development, yet another important difference is one between women who are farm decision-makers and women who work under the authority of male kin as unpaid family labourers. This difference is important because both the public and private sectors primarily seek partnerships with farm decision-makers, who are responsible for mobilising one of the farm inputs; water. Farm decision-makers need water directly. Farm decision-makers are also most motivated to invest labour and capital in to the infrastructure and invest time and fees in to the membership of water users associations. As they are the immediate beneficiaries of these investments, farm-decision makers are motivated in their endeavours.

In contrast, family members working in a farm enterprise, which is managed by male kin (for women) or elder family members (for both sons and daughters) play a secondary role. Evidently, there may be indirect consequences of irrigation investments in terms of extra labour, risks of loan taking that can affect the whole family; and also in terms of indirect benefits, if their kin share the higher farm incomes. Although family members may oppose or stimulate the farm decision-maker to take up irrigation innovations and negotiate a deal, the ultimate decisions are made by farm decision-makers. Public and private irrigation agencies, therefore, assign great importance to the question whether women's "important role in agriculture"is a decision-making role in farming, or a role in providing labour into a family enterprise, even if it is the bulk of the labour.

(ii) Reaching women farm decision-makers in irrigation development improves irrigation performance

The above mentioned differentiation between women also provides clarity about the meanings and merits of a 'gender-inclusive' approach in creating an enabling environment that provides the needed inputs, credits, and markets to smallholders. The lack of clarity about what is meant by 'gender-inclusiveness' was often another factor that may have hampered change agents from undertaking action. Yet, such clarity exists. During the past three decades, virtually unanimous consensus has been reached among policy makers, public and private sector practitioners, researchers, and often also among women and men in local communities, that ensuring support systems reach women farm decision-makers as well as men farm decision-makers serves the goals of productivity *and* improvement of women's incomes besides men's incomes. Ample evidence has shown that women are as efficient producers as men, provided they obtain equitable access to productive resources and human capital and have a say over the output (for an in-depth discussion, see Quisumbing 1996). Women's equal, if not higher productivity, as that of men's is also confirmed in irrigated agriculture in Burkina Faso (Zwarteveen 1997) and Senegal (Deuss 1994). Therefore, women farm decision-makers should obtain access to new technologies, water, credits, training, and markets on the same footing as men farm decision-makers. Thus, gender-inclusiveness, or "good gender performance" of irrigation support systems means that both men and women are reached and that productivity and incomes increase for both genders.[1]

(iii) A gender classification of farming systems is a prerequisite for private and public irrigation development

If it is important to reach both men and women farm decision-makers, the next question is who in any specific context are the farm decision-makers: men, women, or both, and what the proportions are quantitatively. For both public and private sector development of new low-cost technologies, this is basic target group analysis. Elsewhere (van Koppen 2002), a majority of more than two-thirds of women farm decision-makers is defined as a female farming system. Less than one-third of women farm decision-makers represents a male farming system, while the dual farming system is in-between. Farming systems can be classified by examining the intra-household organisation of production in household farming in a given locality or scheme, and calculating relative proportions.

As is now widely acknowledged, households in general and farm households in particular are typically *not* units in which resources are pooled with the male head as the main decision-maker and representative. Instead, it is more plausible if intra-household relations are conceptualised as bargaining processes between the household members regarding the allocation of resources and spending of incomes (Jones 1986; Haddad, Hoddinott and Alderman 1997; World Bank 2001). Or, more precisely for the purpose here, there is an intra-household specialisation along gender lines with regard to productive activities. The household can be considered as being composed of one, two or more intra-household production units (Safiliou 1988). Individual adult household members have production units that are identifiable as theirs, and they have considerable autonomy with regard to labour allocation and income utilisation. While all household members share the common goal of family welfare, each household member tries to maximise benefits for him or herself from the allocation of their labour and other agricultural investments, through negotiations with other members "trying to get the best deal out of it." In all these negotiations, the limiting factor is family welfare and family

[1] Gender-inclusive action for women unpaid family labourers would address the *prior* issue that their status is only that of unpaid family labourer. In rural societies where women's subordinate position is a structural condition for the majority of women, society's unequal distribution of the range of production factors, including land inheritance, education and farm training, access to capital, mobility, socialisation patterns, gender-biased support systems, etc., is at stake. Irrigation agencies can change that only by fostering synergy with a wider movement for more gender equity (Schreiner and van Koppen 2001).

stability. Only in extreme situations in which negotiations completely break down and the prevailing conditions are untenable, household members may consider sacrificing family stability (Safiliou 1988).[2]

Distinguishing intra-household production units not only adequately conceptualises the gendered organisation of irrigated agricultural production, but it also indicates that irrigated agriculture is usually only one activity in the range of income-generating activities of farm households. Worldwide, farms are typically "pluri-active," in that they are engaged in rainfed and irrigated cropping but often also livestock, off-farm employment, trade, food processing, fisheries, etc. An analysis of the intra-household organisation of irrigated farming allows identification of the main decision-maker in one particular domain: farming the irrigated plot.

The existence of these semi-autonomous intra-household production units is also manifest in the provision of capital for cultivation or the adoption of new infrastructure such as treadle pumps. Women may negotiate loans for production factors on their own plots through their own family, neighbours and friends rather than from their in-laws. This was found in the Arabie/Olifants smallholder scheme in South Africa (van Koppen and De Lange 1999). If spouses do lend money to each other, they sometimes charge an interest rate (Safiliou 1988). An example of an issue that needs further investigation, is the impression that their husbands often finance the treadle pumps or bucket drips that women use in Kenya (Kabutha et al 2000). This situation may be one in which women are merely family labourers. Or, if these women are farm decision-makers, they possibly made a deal with their husbands. A better understanding of both men's and women's attitudes with regard to mutual capital provision will highlight whether there is a need for credit systems that are open to women, in order to foster the adoption of the new technology by women farm decision-makers.

(iv) The gendered nature of farming strongly varies, within sub-Saharan Africa as well

The gendered organisation of farming needs to be assessed in each specific situation, because gender patterns of farming vary greatly and change continuously. A multitude of factors influences these patterns. Land tenure is certainly an important one. The spouse with the stronger land titles usually has a stronger voice in the farm enterprise. However, this is not always the case, as elaborated below. Other factors that influence gender patterns of farming include culture and ethnicity, class and wealth status, or gender-biased agricultural technological development. Reportedly, specific agro-ecological zones like wetlands in sub-Saharan Africa also have higher proportions of women-managed plots than adjacent dry lands (Dey 1980; Richards 1986). Worldwide, homestead cultivation is often also a female farming system, although homestead land may belong to the men who also perform specific activities such as ploughing, as in Jambar, a village in South Gujarat, India (van Koppen et al. 2001).

Locally prevailing gender patterns in farming also vary according to household composition, stage in the household cycle and age (Bastidas 1999), head of the household, personal preferences, etc. Gender-segmented off-farm employment opportunities and high male ratios in out-migration lead to the feminisation of agriculture and the change of male farming systems into dual and female farming systems. In Southern and Eastern Africa female and dual farming systems are endemic. In some regions 50 or even up to 90 percent of the farms are female-managed (FAO 1998; Makhura and Ngqaleni 1996; Safiliou 1994). Dual systems may also occur pocket-wise in typically male irrigated farming, as reported in Nepal (Zwarteveen and Neupane 1996).

(v) The method of classifying farming systems can be quick and easy

The variation in the gendered organisation of agricultural production warrants an assessment in each specific situation. A first indication in each specific context is often quite easily obtained. Local project staff, extension workers, or farm leaders, who know existing or potential irrigation contexts, often have considerable insight in the gender of the decision-maker on the various plots, if the questions clearly concern a specific farm. A small random and representative sample already provides

[2] Theoretically, an intra-household production unit can be managed in a truly joint way, but evidence is rare. Probably, the rather egalitarian gendered division of tasks combined with bilateral land inheritance, as reported in the Andean regions in Latin America or parts in Madagascar (Raparson 1989), come closest.

useful insight. Evidently, the method of assessing the intra-household organisation of agricultural production can also be much more sophisticated, leading to more refined typologies, etc.

In carrying out such research one may find that the initial answer to questions about the intra-household organisation of production is ‘jointly’. Interestingly, this may be the case in both male and female farming systems (van Koppen 2002). This answer is easy and nowadays socially acceptable, also in male farming systems. Some further probing is usually sufficient to give unambiguous answers as to whether the farm manager in general, or the household member taking specific decisions or carrying out certain activities, is a man or a woman, or whether spouses or parents and children farm jointly.

A methodological warning is that existing lists of farmers are notoriously misleading, because these tools are for administrative or demographic purposes and tend to register either the household head or the landowner, that is if there is clarity about the registration criteria at all. Administrative simplification tends to ignore production relations and to incorrectly equate farm decision-making to headship of a household or land-ownership.

(vi) Farm decision-making differs from headship of household

It may be useful to re-emphasise the difference between headship of a household and farm decision-making. In female farming systems, such as wetland or homestead cultivation, most women farm decision-makers are typically married while their husbands’ main occupation can also be farming. Households in which men have off-farm jobs while women do the farming activities, may well be seen as male-headed households, even though others would call these *de facto* female-headed households, especially if off-farm employment is at a large distance. Problems of definition of headship easily arise without providing any additional insight into the issue at stake here: farm decision-making. On the other hand, in *de jure* female-headed households, which are more clearly defined, women may leave farm decision-making to others. This was found in male farming systems in large-scale canal irrigation schemes in India. Farm decision-making was only in women’s hands in half of the cases (van Koppen et al. 2001). Hence, targeting female-headed households to reach women farm decision-makers would mean that both targeting mistakes are made: women “heads of households” who are *not* the farm decision-makers would be included; and women farm decision-makers in male-headed households would be overlooked.

(vii) Farm decision-making is prior to land-ownership in public schemes, and a possible obstacle in private technology development

The various relationships between farm decision-maker and land tenure need to be disentangled. Women farm decision-makers tend to have weaker land rights than men in many sub-Saharan countries. Some categories of women, however, have the primary land rights under some conditions, while other women cultivate in their own names on land of their in-laws to which they have life-long tenure security. Men may also cultivate land of their female in-laws. A mix of these situations was found in the Tongwane sub-catchment of the Olifants River in a former homeland in South Africa. Out of 176 irrigated plots in various irrigation schemes in this sub-catchment, women cultivate 62 percent, men 24 percent and both spouses jointly cultivate 14 percent. However, among the women farm decision-makers, 36 percent are *not* the titleholders of the land they cultivate. Of the men farm decision-makers, 10 percent also cultivate land belonging to others (van Koppen et al. 2000). It is also possible, as found in south Malawi and Mozambique, that women have the primary land titles while men are the farm decision-makers on those lands.

The distinction between farm decision-making and primary land titles is especially important in situations in which governmental agencies define water rights and membership rights of water users’ associations. Irrigation management transfer often requires reconsidering such membership criteria. Generally, vesting membership of water users’ associations in the factual farm decision-maker (who is also motivated to increase the farm’s productivity through water) rather than the person with the primary rights to the land, benefits women and stimulates production. This concern of opening up membership of new water users’ associations to women farm decision-makers, irrespective of the type of their land rights, was one of the reasons for the Government of the Republic of South Africa to disconnect land-ownership from membership of water users’ associations in the National Water Act (Republic of South Africa 1998).

Evidently, the real solution for women farm decision-makers who only have weak land rights is to strengthen women's land rights as well as their water rights. Investments in new infrastructure and processes of irrigation management transfer may offer such opportunities of reallocating land in the command area (Traditional Irrigation Improvement Program Tanzania 1993; Projet Sensibilisation 1995).

Land tenure also plays a role in the development and up-take of low-cost individual technologies, such as treadle pumps and bucket drip systems. In these situations, land tenure is often given. In the case of mobile technologies, one could assume that even cultivators, whether men or women, who risk being shifted from the land in which they invested through irrigation infrastructure, are sufficiently motivated to make the investment in irrigation as they will never fully lose their investments. But for land-bound irrigation investments, weak land rights may appear a basic obstacle for women and men to make long-term investments. This issue needs more research, for example, to identify forms of contracts that make the investment attractive to both the landowner and cultivator.

(viii) Gender performance of irrigation institutions in collective irrigation schemes can be measured

In the specific case of externally supported collective irrigation schemes and their institutions, there is yet another issue besides classifying the farming system precisely, as described above, which is the performance question. This second gender issue addresses the question as to whether irrigation institutions reach men and women farm decision-makers equally well in providing water, or other services, and if not, what could be done to change any deficiencies. Irrigation institutions are defined here as the collective arrangements that govern the construction, operation, and maintenance of infrastructure, water acquisition and distribution, and resource mobilisation. It is useful to distinguish three aspects which all require different forms of action, if gender-based exclusion is found to be the case.

- Equal farm-level access to water and related obligations, which is directly related to women's and men's equal access to resources for higher productivity and incomes.
- Equal participation in 'forums' or networks for collective water management arrangements as generally required for strengthening access to water at farm level.
- Equality at leadership-level in the sense that the gender composition of leaders reflects the gender composition of the farmers in the scheme and that women function as well as men.

The answers to these questions give a full-fledged picture of gender performance, which can also be specified. Absence of gender-based differences means good gender performance (+); mild gender-based differences mean moderate performance (+/-); or categorical exclusion means low gender performance (-) for that particular aspect.

The specific role of external intervening agencies in shaping the irrigation institutions, and thus in contributing to a good or weak gender performance of a particular scheme can also be specified at these three levels: farm, forum, and leadership level. The explicit study of the role of external agencies in shaping irrigation institutions, and, hence, gender-based inclusion and exclusion processes, render the study more policy-relevant. Roughly, one can compare the influence of agencies with the role of locally prevailing production arrangements. This helps in defining whether agencies are the "main performer" (which they can change) or whether local reality is the main cause of gender inclusion or exclusion (which agencies alone can hardly change). This approach was elaborated into a "Gender Performance Indicator for Irrigation" by the Poverty, Gender, and Water Project of the International Water Management Institute, Sri Lanka, and tested in nine case studies (van Koppen 2002).

To conclude, one example of the application of the complete Gender Performance Indicator for Irrigation is given, which highlights why gender analysis is important, especially for public irrigation agencies.

(ix) In dual and female farming systems, public irrigation agencies are the main gender performers

This application of the Gender Performance Indicator for Irrigation is in a wetland improvement project in Southwest Burkina Faso (van Koppen 1998). This case not only shows the negative effects of the agency's male bias, but also the resilience of a female farming system. These locally prevailing production relations were the most important factors that "forced" the project to change in later schemes from the male-biased towards a gender-inclusive intervention approach. The later gender-inclusive approach that the project adopted as its standard procedure also appears effective wherever female and dual farming systems exist to enhance both productivity and women's income. The Gender Performance Indicator for Irrigation that was applied before the project, during the first schemes and during the later schemes, captured the essence of the inclusion and exclusion of women farm decision-makers.

2. Gender classification of farming system and gender performance of local schemes

In the low-lying wetlands in the West Comoé Province in Burkina Faso that are used for rice cultivation, 80 to 90 percent of the plots are cultivated by younger and especially older women as their production units. Men as a gender are the farm decision-makers on the upper dry lands, for which they solicit labour inputs by their wives as long as they are young. Inheritance of wetland plots from mother to daughter is common, while husbands and mothers-in-law also mediate in providing rice plots to women. Wetlands are governed by the low intensity common property regimes, mentioned above (Ostrom 1994). Within the clan of the "land chiefs," the local land custodians the women of the clan assume most functions in the wetlands. In some cases, it is even taboo for male land chiefs to enter wetlands during the rainy season, as this is believed to cause inundation. To outsiders, though, brothers, fathers or husbands of the female land chief tend to be the representatives. Male land chiefs also perform religious functions. The Gender Performance Indicator for Irrigation for the pre-project situation is given in Table 1.

This case study is an in-situ experiment, so the respective roles of the project or local arrangements as main cause of events, or "main performer" in the Gender Performance Indicator for Irrigation, can easily be identified, and is identified in the final line of Table 1 and subsequent similar tables below.

Table 1. The Gender Performance Indicator for Irrigation in wetlands in South-West Burkina Faso, before the wetlands improvement project.

Land rights	Membership rights	Water rights at farm level	Inclusion in forums	Inclusion as leaders	Ability to function as leaders
+	+	+	+	+	+/-
Main performer: local arrangements					

3. Exclusion by the agency in the first two schemes

In 1980 a 'Rice Cultivation Improvement Project' started in these wetlands. This project was initiated and implemented by the regional Ministry of Agriculture and funded by the European Community. The project intended to intervene subsequently in eight rice valleys in the project zone up till 1987. It was foreseen that central drains, sluices, and bunds would be constructed according to the contour lines, for better water management in the respective valleys. Before construction, land was expropriated. Land was then divided in to equal-sized plots and reallocated after construction.

The first two schemes were constructed simultaneously. In these two schemes the technical project management, who fully concentrated on rapid construction, only interacted with a handful of (male) village authorities. This elite arranged the expropriation of land, promising to the women that they would get the land back. Yet, after construction when the improved plots were to be reallocated, this small “committee” of project management and village elite decided to allocate the improved rice plots to men only. As “male heads of households,” beneficiary men were supposed to arrange the “intra-household” and “cultural” affair of farming and land allocation. All project staff were misled by the above-mentioned concept of the unitary household, represented by the male heads. Even the social scientists in the project, who mainly relied on demographic survey data and lists from the tax offices, imagined that rice cultivation would become a “family farm” after the project. Even they had failed to discover the existence of women’s own production units and land rights.

When these first schemes started functioning, the male land title-holders expected women to continue providing all labour, while men’s new land rights entitled them to appropriate most of the harvest. The women felt “betrayed by their men.” They had lost their plots plus their say over the rice harvest, all of which discouraged them from producing. Moreover, membership of the new water users’ association, which entailed the obligations for maintenance, was vested in land title-holders as well. Women were excluded from the forums where collective rules were set and implemented. In most parts of the two schemes, however, men failed to fulfil their labour obligations because their primary interests continued to be in the uplands. Lack of maintenance of the infrastructure further contributed to the decrease of production and even abandonment of large parts of the schemes.

Remarkably, even the regional director of the Ministry of Agriculture, who was one of the very few who had understood the previous local farming system and recognised the negative consequences of the project for women and their dependants in the first two schemes, failed to see a solution. His personal interpretation of law was that “after public intervention, the administrative allocation ignores women whose juridical existence is only through the family head.” Thus, even he contributed to the introduction of new forms of exclusion, based on a personal interpretation of marital law, which was totally alien in local land and water tenure. The low gender performance of the first two schemes is summarised in Table 2.

Table 2. The Gender Performance Indicator for Irrigation in wetlands in South-West Burkina Faso in the first two schemes of the wetlands improvement project.

Land rights	Membership rights	Water rights at farm level	Inclusion in forums	Inclusion as leaders	Ability to function as leaders
-	-	+	-	-	-
		Main performer: agency			

4. Resilience of local production relations and women’s inclusion

The change in the procedures of land expropriation and reallocation in the third and fourth schemes was the result of local initiative by women, their husbands and female and male land chiefs, and receptive field staff. The crucial difference from the first two schemes was the time span of some years between the first contacts of the project and the start of construction. During this period full consensus was reached in the community that the existing plot holders, whose names were known exactly by the land chiefs, obtained priority rights for new allocation.

This procedure evolved into a standard gender-sensitive procedure for all later schemes in the project zone (and elsewhere in the world indeed). In this approach, first, open meetings are organised, for which the current farm decision-makers and anyone interested are invited. The participants in the meetings are informed about the project, the technical aspects, and the land redistribution and proposed organisational design. Current plot holders and other candidates are registered as future land and water title-holders before any construction. After construction and land reallocation, they become members of the new water users’ associations, fulfil their maintenance obligations and elect their leaders. In the committees, however, the minority of male rice cultivators remains over-represented. By extensive literacy and other training programmes, the project builds the critical mass for a pool of women candidate leaders.

In all later schemes men were still explicitly invited to apply for new rice plots. Nevertheless, the majority of new applicants were invariably women, except for one site where land pressure on upper dry lands had become high, which caused some men to apply for rice plots as well. Table 3 captures the good gender performance in the later schemes.

Table 3. The Gender Performance Indicator for Irrigation in wetlands in South-West Burkina Faso in the later schemes of the wetlands improvement project.

Land rights	Membership rights	Water rights at farm level	Inclusion in forums	Inclusion as leaders	Ability to function as leaders
+	+	+	+	+	+/-
Main performer: initiated by local arrangements, accepted by agency					

The local socio-economic conditions in the subsequent schemes are rather similar. Only the procedures for land expropriation and reallocation differed. In the first two schemes the agency was most dominant, while in later schemes communities obtained a stronger say. The agency was, therefore, the *only* cause of women's marginalisation. Locally, such exclusion had never existed before. This marginalisation was the result of the agency's complete ignorance of the gendered organisation of farming combined with an authoritarian approach, in which under high time pressure, far-reaching decision-making powers were vested in a handful of local elite.

In later schemes, the locally prevailing organisation of farming smoothly re-emerged as the most obvious basis for the new farming system and irrigation institutions, in spite of the project. It only required time to crystallise. None of the later schemes had the productivity and maintenance problems of the first schemes. The inclusive approach that the agency later adopted is straightforward: recognising and organising farm decision-makers, whether male or female, in a bottom-up way *before* construction, and strengthening the resource rights of the farm decision-makers, while demanding that they fulfil their obligations.

5. Conclusions

The case of the wetland improvement project in Burkina Faso highlights, in a nutshell, the core arguments raised in many other case studies: agencies' blindness to recognise prevailing female or dual farming systems, and the ways in which agencies vest far-reaching decision-making powers in male elites only and exclude women farmers from membership of forums, let alone leadership positions. Reportedly, the loss of women farmers' earlier rights to water and irrigated land, and declining productivity are similar results (Hanger and Morris 1973; Dey 1980; Carney 1988; Illo et al 1988).

The other side of the coin is also documented. In female and dual farming systems, quite a number of agencies learned from their mistakes and started actively adopting the above-mentioned inclusive approach from the design stage onwards. This had the desired effects (Carney 1994; Traditional Irrigation Improvement Program Tanzania, 1993; Hulsebosch and Ombarra 1995;[3] Arroyo and Boelens 1997; De Lange et al. 1999).

Hence, where female and dual farming systems prevail in Africa, Asia or Latin America, there is not only scope for irrigation agencies to enhance women's incomes by supplying them with water in their own names, but also to vest in them the rights to irrigated land. It is often absolutely necessary to

[3] In the West Kano irrigation project, Kenya, the agency only agreed to hold meetings if women constituted at least half of the participants. Otherwise they cancelled. Moreover, in the first years, the agency organised women in women-only groups, in which they were well informed and encouraged to articulate their interests in preparation for the subsequent mixed meetings (Hulsebosch and Ombarra 1995).

achieve the productivity goals of irrigation investments. Agencies themselves are the main performers in either excluding women farm decision-makers or, more recently, successfully including women and men on an equal footing in irrigation institutions.

As women are managers of farms in which water is an input, women's inclusion in irrigation institutions besides men's is a straightforward matter of bottom-up organisation of all farm decision-makers, irrespective of the type of land rights into member-based water users' associations that can demand accountability from their leaders (Shah 1996). Then, gender-based exclusion at farm or forum level is unlikely to occur. Only for inclusive leadership, does support remain necessary in order to develop women's organization and leadership skills. In female and dual farming systems, the key policy issue is that policy makers and interventionists themselves should finally learn.

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Women irrigators and operation and maintenance of small-scale smallholder schemes in Africa

Le rôle des femmes dans l'exploitation et la maintenance des petits périmètres irrigués en Afrique

Felicity Chancellor

Abstract

The formal role of women in operation and maintenance (O&M) on small-holder irrigation schemes in Africa is minimal and belies the role women play in irrigated crop-production. This is a factor constraining small-holder irrigation performance. There are ways to deal with this mismatch and to increase women's participation. Better approaches will take account of men's and women's objectives in their wider cultural and livelihood environments, not simply the irrigation sector. By increasing their contribution to maintenance, women could strengthen their rights to land and water, and their influence on management, while significantly improving sustainability.

The priorities of agencies promoting turnover will differ from those in the receiving communities. While people deal with immediate issues such as food security and financial viability, equality and empowerment may be ignored or sidelined. If it is demonstrated that viability and commercial success of schemes benefit from increased gender-awareness, these risks are reduced. Maintenance of small-scale, small-holder irrigation schemes has been drastically inadequate. Many schemes are rundown and pose huge challenges to their users. Significant improvement is crucial to these schemes' survival. The paper suggests an approach relying on motivating men and women to discuss and develop participation in O&M, and find appropriate solutions. Making and sustaining links with private sector service-providers will be key activities. Participatory research, training, and dissemination of lessons learned among irrigators should all be encouraged.

Résumé

Le rôle des femmes dans l'exploitation et la maintenance des petits périmètres irrigués en Afrique témoigne le rôle minimal qu'elles jouent dans la production irriguée. C'est un facteur qui contraigne la performance de ces périmètres. Afin de remédier à cette situation et accroître la participation des femmes, il faudra adopter des approches qui tiennent compte des objectifs spécifiques des hommes et des femmes relatifs à leurs environnements culturaux et économiques et non seulement le secteur d'irrigation. En s'impliquant davantage à la maintenance, des femmes auront la possibilité de renforcer leurs droits d'accès à l'eau et à la terre, d'augmenter leur influence dans la gestion et d'améliorer de manière significative la durabilité des systèmes. Les priorités des organisations qui promeuvent le transfert des périmètres irrigués sont différentes de celles des communautés bénéficiaires. En se préoccupant des aspects immédiats tels la sécurité alimentaire et la viabilité financière, on risque de s'éloigner les notions d'égalité et de renforcement des capacités. Mais si on arrive à démontrer qu'une plus grande sensibilité aux aspects genre peut améliorer la viabilité et la réussite commerciale, ces risques peuvent être réduits. La maintenance des petits périmètres irrigués n'a pas été assurée pendant longtemps qui résulte en des aménagements délabrés et qui posent d'énormes difficultés aux usagers. L'amélioration de telles situations est extrêmement importante pour la survie de ces périmètres. Cette communication propose une approche dont le principe est d'encourager des femmes et des hommes à davantage de discussion et de participation en vue de trouver des solutions adaptées aux problèmes d'exploitation et de maintenance. L'établissement des liens avec les fournisseurs de biens et services du secteur privé est primordial. La recherche participative, la formation et la diffusion de leçons parmi les irriguants sont à encourager.

1. Introduction

Smallholder irrigation is favoured in sub-Saharan Africa for a number of reasons: small-scale development is physically appropriate to the resources available and suits traditional farming practices. Despite its small scale, smallholder irrigation is complex. Success and sustainability demand careful holistic design. Experience suggests that review of institutional capacity and human capital is a key indicator for efficient operation (Barghouti and Le Moigne 1990).

However, in Southern Africa in the past, schemes were imposed on users, sometimes quite overtly, as in the case of resettlement schemes, and sometimes in well-meaning attempts to reduce poverty. In all cases, design of schemes centred on water and plants and not on people. The political objectives had strong welfare overtones; management was centralised, and was funded and resourced from central monies. Irrigation departments or agencies organised operation and maintenance of smallholder, small-scale irrigation. The cost associated with this system was high, information was not highly valued, and adjustment to change was slow. Dialogue between agency and farmer was directed at male plot-owners, seldom involving women in technical choice or organisation of O&M . Assumptions were wrongly made that African women and men held the same views, that women would not understand technical issues, and that men regularly pass information to their wives and consult them (Merrey et al. 1998; Jones 1999). Participation was so neglected that it is doubtful if the needs of either men or women irrigators were taken into account. Now, as governments withdraw their support from these costly schemes, the difficulty of handling these irrigation enterprises with the reduced resources available is a major issue (Chancellor and Hide 1997a; Ubels and Horst 1994; Vermillion 1997).

For many years, the state has devolved more and more responsibility for operation and maintenance of irrigation infrastructure to farmers. Despite farmers' high motivation to maintain, they face a difficult task to meet costs, provide labour, and organise. Few small schemes can support the cost of full-time professionals; thus farmers must provide management as well as labour. Although women farmers contribute to manual labour for scheme O&M, and women-headed households pay their contribution to costs, women's participation in decision-making about and prioritising of O&M tasks is low.

The history of government smallholder schemes has not encouraged women to take part or to demand roles other than the most menial, but now, to achieve sustainability, schemes must find ways to benefit from women's contributions to decisions and management. Farmer management cannot follow the model of agency management and must devise a new, more appropriate method that will serve their objectives with the resources available.

Schemes already turned over to farmers must review objectives, which are often vague or have been foisted upon them at the time of turnover by the departing agency, before they can address short-term management and maintenance issues. However, to assist the process of review, farmers need to understand desired levels of maintenance, what needs to be done and why, how often, the consequences of neglect, manpower requirements, skills, materials, sources and costs. Decisions about priority tasks, who is responsible for them and who contributes to their cost, can then be addressed. Unfortunately, most retiring agencies don't have this information to offer to those taking over.

Until recently, there has been little incentive for the private sector to provide irrigation services for smallholders, or to retail equipment needed for service and repair of infrastructure. Thus, when responsibilities are devolved, a gap is revealed between the farmers' need for maintenance skills and materials, and the reality of obtaining them from the private sector. Although non-government schemes tend to use lower-tech methods, they too find it difficult to get access to reliable, affordable services. Establishing commercial markets in which smallholder irrigators can buy appropriate services and materials is a key priority. In Africa, the total amount of smallholder irrigation is relatively small. In Southern and Eastern Africa the percentage of agricultural land under irrigation varies from as little as 3 percent to as high as 30 percent in Swaziland (Osoro 1996), although much of the Swazi total is irrigated, estate-grown, sugarcane. Thus the pull of the smallholder irrigation sector for private service providers is weak. Countries such as Nigeria, Zambia, and Ghana, in which there are large numbers of individual irrigators, outside irrigation schemes, may present better opportunities for expansion of the private sector.

The dramatic rise in the number of women *de facto* farm managers and the number of women-headed households in sub-Saharan Africa has an impact. The percentage of women in rural areas managing alone is said to be over 31 percent. These changes in intra-household arrangements have had a profound impact on the role of women in African agriculture (FAO 1998). This trend also has impacts on the demand for irrigation equipment. Women are now often the buyers of equipment, but they remain disadvantaged in relation to access to land and productive resources, especially cash, and training and advice. Women, therefore, generate a very limited demand for private sector services. Their increasing numbers mean that weak demand will persist and will potentially limit private sector involvement and expansion, and constrain women's ability to increase productive resources and establish a role in future irrigation. However, there is much that can be done to alter such predictions, particularly if account is taken of women as skilled managers and people who have great capacity to raise funds and establish commerce locally (Spring 2000).

Several factors contribute to the difficulties men and women have in establishing service links:

- Land tenure;
- The dispersed and remote nature of small-holder irrigation;
- The relative poverty of rural areas and of small-holder irrigators, particularly women;
- Mismatches between technologies in use and users' needs;
- Poor organisation within schemes for routine operation and care of equipment and infrastructure.

In the following sections, constraining factors will be discussed from a gender perspective. Strategies that potentially serve the farmers are considered alongside gender aspects of farmer-managed schemes. Strategies that mobilise women's contribution in a beneficial way, and strengthen women's participation and rights in smallholder irrigation, are of special interest.

2. Land tenure differences between men and women

Land tenure is often cited, as limiting women's access to resources, and it is true that, in the majority of government smallholder schemes, land ownership is vested in male household heads. Nonetheless women secure user rights to use irrigated land and are major users of irrigation, often relying on it exclusively to feed themselves and their families.

Two major issues illustrate the disparity between men and women in relation to land:

- User rights for women are less secure, depending largely on the relationship of women with husbands and male relatives. This limits women's motivation to maintain and invest in their land.
- Production is limited by resources and social norms and determines the value of land as a livelihood asset.

These differences must be considered when developing strategies for irrigation turnover.

However, the situation is constantly changing. Women are increasingly allocated land, and entire schemes are dedicated to women for food production. NGO developments often favour women, and private donors respond to women's requests. In Eritrea, women have influenced local land allocation by proving themselves capable in both O&M and commercial activity. In some places, working as groups, they have been granted rights to cultivate that are better than those currently available to local men (EU 1998).

However, the scale of women's schemes tends to be small, as are the plots allocated to women and women's groups within larger schemes. In relatively secure tenure conditions, women show themselves competent to produce high yields on small plots. They often form savings groups to finance inputs because their lack of land ownership makes it difficult to obtain loans. Similarly, they organise and fund O&M effectively on small schemes, despite difficulties in accessing services and spares. There is also change in women's domestic situation with increasing numbers of women taking responsibility for whole families. For these women, subsistence irrigation no longer meets their need for cash income to fund the upbringing and education of their children. As women increasingly find themselves the major breadwinners, there is growing demand for stronger rights to land to enable them to obtain loans, invest, and grow on a commercial basis.

3. The impact of location on men and women irrigators

Generally, distance to the nearest town is the determining factor of remoteness and influences farmers' ability to access both inputs and markets. However, other factors, such as the availability of transport and infrastructure, influence remoteness. Schemes near main roads generally have sufficient access to transport and passing customers to overcome these difficulties.

> Kibirigwi scheme in Kenya straddles a main road about 10 km south of a market town. Farmers have little difficulty to obtain spares or equipment and have good links to suppliers. The area supports a mix of 'individual' and 'scheme' irrigators. Sustainability, however, hinges on marketing and maintenance (Chancellor and Hide 1997b). In contrast, Rufaro scheme in Zimbabwe which is only 15 km from town, in an area of low economic activity, has poor road access, poor transport and lacks links to services. Farmers are unable to maintain the system (Chancellor et al. 1999b).

Transport affects men and women differently. Women often find it harder than men to leave family obligations for long periods, despite strong support networks, or they may have less cash to pay fares and buy their share of privately offered lifts and hires. As a result of infrequent visits to local trade centres and low spending power, rural women have fewer urban and commercial links than rural men do. Thus the remoteness of schemes is not only a matter of distance but depends on infrastructure, the gender composition and wealth of the membership and the general economic activity of the area. Remoteness impacts differently on different subgroups.

> **Chikava, a remote CARE-assisted women's scheme in Zimbabwe**,
>
> - Women have little access to transport and must use buses.
> - Local buses are often too full to stop, or refuse to carry produce.
> - Buyers of surplus produce must be within walking distance.
> - Women seldom visit town.
>
> Consequently, women have limited access to:
>
> - Inputs.
> - Equipment.
> - New ideas.
>
> Despite diligent attention to maintenance tasks, they have limited capacity to improve production, invest in labour-saving equipment or gain new experience.

In places like Chikava, CARE (Cooperative for American Relief to Everywhere) draws on international experience and funds to address these issues through "agency" programmes with local retailers and with intensive attention to market information and training. In contrast, local irrigator associations, despite detailed local knowledge and close ownership of projects, encounter problems due to lack of experience and information. The widespread scarcity of resources means that schemes rarely can afford to learn from experience. For women, scarcity of resources is generally more acute than for men.

At Apel irrigation scheme, a remote, private initiative of the Rural Women's Association, in Northern Province, South Africa, irrigation depends on pumps.

- The women are not trained to maintain, troubleshoot or repair pumps.
- They are totally reliant on distant private-sector operators.
- Women contribute regularly for maintenance, fuel and small repairs.
- The women are innovative in obtaining inputs and serving local markets.

Pump breakdown jeopardises the scheme. The women have little experience or appreciation of repair and transport costs and, in arguing the repair price and arrangements, incur delay and water shortage. The losses of revenue and subsistence that result probably outweigh the extra cost of prompt attention.
(IWMI 1999)

In contrast, peri-urban irrigation is characterised by individuals or small groups acquiring equipment; the urban location allows wide choice of suppliers. Irrigation costs are often subsidised by other income-earning activities, but surprisingly less through paid employment than expected. The urban growers face more difficulty in acquiring water, and in securing crops and equipment, than in accessing technology and markets. In Nairobi, a survey of peri-urban irrigators, of whom 63 percent were women, found that 38 percent had invested in and were using small pumps (Hide and Kimani 2000). The irrigators were young and relatively inexperienced but entrepreneurial compared to older, experienced farmers in rural Kenya. Most peri-urban irrigators use land illegally, thus advisory services bypass them. But conditions are sufficiently favourable for irrigation to contribute positively to livelihoods, despite limited information, advice, and risk to health from use of poor-quality water.

Women are potentially more restricted than men in remote areas by difficulty in accessing services, markets, and profits. Women in women's schemes take on O&M successfully, but modern technology, for which specialist services might be needed, increases women's difficulties disproportionately in remote areas. Lack of knowledge and the personal contacts that people rely on in making arrangements remotely, are the main limiting factors. Improved access to training for women, combined with targeted outreach by private-sector service providers could address these constraints. Difficulties associated with technology and access to services and markets are less acute for peri-urban women irrigators. Women in remote mixed irrigation schemes generally take part in maintenance as part of their labour contribution, but often in an informal way and in unskilled roles such as labouring; they seldom make decisions related to maintenance.

4. Poverty

Poverty affects irrigators in two ways; firstly, poverty among irrigators reduces the potential for production and, secondly, poverty in the surrounding communities reduces the potential for profit. In addition, structural adjustment has already significantly raised the costs of inputs, affecting women disproportionately because they are among the poorest irrigators, in relation to both cash and resources.

On all irrigation schemes there is a range of wealth among the farmers. Women's poverty relative to the whole group of irrigators is generally a result of social norms, particularly those relating to land tenure, education and paid work. Ownership and permits to occupy or use land are often in male hands, and restrict the rights of women to realise cash from crops they have grown. Women's bargaining position within households is weak and the *status quo* is supported by strong traditional views in the community at large. Married women complain that while a crop is in the ground and needs their care, relations with their husbands are amicable, but when the crop is harvested and ready to sell, attitudes harden against them. Husbands who sell the crop at a distance often return home without a share of the profit for the wife and her children and for next season's planting.

Women who farm as household heads exert more control over resources and benefits, but suffer disparity in their ability to access services, water, and advice. Women tend to sell crops locally because of the time, linkages, and resources required for distance selling. They have considerable insight into local markets and they often develop successful strategies such as selling in very small quantities, selling at local gathering points and taking produce to the buyer's door.

An example comes from Apel: One of the Rural Women's Association enterprises is poultry. Chickens are reared to be ready for sale when pensions are distributed. People feel well-off that day and the chickens sell easily.

Another example from South Africa: A man who has an irrigated orchard fills his small truck with apples and takes them to a particularly poor township. There he swaps the apples individually for empty bottles. He delivers the empties to the depot and collects the refund money. This option is probably not open to women, who could never afford the truck, but the idea is innovative.

In Zimbabwe: Women in a remote scheme barter irrigated vegetables for the use of draft animals for land preparation. Although this helps their resource problem, it does not solve their cash problem.

In general, cash-poverty restricts production among women, but innovative marketing on their part makes the best of local markets and helps to ameliorate the effects of limited productive resources and opportunities to travel.

Lack of resources among irrigators is particularly acute among *de facto* women-headed households, and limits the amount of irrigated land that is used. As the amounts of land available to women may be small already, this is very restrictive. Women often lack resources for land preparation and may have to wait to the end of the queue for ploughing services. The late planting that results disrupts watering schedules and leads to lower yields or poorer quality produce. The overall effect is lower revenue.

Although poor women are skilled in mobilising local savings, and achieve reliable repayment on group loans, and although credit providers are therefore becoming more willing to extend loans to women's groups, this does not necessarily overcome the social forces that push them to the end of queues.

Another aspect of women's poverty is their high workloads due to their triple roles as reproducers, domestic providers, and agricultural workers. Limited access to resources further contributes to women's heavy workload. Women prepare land by hand, or walk long distances to acquire essentials such as drinking water. Irrigation intensifies the drudgery in their daily routine.

Women's labour is disproportionately increased by irrigation because of:

- the year-round nature of cultivation (men may remain in the seasonal rain-fed sector).
- the extra weed growth resulting from applying water (traditionally, women weed).
- the extra burden of land preparation and levelling (now increasingly the responsibility of women).

The additional workload does not always bring proportional increases in benefit.

Where smallholder irrigation is set in poor rural areas, with low levels of economic activity, which is often the case due to earlier policies, irrigators face low levels of local demand, particularly for high-value products. Peri-urban irrigators are less affected, due to the proximity of a wide range of consumers and the greater opportunity for sales.

Contracts between irrigators, usually male plot-owners, and private commercial companies or entrepreneurs are often seen as a solution to distance marketing (SIBU 2001). It is not clear how private-sector entrepreneurs view women producers. While women, given equal access to resources, produce as well as men, it is also realistic to recognise that they are disadvantaged in terms of resource control. Even where the entrepreneur provides packages of seed, fertiliser and spray, women's limited ability to command ploughing services and water supply renders their production more prone to risk. There is potential for improvement in two aspects: firstly, women becoming more active in ensuring reliable water supply and secondly, groups of women acting together to secure contracts.

At Thabina, in South Africa, a few irrigators grow high-value horticultural crops. The major constraint is marketing. Many factors contribute to high costs, such as land preparation, input costs, transport costs, maintenance, and security for the growing crop. Women find it hard to compete in this market.

Local conflict, lack of commercial links and agricultural advice, and lack of demand contribute to low incomes for women irrigators. Emphasis on production of locally popular, low-priced produce, such as maize cobs sold off the field, may prove a viable alternative. High transport costs are avoided, as are lack of demand, lack of commercial links and agricultural advice. Some women grow and sell maize, others sell small quantities of vegetable on-scheme (SIBU 2001).

Where poverty is widespread, the level of reliable income needed to plan is elusive, and many scheme committees can only pursue crisis management. This sort of management works against women too by bringing decision-making into informal male domains and by prioritising the needs of those with most to lose (usually men with large landholdings and more resources invested in inputs). The result is very uneven production over the scheme and over time. There is evidence to suggest that good maintenance, good organisation of repair, and trouble-shooting not only improve production by reducing the risk of water shortage, but also reduce workloads, particularly for women.

5. Technology

Reliable, affordable and easy water delivery is crucial to irrigation sustainability. The water delivery technology must therefore meet user needs. To match technology to users, the day-to-day users must be identified and their skills and resources taken into account. A survey in a Zimbabwean scheme revealed that men and women perceive and report their work differently, and there is constant change in the allocation of work from season to season and place to place, depending on the outcomes of intra-household bargaining and changing social norms. Irrigators themselves are close to these changes but generally need help to analyse the dynamics and articulate the results when they are required to participate in decisions to match technology and people.

Many irrigation management committees would benefit from a method that would assist them to forecast areas of potential conflict, such as the timing of agricultural tasks. Irrigators are not a homogeneous group: social, ethnic, religious, gender, and economic differences influence attitudes and behaviour. Thus farmers and irrigation professionals must take account of sub-groups, gender aspects and power structures in order to make sense of the situation. On-going, inclusive participation is essential (Chancellor et al. 1999a).

The fact that land levelling is often a 'woman' task, and increases women's workload in irrigation gives us one example of the sort of complexities that arise. Sprinklers are seen as a solution to land levelling problems, and therefore as a woman-friendly technology. However, women face particular problems in relation to advice on sprinkler-technology use, and in availability and cost of spare parts.

Pumps are a significant source of problems and disparity between men and women, either when used in conjunction with sprinklers or to feed gravity distribution systems. Reliability is crucial to smallholder irrigation, yet many pumps perform poorly. The causes of poor performance are generally lack of regular care and inappropriate operation, poor service availability and poor organisation. However, women are seldom included in training for servicing, operating, or managing pumps. They are therefore put into a position of dependency (either upon male relatives or outside help that must be contracted and paid). Serious interruption to water supply results, reducing yield and, in the worst cases, causing total crop failure.

Where pumps are operated and maintained by agencies, organisation is often inappropriate and requires the negotiation of bureaucratic hurdles. Problems become acute if more than one agency is involved. Users may find that in case of breakdown the task of contacting the appropriate agency is insurmountable. The opportunity exists to improve performance by developing communications and streamlining practices. Poor institutional arrangements make it difficult for users to approach responsible departments and request essential repair. Women, who have difficulty travelling to distant towns to tangle with bureaucracy, suffer disproportionately from poor communication (Chancellor et al. 1999b).

Social factors strongly influence arrangements for pump operation and management in communities. Although men are keen to own pumps, they are often unavailable to deal with breakdown, leaving poorly equipped women to cope, or to suffer water shortage. Training in mechanical skills to deal with routine maintenance and simple breakdowns seldom has been targeted to women, and as such, slow, expensive, external repairs are the only option. Where women's technical training has been possible, particularly in the Water Supply and Sanitation sector, women prove to be conscientious students and are more likely to remain in and serve their community. In The Gambia, women were selected and supported by communities for training in the use and care of hand tractors for just these reasons.

The running costs and maintenance needs of pumps and other modern technologies are often unclear to users, who are unfamiliar with the rationale for timely repair and replacement. Although it is tempting to substitute technology for labour, when rehabilitating or planning schemes, change must be approached with caution, and support strategies adequately prepared if such substitution is to be successful (Berejena et al. 1999).

In general, maintaining infrastructure or machinery used on a communal basis is problematic: planning, organising contributions and allocating responsibilities are fraught with difficulty. These problems are exacerbated when the organisation is voluntary, as is often the case in farmer-managed systems. The disparity between men and women in relation to objectives, workloads, resources and access to benefits, leads them to prioritise different tasks and contributes to operation and maintenance problems.

> At a Zimbabwe irrigation scheme, men wanted to use the tractor for journeys to town (a mix of agricultural and social objectives, say the women), and women wanted the tractor on-site to plough. This conflict resulted in both men and women being reluctant to co-operate to fund maintenance of the tractor.

It is widely asserted that improved performance results from gender-balanced participation in project design. Research undertaken by the DFID (British Department for International Development) Gender-sensitive Design Project supported this view, but highlighted the need for significant improvement in the way participation is planned, carried out and resourced. Gender disparity in participation was identified as a major source of poor design decisions, and gender-blindness in institutions as a major contributing factor to the continued marginalising of women (Chancellor et al. 1999b). The interaction between farmers and designers was also identified as a key process. Not only are farmers presently ill-informed about the requirements and limitations of technology, but also designers are ill-informed about agricultural practices and the impact of their technology on workload. Good communication is another key requirement and the use of lay terms should be encouraged where possible to assist both farmers and planners towards more sustainable irrigation technology choices.

6. Participation and organisation

It is important to create an enabling environment for participation: relevant information, effective communication, and awareness-raising among all stakeholders were seen as crucial preliminaries to participatory activities, as is inclusion of women in all levels of participation. Bringing irrigation issues into public debate, involving a wide selection of stakeholders and discussion of irrigation issues in a livelihood context encourage effective participation.

Detailed participation, if it takes place, is generally between a headman, or a mainly male committee, and male developers. Women and poor people's "best interests" are considered, but without their participation. The importance of intra-household decision-making is ignored. Many irrigators are left out, for a variety of reasons, and gain no experience of participation and no confidence in their own ability to participate. Participation is often frustrated by lack of confidence to an extent that drives the community to hand over decisions to agencies or development authorities, saying, "we will be guided by you." This phenomenon is common when people lack information, cannot understand the information they are given, or do not want to take responsibility for technical choices. Unfortunately, dodging the responsibility of choosing often means that farmers are saddled with choices made by someone who knows about technology but not about farming and businesses. Despite the perceived superiority of the person's qualifications, his or her choice may be wrong. Where responsibilities are the issue, there is usually some good, but not necessarily obvious, reason for avoidance.

Agencies are not well motivated to enforce good participation practice, despite their nominal commitment to the process. Agency staff often feels participation is not the work they trained for. Participation delays them in achieving set goals (implementing or rehabilitating an irrigation scheme) that have to be reached in a set time. Reticent women present barriers and delays; it is tempting to leave them out. After all, the long-term success of schemes has little bearing on the careers of agency staff. In addition, agencies find it conceptually and financially difficult to take participation to a deep enough level. Participation with subsets of stakeholders and with households is often neglected or cut short before deeper levels are reached, because the process is overtaken by the administrative or budgetary constraints. Conversely, among NGO staff, motivation, funding, and participation skills are generally good but poor technical skills sometimes spoil project results.

At scheme level, lack of participation makes it difficult for scheme organisations to be clear about what they are doing. Within the scheme, individual irrigators are clear about objectives, but it is unusual to find similar clarity in irrigation scheme organisations. Most organisations have very laudable mission statements that lack detail (SIBU 2001). These general statements do not provide a tool for the decision-makers against which to measure the impact of decisions. The objective of a scheme cannot simply be a scaling-up of individual objectives, as these all differ. Scheme members face a fundamental difficulty: whilst they must co-operate to maintain the scheme and share water effectively; they must also compete to sell produce. Each scheme must decide what is the appropriate level of co-operation needed for the scheme to be sustainable. For many, more communal activity might be appropriate; for others, less. These decisions are rare because there is seldom an effective mechanism by which they can be reached.

Features common to Southern African Schemes:

- Lack of individual title to lands.
- Sharing common water source.
- Common commitment to shared primary infrastructure.
- Low levels of asset accumulation.
- Labour intensive methods.
- High involvement of women in production.
- Lack of commercial links and credit.
- Absence of marketing groups and co-operatives.
- Negative marketing experiences.

(SIBU 2001)

People must reach consensus about what they want out of the irrigation scheme, in order to determine what form communal action might take. They must seek a collective objective, or range of objectives, that meets the needs of the members. It is clear that few farmer committees formally, or even informally, adopt targets, or even consider such approaches. Women's participation in the forming of consensus is poor and it is important that irrigators appreciate that the poor performance of smallholder schemes is linked to this. If the aspirations of more than half the people working in irrigation are ignored, poor commitment to decisions is inevitable. And if the committees adopt no targets then no-one's needs are served.

Consensus about the desirability of reliable, equitable and relatively cheap water is easy. Good operation and maintenance are key requirements for achieving this goal: the difficulties arise on the detail of how good operation and maintenance are to be achieved.

In South America, investigation of irrigation in an Andean community highlighted the crucial role of adequate organisation among the irrigators. Organisations must command respect and exert discipline if they are to work. Creating or adapting a system of rights and obligations is crucial to giving people a framework in which they respect and accept discipline. The core idea behind the organisation is that irrigation system maintenance entitles irrigators to maintain their rights. People are obliged to maintain in order to remain members. The whole construct is supported by capacity-building, training, and communication, much of which is specifically designed to meet the needs of the women irrigators and to continue to meet their changing needs on an on-going basis. The project community decided on this emphasis after careful participatory analysis of the earlier system shortcomings. (Boelens and Apollin 1999). Social constructs of this type are suited to small communities where people are aware of each other's activities and know each other well. Women can take advantage of opportunities to contribute to maintenance and sustainability and improve their status and rights through adoption of similar constructs.

Outside of smallholder schemes, supporting organisations are needed to provide structures to help irrigation committees and managers to co-ordinate activity, take part in catchment-management decisions, and benefit from the experience of other irrigators. Government departments, WUAs, or Catchment Authorities might take this role. It is important that supporting and co-ordinating bodies are gender-balanced, gender-aware and provide a mechanism by which experiences can be shared. Publicity about women's success in technical fields is a great boost to the confidence of women irrigators and increases innovation.

7. Training

Men and women need training to develop and focus organisational skills, to address long-term needs, and to improve performance and agricultural and mechanical skills. Specific vocational training is needed but must be supported by management and business skills. Sustainability, ostensibly the goal of IMT and private sector involvement, demands that this happen extensively and quickly.

The quality of training offered is crucial and the questions of what training is needed and who should be trained must be answered before a training programme is established. Equally important is establishing how training will be provided and funded. In project work, funds are set aside to meet very specific training needs, but there are serious difficulties with scaling up this sort of provision. Not least is the difficulty of identifying the appropriate providers. It is hard to envisage how training can be provided on a "user pays" basis; equally hard to visualise is government budgets that cover training for new skill needs of men and women.

Private-sector individuals, that is irrigators, have an interest in promoting sustainable smallholder irrigation because they live by irrigation. Private-sector corporations, on the other hand, will only become involved if a profit motive exists. Hitherto motivation for involvement has been weak and demonstrated success is needed to encourage expansion. The expansion of private-sector companies will stimulate smallholder production but it does not come with guarantees of gender equity or poverty alleviation.

Interestingly, in a few South African smallholder schemes, women's gangs carry out maintenance on a paid basis and with on-the-job training. In The Gambia, women were selected to go for specific technical training. The community provided support so that women could leave their homes for residential training in the use and maintenance of hand tractors. In Eritrea, women were supported while they undertook training in hand-pump repair. Subsequently, communities or Water Supply and Sanitation committees pay them for their repair work. This provides a dual benefit for women in terms of income and status and a benefit to the community in reliable service availability.

In the Andean projects, the use of scale models was central to training. The models facilitated awareness-raising and discussion, allowing people to illustrate their points easily, particularly with reference to design and technology. The understanding of all the participants was greatly helped by running water through the model. The approach was particularly effective for women, who had limited literacy skills but on whom future irrigation would depend because of the high rate of male out-migration (Boelens and Apollin 1999). The approach was thought-provoking and highly inclusive but relied on heavy investment in staff time provided by the project. It provided an opportunity for men and women to discuss options and ideas together and to benefit from each other's experience. The inclusion of women, particularly in Southern Africa, is complicated not only by men's views but by the attitudes of women themselves, and particularly by the reluctance of older women to embrace new freedoms, torn as they are by ambitions and fears for their daughters.

Outsiders are not necessarily the best people to introduce new approaches. Research on information sources in the agricultural sectors in Uganda and Ghana concluded that group membership was an important determinant of confidence among farmers, particularly women. The study highlighted the importance of animators and people who can "read for the group." Among the factors influencing information flows and empowerment were confidence, two-way interaction with trusted people and a sense of common purpose. It was recognised that empowerment followed a gradual slope to the point where a group became an agent of empowerment itself. Extension and local innovators were significant sources of information (Carter 1999).

The extent to which government and policy makers should lay down a framework for action, within which women's training and education can be promoted by irrigation agencies or catchment authorities, is not clear. There is evidence to suggest that engendered approaches and women's inclusion are not priority activities in farmer-managed schemes.

> Research in 14 schemes in Zimbabwe and South Africa revealed widespread gender disparity and identified the main issues of concern at each scheme. Arranging schemes according to management type, the data showed that women voiced fewer gender-based concerns in government schemes. There is a danger that this indicates that women's aims are presently better supported by government than by local communities.

8. Discussion

In the last quarter century, maintenance of small-scale, smallholder irrigation schemes has, for many reasons, been drastically inadequate. Many schemes are rundown and pose huge challenges to their users. Rehabilitation in advance of transfer sets out to reduce the immediate task facing farmers in management turnover. Nonetheless, significant improvement on the standard of O&M recently achieved by government is crucial to the survival of small schemes after turnover. If farmers have to achieve this with little outside assistance, they must mobilise as many stakeholders and skills, as efficiently as possible. In this respect, it is important to look at men's and women's present roles and consider what changes might be appropriate.

The distinction between informal and formal inclusion is important. The informality of women's activity in smallholder irrigation allows their contribution to go unrecorded and undervalued and provides no mechanism for them to benefit from the work they have done. This is true at both household and scheme levels. Lack of formality makes it difficult for women to contribute to decision-making. Given the dominant role of women in the day-to-day work of irrigating, their lack of input to decision-making is likely to render those decisions less relevant to sustainable irrigation.

The informal and unpaid nature of women's work allows increases in their workload to go relatively unnoticed. It also allows delays, caused by poor O&M and their impact on workloads and productivity, to be largely ignored by men, and little thought to be given to improving these aspects of production. Low gender-awareness, and low capacity to analyse, constrain performance and, ultimately, irrigators' ability to market products successfully. Sustainability is reduced by these impacts.

Formalising contributions can be addressed: firstly, by recording people's activities in a simple way, recording who takes part in meetings and O&M; and secondly, by payment for services rendered for the common good. The two strategies should benefit both men and women and provide management information. A system of payment requires members to contribute regularly to a central fund, which in turn requires transparent administrative practices and members' confidence in the responsible individuals.

Irrigators are likely to give priority to risk reduction, particularly where food security and financial viability are perceived to be important issues. On the other hand, the priority for the retiring managers may be to achieve transfer quickly and to gain as much kudos from the procedure as possible. This can lead to rhetoric on gender equity and women's participation, which may be rejected by the incoming farmer managers because it is perceived as an additional risk in an already frighteningly risky situation. It is important, therefore, that the champions of women's inclusion also take a gender-analytic approach that includes men's issues and demonstrates the impacts of gender considerations on responsibilities as well as rights.

8.1 Improving participation

Prior to transfer of irrigation schemes, agencies should reconsider their assumptions about goals, objectives, and performance of smallholder irrigation and compare them, in a participatory setting, to the assumptions and goals that will be appropriate in future for the agency and the farmer managers. Old priorities such as good water-use efficiency, and practices to support that objective, might not equally serve for managers whose objective is creating sustainable livelihoods. Where new practices are needed alternative management ideas must be explored. Central issues would include:

- Identifying necessary changes in participation and responsibility within the scheme (primary stakeholders);
- Identifying an appropriate level of affirmative action in relation to gender-awareness;
- Including a wider range of local establishments (secondary stakeholders) such as local government, women's clubs, schools, churches, and private-sector service providers.

Support of local organisations is likely to be crucial in the absence of government support. Review can and should contribute significantly to understanding stakeholders' motivation in the wider context and thereby assist in development of more effective participation.

Private sector companies and the transferring agency must interact with farmers to improve understanding and communication, and to provide opportunities for new links during the transfer process. Smallholder farmers cannot afford delays. The process has already begun in many countries where the private sector works closely with irrigation departments in pre-turnover rehabilitation.

8.2 Private sector

The private sector must invest if irrigation is to continue. Some investors will be private individuals investing in their own production system, in the systems of neighbours they perceive to be successful or in in-field services for which they can predict demand. Some investors may be private companies investing in future customers. It remains to be seen whether private-sector businesses consider the potential returns to be sufficient for this level of investment. It is possible that, initially the state will have to offer some inducements to stimulate private companies' interest, but more information is needed about smallholder prospects and private-sector objectives before predictions on post-transfer developments can be made.

The transfer process should provide a forum for exchange of views and information, and encourage dialogue on issues of gender balance and poverty alleviation.

In Kenya, indigenous "jua khali" industries have sprung up to supply smallholder irrigators' equipment needs, such as sprinkler replacements. The relationship is successful. The "jua khali" versions are a commercial response to demand on the part of irrigators. "Jua Khali" products cost significantly less than imported hardware and are affordable for both men and women farmers. Locally-based, they provide the multiplier effects so sought after in rural development theory. In Zambia and Malawi, promotion of treadle pumps in remote areas has gone hand-in-hand with distribution of spare parts to private-sector distributors. Parts are relatively cheap and many parts can be manufactured locally.

Thus individuals and small groups of men and women are able to repair them without trouble (Chancellor and O'Neill 1999).

In Zimbabwe, CARE promotes agency outlets to overcome the problems of access to inputs for farmers in remote irrigation schemes. Local shopkeepers are given opportunities to increase trade in seed, fertiliser, and small equipment. They are encouraged to stock tools for cultivation and for O&M. The volume of trade, however, will only reach satisfactory levels if farmers are able to market their crops successfully and earn reliable incomes. These examples illustrate that commercial links at individual level are developing. There is a difference between this and "scheme" needs for services, in that the customers are individual and decisions intrinsically simpler.

Provision of ploughing services in South Africa is rapidly moving from the state to the private sector. The private service is presently more expensive for farmers than previously, but timeliness may improve profitability enough to justify the added cost. Government extension staff are key to making the arrangements between the schemes and the providers. There is little evidence of similar arrangements developing for marketing, where arrangements are made between individuals and external buyers.

8.3 Developing effective O&M training programmes

Breakdown of water delivery systems causes conflict and the link between effective O&M and farmers' ability to produce crops to meet market demand is clear. Not quite so clear is the relationship between physical breakdown and management breakdown. There is low appreciation among smallholders of the risks that go with avoiding maintenance and proceeding with crisis management tactics. To assist farmers in identifying the trade-offs that exist between expenditure and risk, they need training, and they need to be involved in review processes.

It is important that the attention of men and women is drawn to management training, including gender-awareness, not as a separate optional issue but as an integral part of addressing O&M. However, it is not clear how this is best approached.

Firstly, the objectives of the training have to be established and the links to actions to achieve objectives understood. This process should establish the essential features of training content and "best bet" target groups from which candidates must be selected.

Secondly, consideration should be given to who will provide the training and where training will take place. It is important to remember that women are easily excluded at this stage because of the difficulty they have in leaving their homes and families. Hitherto it has been assumed that training should be delivered by existing irrigation agencies, but it is questionable whether this is an appropriate strategy. Evidence should be sought on quality and delivery before a provider is selected.

8.4 Formalising the role of women

Gender disaggregated data is still scarce in the irrigation sector. A general lack of performance information was highlighted in the recent debate on irrigation management transfer. Participants predict that high management costs will deter farmer managers from investing in monitoring. Decisions will become less supported by fact, and gender aspects are likely to remain invisible. It will be difficult to achieve equity in these circumstances. Yet equity will be crucial in systems that rely on user payments to fund recurrent cost and investment. Although this may be an overly pessimistic view, governments may initially need to set quotas for women's participation and recommend minimum levels of recording if the role of women is to be realised and formally recognised.

There is potential to promote fundamental and widespread change. Potentially, where women are employed in O&M, not only is a job done reliably but also women gain a source of regular income, which they can use productively. The skills they develop serve both them and the community. Women prove to be adept and reliable in maintenance of small pumps in India, in care and operation of hand tractors in the Gambia and of hand pumps in Eritrea. They fix and replace sprinklers in Kenya and Zimbabwe. However, the drive to encourage women to enhance their technical skills mainly comes from projects and largely remains there. Wider publicity about the changing role of women is needed, in a manner that stimulates farmers to take a more innovative approach to gender issues in their own schemes.

More information is needed about the perceptions of men and women on maintenance issues, about the performance of men and women in specific maintenance tasks. Evidence is needed about the changes in reliability and adequacy of supply resulting from changed O&M arrangements. Information of this type should be used to inform and encourage the private sector to provide affordable training. It is in their interests to promote sustainability and thus future business.

8.5 Linking rights to human capital inputs

Irrigation cannot be considered as an isolated activity, but should be set in the context of other important areas of stakeholder interest. Employment, farming, forestry, water supply and sanitation, education and other locally important activities must be taken into account. Without the total picture, it is difficult to understand either men's or women's objectives or what motivates them to take part in irrigation. It is also important for communities to decide what level of welfare is acceptable or necessary for them to run the system. Some communities will opt for "user pays" systems with high degrees of equity while others might choose systems that allow farmers to operate at different levels, with a degree of subsidy within the scheme that still allows poorer farmers to function. This will be very important in areas with high numbers of women- and child-headed households.

In either case, a system that links O&M contributions to rights to participate in making decisions could be valuable. At the individual level, such a system would allow poor people and women to maintain or improve their status within the scheme. It encourages those who do not prioritise O&M to pay others to fulfil their obligations; thereby creating jobs that might benefit women. It helps people to decide if they want to continue to irrigate and might potentially encourage renting of irrigated plots, whilst still maintaining rights. Extra land for rent benefits women, and young people.

At the scheme level, such a system might increase participation in O&M, increase the amount of maintenance done in a season, and the area of land cultivated and thereby the maintenance contribution. It coincides with the "user pays" concept while being flexible in application.

Rhetoric on empowerment of women is often met with strong resistance in the farming community itself. Communities often claim that their culture does not favour changes in the dynamics between men and women. However, careful analysis of who does what, particularly if it is done in a participatory (and humorous) way, often reveals considerable potential for flexibility. However, the existing gender bias (if that is the case) is condoned, if not encouraged, by the attitudes in irrigation departments and agencies. Professionals, while playing lip service to the importance of gender-awareness, recommend that important issues of increased production and rehabilitation must be addressed first. They cite the importance of income and food security to support their approach ignoring the potential for women's inclusion to improve performance in just these aspects. Past reluctance to invest in women's training and participation has had plain results, however, change is perceived to be hard work. Farmers and professionals must be convinced that the hard work will achieve long-term benefits. Women must also be proactive in making their contribution visible and negotiating acceptable terms for continued and increased contributions.

9. Conclusions and recommendations

Concerted involvement and action by stakeholders are crucial to ensure that turnover to community management and private business involvement is a catalyst for women's greater involvement, rather than a missed opportunity. At present, women's involvement largely comprises effort at field level and fails to give them sufficient voice in determining the future of irrigation as part of their livelihood. Women's lack of voice is a constraint to sustainability as well as a frustration to women. The stakeholders must at least include the presently responsible agency, the men and women of the irrigation scheme and the private sector, but a wider representation should be encouraged.

Private sector involvement in smallholder irrigation in Africa provides an opportunity for change. If women are to benefit from the changes and increase their contribution, they must extend their activities from the field level into management, service provision, and communications, internal and external to the scheme. One possible strategy to start the process would be to focus women's attention on O&M. This would give them an opportunity simultaneously to improve the performance of their scheme, develop skills, confidence, and participatory techniques, and change attitudes towards their future participation in decision-making.

It is not suggested, and is in no way sustainable, to simply increase women's workload further, by adding O&M, without recognition and benefit. Ideally, payment for work should be clearly established and, where this cannot be arranged, an acceptable alternative reward must be agreed. This principle is fundamental and must apply equally to men and women. The concept that farmers, men or women, should run irrigation schemes for the common good by voluntary contribution of their time to either management or maintenance is unlikely to result in a sustainable and effective organisation.

Changes in behaviour are needed. Firstly, by the transferring agencies in getting to grips with the changes that must be promoted for schemes to survive in the commercial world. Secondly, among both men and women irrigators, in the way objectives are set, and co-operation and conflict at household, group or scheme level are handled. In order to achieve these changes, people must develop analytic skills, management skills, their own monitoring systems, and confidence in their judgement and ability to deliver results. They will need assistance. The form of assistance and the best providers still need to be identified.

9.1 Greater attention and resource for participation

Standards for participation need to be raised if a great deal of money is not to be wasted. Participation is all too often carried out in a vacuum, without monitoring of impacts. There is a general failure to clarify the objective of the scheme, as opposed to the objectives of individual members. When the objectives of powerful members become "scheme objectives" by default, arrangements will not work in favour of women and the commitment of the majority of the workforce will be weak.

Awareness-raising, gender-sensitive approaches and relevant, clear information are essential preconditions for good participation, but they need resources. The quality of participation will not improve without application of skills and resources specifically for that purpose. Where participation has to compete with hardware and operational demands for resources, it will remain under-resourced. Specific participation funds must become routine in budgeting the cost of transfer and should allow for special attention to the dissemination of relevant information, awareness-raising initiatives and purposeful inclusion of women.

9.2 Wider dialogue

Management transfer cannot be viewed simply as a transfer from agency to private farmers, nor can irrigation expansion be planned only with irrigators. Other actors are involved and their contributions have impacts on sustainability. It is crucial therefore not to limit the debate to irrigators and would-be irrigators on the one side or to government departments on the other. It is also important to include both formal and informal farmer groups. Among these women's groups deserve special attention if the dialogue is to reflect women's views adequately. Mixed groups and mass meetings cannot be relied upon to reflect the aspirations of sub-groups and are easily hijacked by powerful people and holders of traditional authority. All community members will have useful views. In the case of women agricultural workers, views and reactions are key to the success of the turnover process, because of their direct impact on scheme performance.

Private sector corporations, agri-business, consumers, government departments, and local authorities all have roles. Profit motives will be weak as turnover occurs, because of the subsidies that previously existed. Private-sector business will only be motivated to participate if a profit motive is identified. Wide dialogue is difficult to organise but, if handled well, contributes significantly to the success of the change process and can avoid misunderstanding.

9.3 Governance of the private sector and provision of training

It may be necessary for the state to protect the welfare interests of vulnerable groups by providing rules and recommendations for the private sector. Quotas are one example of this type of rule. However, education must be the basis of progress and quotas should only be used to support it, and not be a replacement for it. It is therefore necessary to recognise women's specific need for education in technical and managerial aspects of irrigation to enable them to fulfil their responsibilities and claim their rights.

Attention must be given to increasing women's uptake of training and addressing social and cultural norms that link men rather than women with technology. Private sector provision of training, if necessary in partnership with national, provincial and local authority, is an opportunity to promote change that should not be overlooked. There is scope to guide provision by research if the private sector is linked to research. Identification of levels of O&M that are consistent with sustainability would improve training. Comparative analysis of successful O&M on the basis of involvement and responsibility of key sub-groups such as women, the elderly and youth groups in O&M should be given priority before widespread policy changes are recommended. Training could potentially be improved in two aspects: firstly, women trained to actively ensure reliable water supply, and secondly, groups trained to secure and fulfil contracts. Inducement to the private sector initially to develop training materials might be required.

9.4 Lessons from other PPP and PFI initiatives

In parallel, identifying lessons from other sectors where public-private partnerships have been established or where private finance initiatives have replaced government investment programmes is useful. Lessons from other sectors that have positively increased the participation of women in O&M tasks might yield important pointers as to where changes have benefited or been disadvantageous to women. Developments in the Water Supply and Sanitation sector, where women have in some cases established formal roles and in other cases have not, are likely to yield information to help develop effective policies for smallholder irrigators. Dissemination of findings from other sectors, however, should encourage men and women farmers and communities to discuss the issues in a structured and analytic way and to use that analysis to assist in selecting sustainable strategies themselves.

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Can irrigation management transfer revitalise African agriculture? A review of African and international experiences

Le transfert de gestion d'irrigation, peut-il redynamiser l'agriculture africaine? Une revue des expériences africaine et internationale

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Abstract

The paper reviews experiences of irrigation management transfer in smallholder irrigation systems in several African countries, and compares the observed outcomes with reported experiences in Asia and in commercial farming in Africa. The authors conclude that instances of successful transfers, in the smallholder sector, are very few in Africa. Four pre-conditions for successful transfers are identified, which are seldom satisfied in African smallholder systems. They note greater success in transferring commercial systems, explained by the larger size of holdings, implying that transaction costs of self-management are much more serious for smallholders, but represent a relatively small fraction of gross agricultural product for larger farmers. Smallholders are not motivated to want self-management nor to apply the effort for making it succeed. The paper concludes that transfer must be preceded by a strategy for general enhancement of the economic situation of the smallholders, and removal of a range of existing constraints.

Résumé

Cet article examine des expériences en matière de transfert de gestion de petits périmètres irrigués dans plusieurs pays africains et compare les résultats observés à ceux obtenus en Asie et dans le secteur de l'agriculture commerciale en Afrique. Les auteurs démontrent qu'il y a peu d'exemples réussis du transfert dans la petite irrigation africaine. Quatre conditions préalables pour garantir la réussite du transfert sont identifiées mais elles sont rarement respectées dans le cas des petits périmètres africains. Ils notent que le transfert des périmètres commerciaux est plus réussi, en raison de la taille plus importante des exploitations, ce qui implique que les coûts de transactions liés à l'autogestion sont plus élevés chez les petits agriculteurs alors qu'ils ne représentent qu'une proportion relativement réduite du produit brut réalisé par les agriculteurs commerciaux. Des petits agriculteurs ne sont pas motivés à vouloir l'autogestion et ils ne semblent pas disposés à déployer les efforts nécessaires pour la réussir. En conclusion l'article propose que le transfert doive être précédé par une stratégie visant à renforcer la situation économique des petits exploitants et à lever les contraintes de tous ordres.

1. Introduction

Irrigation management reform has a history of more than 50 years. It has gathered momentum during the past two decades. Irrigation management reforms are a key component of government policy in almost all countries with a significant irrigation sector. The overall experience has been mixed in the approach adopted in designing and implementing reforms, the extent of reforms, and their impacts on irrigation system performance as well as on farmers. Since the mid-1980s, the centre-piece of the reforms has been the transfer of management (only rarely ownership) of irrigation systems—wholly or in part—to Water User Associations (WUAs) or other non-governmental agencies, combined with the down-sizing or withdrawal of government's role in operation and maintenance (O&M), fee collection, water management, and conflict-resolution.

The driving force behind the reforms is usually the need to reduce the government's recurrent expenditures for irrigation. Irrigation systems in many developing countries were established with substantial financial contribution from international donors. It was assumed that the government and/or water users would be able to incur the cost of O&M of the systems, made possible by enhanced financial gains from improvements in productivity levels of irrigated agriculture. This assumption has often proven unfounded; public irrigation systems in the developing world have failed to generate returns commensurate with expectations. Moreover, governments have failed to set irrigation charges that cover actual O&M costs and even more so have failed in collecting them.

Some of the key stated and unstated assumptions underlying the recent reforms are:

(a) Government management is neither a viable nor an ideal and sustainable approach to managing irrigation projects.

(b) Most irrigation schemes are, in principle, financially and economically viable or have the *potential* to be so under reasonable management.

(c) Transferring the management of irrigation systems partly or wholly to WUAs would result in better O&M of the systems; improve water management, conflict resolution and fee collection; and enhance productivity and food and livelihood security of the farmers in the schemes.

(d) Management transfer takes time and requires capacity-building, and succeeds to the extent the enabling conditions ("supportive socio-technical context," legal framework, water rights, and so on) are in place to ensure their success (Vermillion 1996; Vermillion and Sagardoy 1999; Frederiksen and Vissia 1998).

It was initially expected that farmer-management of public irrigation systems would enhance their performance and bring about wide-ranging socio-economic changes that would enable farmers to substantially improve farm incomes. In more recent years, management transfer is considered to be beneficial even if it just "saves the government money, improves cost- effectiveness of operation and maintenance while improving, or at least not weakening, the productivity of irrigated agriculture" (Vermillion 1996). The drift of the irrigation management transfer (IMT) discussion, in recent times, has been more towards getting irrigation off the back of the governments than towards improving the lot of the farmers and the poor, the original goal to which much public irrigation investment was directed over the past 50 years. Numerous case studies of the process and impact of management transfer are now available. Asian experiences are reviewed in a separate paper at this seminar (Samad 2001). The global experience with IMT is not uniform, and in many instances has been disappointing.

Many overarching patterns that emerge from a reading of the international IMT experience seem relevant to Africa but have not received adequate attention in the literature. IMT has been relatively successful where irrigation is central to a dynamic, high-performing agriculture, where average farm size is large enough for a significant proportion of farmers in the command area to operate like agri-businessmen; where backward linkages with input supply systems and forward linkages with output marketing systems are strong and well-developed; and where the costs of self-managed irrigation are an insignificant part of the gross value of product of farming. These conditions prevail in Mexico, Turkey, USA, and New Zealand where IMT has been a success.

In general, then, IMT has worked in situations where individual stakes are high and the irrigation community has been able to take the additional burden of self-management—financial and managerial—in its stride. This ability is strongly linked with the micro-economics of irrigated production, which propel the economy upward by generating powerful incentives for self-management. In sum, international experience with IMT suggests that four conditions must be met before a farming community makes a success of an IMT intervention:

(a) It must hold out the promise of a significant net improvement in life-situations for most members.

(b) The irrigation system must be central to creating such improvement.

(c) The economic and financial cost of sustainable scheme management must be an acceptably small proportion of improved income.

(d) The proposed organisation design must have—and be seen to have—low transaction costs.

A hard look at most smallholder IMT programme in Africa shows that they rarely satisfy these conditions. This larger perspective needs to inform our assessment of the prospects for successful management transfer of government irrigation schemes to African smallholder communities.

2. The African smallholder irrigation context

In many respects, the African smallholder situation differs from those where IMT has worked and has been sustained. Some of these differences are discussed in the following paragraphs.

2.1 History of dependency

IMT in Africa has often begun with reforms that entailed the drastic curtailment of the functions of parastatal agencies that were responsible for providing support services and management of irrigation schemes. Examples of such parastatal agencies include the Agriculture and Rural Development Corporation (ARDC) in the Northern Province of the Republic of South Africa, the White Nile Agricultural Services Administration (WNASA) in Sudan (Narayanamurthy, Samad, and Johnson 1997), and the Society for Land Management and Development of the Senegal and Falme River Valley (SAED) in Senegal (Wester et al. 1995). Although these are smallholder irrigation schemes, the parastatal agencies managed them in an "estate mode" in which they centralised input supply and output marketing functions to such an extent that farmers were often reduced to being workers on their own land.

In South Africa, the ARDC and its predecessors for over three decades managed smallholder irrigation schemes through an elaborate top-down command and support system that has proved to be unsustainable. Under a version of contract farming system, irrigation was fully subsidised. The ARDC organised mechanised cultivation, planting and fertiliser application. All that the plot holders or "farmers" did was weed, harvest and move the irrigation pipes around. They did not invest much working capital; nor did they make any decisions about farm management. The parastatal also organised the marketing of pooled produce. It deducted its expenses and the residual sum was given to the farmers. Under this arrangement the plot holders were neither farmers nor wage labourers. They did not take any entrepreneurial or managerial decisions. In reality, they only collected wages for weeding, harvesting and managing field irrigation. However, they shared the risk of crop yield variability, and in that sense, were not pure wage labourers.[1] As Bembridge (1999:11) notes: "Scheme managers have been attempting to 'manage' farmers rather than encouraging entrepreneurial development." The situation is similar in other African countries.

The abrupt withdrawal of parastatal agencies from the management of irrigation schemes and the elaborate institutional support systems they provided has had serious impacts on smallholder farmers in many African countries. In the Arabie-Olifants scheme in the Northern Province of South Africa, the gross cropped area declined to 30 percent of the total arable land, a year after the withdrawal of ARDC, as plot holders were unable to mobilise working capital to pay for inputs and services (Shah and van Koppen 1999). Attempts were made to obtain crop loans from the Land Bank. Although the Bank had agreed in principle, no credit has been provided because farmers do not have titles to their land; and the Bank has been unwilling to accept other forms of loan guarantees.

In many African countries the management of smallholder irrigation schemes by parastatal agencies has left behind a legacy of a dependent and an impoverished group of farmers.[2] Often, such management has degenerated into oppressive 'spoils systems' that destroyed all pre-existing informal institutions. Nowhere, is this more vivid than in the descriptions of the Mwea irrigation and settlement scheme in Kenya (Kabutha and Mutero 2001).

2.2 High cash costs due to mechanisation

Under parastatal management smallholder irrigated farming in Africa emerged as a highly mechanised and capital-intensive activity. The ARDC in South Africa used heavy equipment for ploughing, spraying and harvesting. With the withdrawal of parastatal management, hiring farm machinery and equipment at affordable rates has become a major problem. The development of equipment rental markets at local levels has been slow and variable. The rental rates are high. As a result, the rising

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[1] A World Bank study on the organisation of settlement farming in West Africa concluded: "Problems are encountered …when the so-called 'farmers' are settled on centrally managed estates, where the 'farmer' has no decision-making power, yet carries the risks of failure" (cited in DWAF 1995:9).

[2] For the Nigerian experience in this respect, see Ogunwale, Maurya and Owonubi, 1994.

cost of production has not only eroded the margin from irrigated farming but has also increased working capital requirements. Most importantly, the high fixed costs have made smallholder farming extremely risky, with net gains plummeting far more rapidly than yields in a bad year.

In the Arabie-Olifants scheme in South Africa net incomes (excluding electricity) for wheat, computed from ARDC records, tended to be 20-25 percent of the cash costs of farming, which is less than the interest charged by private money lenders for short term loans to farmers. In the same scheme, farm budgets computed by Tren and Schurr (2000) showed that gross margins per hectare of wheat and maize were a mere US$2 (R 14) and US$289 (R 2,021) respectively. Further, these small farms face much higher "operating leverage"[3] compared to Asian smallholders because the latter incur much lower cash costs. As a result, net income per hectare shows extremely high variability with respect to changes in yields: according to a document from South Africa's Department of Water Affairs and Forestry (DWAF 1995: table 5), for example, gross margins in maize, onions and potatoes are R 408, 1,487 and 5,739 per ha, respectively, at normal yields. But they reduce to R 0 at 50 percent yields; and for tomatoes, the gross margin falls from R 13,227/ha to a mere R 765/ha with the halving of the yield!

2.3 Absence of credit, input and output markets

Most smallholder schemes in South Africa are located in former homelands in remote areas away from towns and cities with which they often have poor linkages. With the rise of the "estate mode" of farming under parastatals, such markets as existed previously gradually disappeared; and now that the parastatals have withdrawn, there is a huge institutional vacuum. Based on a field assessment of the prospects of IMT in Dingleydale and New Forest, two of the better schemes in the Northern Province of South Africa, Merle and Oudot (2000) wrote: "Access to inputs is difficult. A lot of farmers fetch them from Hoedspruit or Hazyview with important transportation costs. Hiring a *bakkie* (small pickup truck) for 20 bags of fertiliser costs between R 100 and 150 ($14-$21)." Moreover, "Traditional markets that were available seem to have disappeared. The farmers are nowadays in direst need of markets especially for the winter crops. A lot of vegetables get rotten in the fields due to lack of buyers. The potential of the area for sub-tropical fruit trees must be accompanied by corresponding markets." This story—absence of markets—is repeated in other parts of Africa.

2.4 Land tenure issues

One conclusion of international IMT research suggests that for farmer management to work, it is important to assign clear water rights. In the African smallholder context, land rights pose an additional intricate challenge (Lahiff 1999). Insecure tenure limits farmers' incentives to make long-term development investments on their land. Moreover, the present arrangement does not provide much room and incentive for uninterested farmers to sell out and for interested and capable ones to expand their holdings (Bembridge 1999). Nor does it lead to the emergence of flexible rental markets in irrigated land, thus keeping it from achieving its full productive potential.[4] As already mentioned inability to offer land as collateral for obtaining credit works as another disadvantage. Often, the lack of clarity amongst the plot-holders about what their rights precisely are with respect to their plots seems more problematic than the absence of ownership. In Dingleydale and New-Forest Schemes in the Northern Province of South Africa, Merle and Oudot (2000) noted that "some farmers do not know if they are allowed to rent their land, and are unwilling to discuss the matter in any detail. Some people are very reluctant to let someone crop on their field because they are afraid they won't be able to get it back. The land is lent to trustworthy persons, such as influential persons, friends or relatives." Abernethy et al. (2000:8) and Manzungu et al. (1999:6) report similar problems in Niger and Zimbabwe, respectively.

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[3] Operating Leverage, the opposite of break-even volume, is defined as fixed costs/[contribution/ha]. For the Asian smallholder, a crop failure implies wasted human and animal labour, both of which have low opportunity costs, but no major cash costs from borrowed funds. For a comparable African small farmer, a failed crop is significant cash loss and the risk of falling into a debt-trap.

[4] In a wide-ranging review, Rukuni (1997) suggests that communal ownership of land and the present tenurial arrangements would promote productivity and efficiency enhancement if only the communal ownership was secure. In his assessment, problems of tenurial insecurity arise primarily because all communal land that tends to be viewed as state-owned gives every bureaucrat the power to intervene at will and tinker with communal lands.

2.5 Irrigated holding size and smallholder hedgehog behaviour

Literature documenting international IMT experience suggests that most farmers in successful IMT cases are full-time farmers deriving a substantial proportion of their livelihoods from irrigated farming. This builds their stake in self-management and committing time and resources to it. In the African smallholder context, farmers who work tiny plots are forced to pursue what Chambers (1983) calls a "hedgehog strategy" of depending on a variety of sources to earn a livelihood. In Senegal's Village Irrigation Schemes (Périmètres Irrigués Villageois), the plot size varies from 0.1 – 0.4 ha (Wester et al. 1995:3). In a sample of smallholder schemes studied in the Niger valley, the plot size was 0.25 ha or less (Abernethy and Sally 1999). In the Nyanyadzi scheme in Zimbabwe, it ranges from 0.76 to1.1 ha (Manzungu et al. 1999). In the five schemes proposed for rehabilitation in the Northern Province of South Africa, the plot size is about 1 ha (NPDALE 1999).

Inability to depend upon irrigated farming for a substantial proportion of their livelihood modifies the incentives and behaviour of smallholders. It is common for men to seek urban jobs while the women cultivate the plots. The smaller the plot, the stronger is this tendency (Mpahlele et al. 1999; Ngqaleni and Makhura 1996). Similar patterns are reported in Niger (Abernethy and Sally 1999; Abernethy et al. 2000), Zimbabwe (Manzungu et al. 1999) and elsewhere: household members pursue a wide variety of livelihood strategies to reduce risks and enhance their income.

This has many implications. Firstly, plot holders are often more interested in keeping their plots as insurance rather than working them to their full productivity potential. According to Charles Crosby, a senior South African observer, "Their plots are some sort of security although few are interested in active farming… there is danger of losing their holdings if they do not use them" (Crosby et al. 2000). Secondly, there are stringent limits on the amount of investment of time, effort and resources a typical smallholder irrigator might be willing and able to make on activities associated with the irrigated plot, if it involves sacrificing other livelihood options. Thirdly, the large number of members, even on a small scheme, greatly increases the invisible "transaction costs" of collective self-management—such as costs of fee collection, responding to complaints, delivering water to each user, extracting consensus on key decisions, etc—all invisible costs that vary directly with the number of irrigators served by the scheme and inversely with the average landholding.

2.6 High cost of pump schemes

African smallholders seem to have received more than their fair share of pump irrigation schemes, which are more costly and difficult to operate and maintain than gravity schemes. As outlined earlier, an aspect of successful IMT experience world-wide is that operation and maintenance costs are an insignificant proportion of total income – typically less than 5 percent of the gross income from farming. In many African pump irrigation schemes, this proportion is far higher. If the Arabie-Olifants scheme were to be turned over to farmers in today's conditions, running it would cost 20-25 percent of the total value of irrigated output the scheme produces (Shah and van Koppen 1999). Similar high costs of pump schemes are reported in Zimbabwe (Manzungu et al. 1999), Senegal (Wester et al. 1995), Nigeria (Ogunwale et al. 1994), and Burkina Faso and Niger (Abernethy and Sally 1999). Even after paying extremely high fees, Abernethy and Sally (1999:216) concluded "none of the nine organisations which have been studied in the two countries seem to be sustainable in the long run, because none can undertake the necessary major maintenance and renewals of equipment or facilities." If net income is 20-25 percent of the gross income and if irrigation fees under self-management are as high as 15-20 percent of gross income, the implications are that most turned-over pump schemes would leave the farmer in the red, unless gross income increased substantially before the transfer.

Despite this, pump schemes offer a window of opportunity for farmer management because, if maintained well, they offer better-quality irrigation and also, by their design, they help impose a certain financial discipline. Gravity systems generally cost more to build but less to run than pump schemes. However, many invisible transaction costs involved in farmers' management of gravity systems probably tilt the balance in the other direction. In general, with a favourable economic environment and high land and water productivity, pump schemes, though costlier to run, may well be more amenable to farmer management than gravity schemes, because the transaction costs of the latter are high. The problem in African smallholder pump schemes is that they cannot use the unique managerial advantages offered by pump schemes because of low farm productivity and income and high cash and transaction costs.

3. Downward ratchets

Crosby et al. (2000:chapter 9), reviewing the prospects of small-holder irrigation in the Northern Province, South Africa, write: “It is unbelievable that with the exception of sugar projects there are virtually no schemes that have been successful … (and) the pattern of failure is so similar that it is not really necessary to undertake a needs analysis for individual projects.” This pattern of failure is what we refer to as “downward ratchets.”[5] The overall micro-economic dynamic is such that piece-meal interventions with marginal benefits will most likely fail to relaunch the small-holder schemes into a significantly higher trajectory of productivity and farm incomes from where the irrigation community can take the additional costs and effort of self-management in their stride. In the analysis by Crosby et al. (2000:3), the downward ratchets are evident in the “common aspects (which) are: total dependence→water supply infrastructure dilapidated→ineffective water management→low production levels→little knowledge of crop production or irrigation→ineffective extension→lack of markets and credit→difficulty in sourcing inputs→expensive and ineffective mechanisation services→unrepaired fencing→damaged soils.”

Other observers have arrived at similar conclusions elsewhere in Africa and found that farmers in small-holder schemes need and want support systems that go far beyond just irrigation if they are to improve their livelihoods significantly (Ogunwale et al. 1994; Maluleke 1999; Narayanamurthy, Samad and Johnson 1997; Shumba and Maposa 1996; Manzungu et al. 1999).

Many observers focus on the high productivity of tiny holdings, and this is supported by a good deal of empirical evidence (e.g., de Lange et al. 1999; Mpahale et al. 1999; Rukuni 1997). Nobody can deny this internationally supported negative relationship between farm size and productivity. The point is that small-holder irrigated farming income *per household* for food plot owners as well as so-called small-scale commercial farmers remains too low for them to meet all their subsistence requirements and generate the surplus needed for development. As a result, food plot farmers who achieve high productivity as well as 2.5 ha plot owners who do not – all “could be classified as poor or vulnerable to poverty” (Mpahlele et al. 1999: 23). The issue in making a success of IMT in African small-holder irrigation thus is not only of getting the “process right” nor of getting laws and rights right but in addition, of devising a “lift strategy” to replace the downward ratchets by upward ones.

In our analysis, then, the only way farmer management of African small-holder irrigation can be sustainable, is for management transfer to be part of a larger “lift strategy” that can dramatically enhance economic returns to smallholder farming. Such a lift strategy, however, will have to include much more than just irrigation management transfer. It will need to deal effectively with the whole host of constraints that African smallholder schemes are facing. As Crosby et al. (2000) assert: “Sustainable irrigation farming is only possible if the production levels attained make it affordable. This implies favourable natural resources, knowledge, motivation, management and the essential independent support services.”

4. Institutional support systems for sustainable farmer-managed irrigation

Throughout Africa, there are very few cases of successful and sustainable farmer-management of smallholder irrigation schemes; and there are hardly any cases of *institutional failures* in farmer-management of irrigation schemes involving large, commercial farmers. Putting in bold relief the importance of upward and downward ratchets in shaping successful IMT, Tren and Schurr (2000) contrast the results of two commercial Irrigation Boards (Loskop and Hereford) and two smallholder schemes (Hindostan and Coetzeesdraai in Arabie-Olifants Scheme) in South Africa. In the smallholder schemes, farmers pay little or nothing for irrigation, whereas the Irrigation Board farmers pay for irrigation on a full cost of O&M basis and they will pay much more for water itself once the government’s new full-cost water pricing policy comes into force. Yet, farmer management in the smallholder schemes is deemed to be a failure whereas Irrigation Boards are highly successful.

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[5] After “ratchet effects” used by Robert Chambers to describe how the operation of multiple constraints disable poor people “like movements down past a cog which are difficult or impossible to reverse, making poor people permanently poorer…” (Chambers 1983: 115).

The most important distinguishing factor is the *stake*s of farmers in their farming and in the irrigation system. Farmers in the Irrigation Boards have reasonably large farms, access to capital to invest in commercial crops, and average farm incomes in the range of R1–2.5 million (1 USD = R7). Farming is the only or the primary source of livelihood and income for these farmers; and in their case, the double-coincidence of need and capacity is well established. A well-functioning irrigation system is central to their livelihood (need). They have the resources, significant interests as well as the management skills (capacity) for trouble-free and sustainable management of large systems. Smallholder groups have neither: their tiny farms give them little or no net income. And they do not have the resources and management capacity to operate their schemes viably. A Policy Proposal prepared by a group of South Africa's most experienced scholars appropriately asserts that: "Irrigation farming can be very remunerative provided the following are present: high quality management, markets and infrastructure, and sufficient equity capital" (Backeberg et al. 1996: vii). Africa's smallholder irrigation farmers have none of these; and without these, IMT can easily become a "millstone around the neck."

Farmer management of small-holder irrigation schemes can become viable and sustainable but only as an element in a broader "lift" strategy that attacks at once an entire complex of constraints (including capital scarcity, low enterprise and risk-taking capacity, shortage of machines, poor market-linkages). Such little African evidence as is available suggests that smallholder schemes can survive when farmer organisations are designed to work on this broad array of constraints rather than just manage the irrigation system. Saga, a pump scheme in Niger studied by Abernethy et al. (2000), is such an example: despite extremely high irrigation fees, the effective marketing and support system enables farmers to earn good profits from irrigated agriculture. We have found successful cases in South African sugar projects, where smallholders have access to broad-based credit, input supply and market access (e.g., Pike, cited in Makhura and Mamabolo 2000).

In sum, then, plain IMT—with all the accent on "process," capacity-building, getting the right socio-technical conditions in place, and so on—is by itself unlikely to work in the context of African small-holder schemes. Successful IMT will have to be accompanied by a quantum jump in smallholder productivity and incomes; and unless communities feel confident about managing these schemes viably, they will be reluctant to accept IMT. Successful IMT requires much more than smooth transfer of these irrigation schemes to farmers, i.e., it entails removing a host of other constraints.

5. The way forward

Under intense budgetary pressure to curtail expenditures on O&M, many African countries have taken recourse to plain abandonment of smallholder schemes that have gradually collapsed. In South Africa, the latest to initiate state withdrawal, this implies virtually writing off, as sunk costs, over R 2 billion of past investments of public funds in the small-holder irrigation sector. Instead of abandonment, however, South Africa has chosen a more positive and proactive stance towards the management of state withdrawal from smallholder irrigation schemes. The National Department of Agriculture has led a process of study and consultation aimed at developing a viable national policy.

Besides getting the process right, South Africa—and the rest of Africa—must focus on evolving an IMT strategy that addresses the entire complex of constraints that small-holder irrigation schemes are facing, replacing the so-called downward ratchets by strong upward ones. The tenor of discourse in the African smallholder irrigation context needs to shift from institutional reform of smallholder irrigation management to institutional interventions designed to significantly enhance smallholder productivity and incomes. Institutions appropriate for this are probably not pure Water User Associations, but either farmer-controlled organisations with a much bigger mandate and capacity or strong institutional linkages with agri-businesses to play a central role in executing a lift strategy.

Regrettably, there are not many examples of such broad-based smallholder support systems that have succeeded and proven sustainable, especially in Africa. But what we can find suggest that central to an effective lift strategy for African small-holder communities is helping them find stable, reliable markets for value-added products; once this is ensured, much else follows. Africa is replete with many examples of contract farming that have failed, but it is not clear if the potential offered by this institutional alternative has been explored fully, especially in the context of small-holder irrigation schemes. Doing this is important because in the African smallholder irrigation context, agri-business companies have operated farmer support systems akin to what the erstwhile parastatals were originally to offer.

Coulter et al. (1999) have explored “contract default,” both by the company as well as the farmers, as the major impediment to developing the agri-business path to small-holder farming. They have suggested that one reason why farmers as well as companies default on their commitments is that the farmers are not organised. According to them, when companies make input supply, credit and marketing commitments to a self-help group or a co-operative of small farmers, peer-pressure checks individual default. Equally, organised groups of small farmers with their superior bargaining power can extract more favourable terms for contract farming and guard against company defaults. With organised small farmer groups, there is also room to design and introduce self-enforcing incentives and penalties with respect to honouring the contract, thereby drastically reducing the monitoring and contract enforcement costs that scare agri-business companies away from smallholders.

In conclusion, our review of global and African experience suggests that straightforward IMT will not work in African smallholder irrigation. Indeed, it would be surprising if IMT, with its stress on “process” and capacity-building, will meet even the moderate expectation of IMT success, that it “saves the government money, improves cost- effectiveness of operation and maintenance while improving, or at least not weakening, the productivity of irrigated agriculture” (Vermillion 1996:153). This is because of the entire complex of institutional constraints affecting the viability of most smallholder irrigated farming.

Institutional alternatives that have the greatest chance to work in this situation are those that help small-holders move to a substantially higher trajectory of productivity and income from where they can take in their stride the additional cost and responsibility of managing their irrigation system. And the best place to start seems to be markets: bring smallholder communities in contact with stable, reliable markets for value-added products. This will help install upward ratchets; and once their irrigated holdings help them make decent livelihoods, African smallholders will be ready and eager for IMT.

Acknowledgements

Earlier drafts of this paper have benefited from comments by many people, both within IWMI and elsewhere. They are too numerous to mention here. We would like to thank the anonymous external reviewer of the larger paper that is forthcoming as an IWMI Research Report.This work was carried out under a research grant provided by the British Department for International Development (DFID) for Achieving Sustainable Local Management of Irrigation Water in Water-Short Basins: South Africa Case Study (Reference NRE 9800 605/966/001A). IWMI is grateful to DFID for this support. This paper is a revised and abridged version of a forthcoming IWMI Research Report, *Institutional Alternatives in African Smallholder Irrigation: Lessons from International Experience with Irrigation Management Transfer*, by Tushaar Shah, Barbara van Koppen, Douglas Merrey, Marna de Lange and Madar Samad.

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Assisting sustainable irrigation management transfer: Case studies of good practices in West Africa

Soutenir le transfert durable de gestion de l'irrigation: Etudes de cas de bonnes pratiques en Afrique de l'ouest

Ingrid Hermiteau, Audrey Nepveu de Villemarceau and Christophe Rigourd

Abstract

Twelve irrigation systems in five West African countries were monitored, in order to identify good practices that appear to be related to better performance. Most of these systems were small, the range being from 20 to 3,295 ha. Most had been externally planned and designed but have since been transferred to farmers' organisations for management of operations and maintenance. Overall, the study identified 26 good practices that seem to contribute to enhanced performance. Six of these practices, concerning organisational processes, are presented here. The success of these practices is dependent on local contexts, and further research will be needed to evaluate the conditions appropriate for replication. From these studies, the authors provide recommendations in four areas: organisational strengthening; integration of irrigation activities with pre- and post-production actions; promoting the emergence of new service-providers; and new support roles of government agencies after management transfer.

Résumé

Douze périmètres irrigués dans cinq pays de l'Afrique de l'ouest sont suivis en vue d'identifier les bonnes pratiques qui conduisent à de meilleures performances. La plupart de ces périmètres sont de petite taille avec des superficies allant de 20 à 3295 ha et ont été conçus et réalisés par des organisations externes. Depuis, les responsabilités d'exploitation et de maintenance ont été transférées à des organisations paysannes. L'étude a identifié, au total, 26 bonnes pratiques qui semblent contribuer à des performances améliorées. Six d'entre elles, afférentes à des processus organisationnels, sont décrites dans cette communication. La réussite de ces pratiques dépend des contextes locaux et il faudra poursuivre la recherche pour évaluer les conditions aptes à une large diffusion. A partir de ces études les auteurs font des recommandations couvrant quatre domaines: le renforcement organisationnel; la nécessaire intégration des activités d'irrigation avec des activités pré et post production; la promotion de l'émergence de nouveaux fournisseurs de services; de nouveaux rôles que doivent jouer des organisations gouvernementales après le transfert.

1. Introduction

The period 1960 to 1990 witnessed the development of irrigation in response to drought and famine in the Sahel. Since then, governments in the region and their donors have targeted huge investments at irrigation development, with a priority for rice production. Initially, irrigation development was exogenous, but after three decades of state interventions in irrigation, the 1990s witnessed major and rapid changes: market liberalisation, state withdrawal from irrigated schemes, CFA franc devaluation, and transfer of irrigation management to farmers' associations. Irrigated schemes which were planned initially to satisfy social objectives (food security, and limiting rural migration) now had to prove their competitiveness and financial sustainability. Large irrigation schemes for rice involving pumped irrigation have been much criticised because of poor performance, especially due to the non-competitiveness of rice and poor maintenance of schemes.

In a project conducted by IPTRID,[1] 12 irrigated schemes in sub-Saharan Africa were compared. This comparison yields a more positive picture that contrasts with the often-pessimistic vision of irrigated agriculture in Sahelian Africa and shows that the identification and dissemination of good practices could improve the performance of irrigated schemes. However, even if technical progress

[1]A list of acronyms is at the end of the paper.

is possible, the real lever is organisational change. Schemes where irrigating farmers adopt more of a professional approach, along with the emergence of new private-service providers, appear to be better organised and more productive.

2. The project

The project "Identification and dissemination of good practices on irrigated schemes in West Africa" was financed by the French Ministry for Foreign Affairs and conducted by IPTRID. The project was undertaken in partnership with EIER, PSI-CORAF, AFARtct, AMVS, SPFS and SENAGRHY.

Twelve irrigated rice schemes in five West African countries (Burkina Faso, Mali, Mauritania, Niger and Senegal) were studied during one, two and three cropping seasons. On all the schemes studied, water is pumped and distributed by gravity. The schemes vary in their levels of complexity and in size from 20 to 3,295 ha. They are smallholder collective schemes. Most have been transferred to farmers' associations, but were exogenous (externally planned and designed). This means that farmers' associations (usually co-operatives) are responsible for their operation and maintenance.

The project aimed at forming a picture of rice production in the region. The objective was to identify, assess and disseminate efficient practices to improve irrigated production performance. The overall study resulted in 26 case studies of good practices. These good practices are varied — some are at farm and some at scheme level; some are technical and some organisational; and they deal with agronomic, hydraulic and economical themes. We classified them into five main categories (see annex 1).

These case studies proved efficient on site, but need further confirmation in time: they are not to be disseminated as such, but can illustrate possible ways to build a local solution.

In accordance with the theme of the seminar, we have chosen to focus this paper on case studies of organisational good practices. They illustrate the extension of the private sector in sub-Saharan irrigation, in order to show how irrigation management transfer may be assisted.

Table 1 summaries these **organisational good practices at scheme level**. They all illustrate solutions and strategies developed by farmer groups in order to undertake the new functions transferred to them, namely:

- management of agricultural production;
- operation and maintenance of the irrigation scheme;
- integration of actions upstream and downstream of production;
- crafting their own institutions.

Table 1. Summary of good scheme-level organisational practices.

Transferred function	New challenges for co-operative	Identified good organisational practices
Management of agricultural production	1 To reconcile individual and collective interests; 2 To ensure an operational link between farmers and their technical and economic environment.	▪ Co-operative involvement in quality seeds production; ▪ Locally centralised rice nurseries; ▪ ***Organisational practices for agricultural planning;*** ▪ CalCul : software to elaborate an estimated cropping calendar for irrigated rice.
Operation and maintenance of the irrigation scheme	1 To meet irrigation requirement and assure the equity of water supply; 2 To reach a sufficient maintenance and assist a sustainable system; 3 To lower pumping costs and save water.	▪ ***Externalisation of hydraulic function on irrigated schemes;*** ▪ ***Contract for pumping-station maintenance;*** ▪ Collective works for maintenance; ▪ ***Quality control of maintenance works.***
Integration of actions upstream and downstream of production	1 To regain control of the production system and break the vicious circle: selling difficulties ➞ credit problem ➞ delay in input supply ➞ poor agronomic performance; 2 To strengthen post-production activities and sell paddy at a suitable price; 3 To manage short and long term financial aspects of production, with integration of the notion of risk.	▪ Reserve funds for special expenses; ▪ Creation of working capital; ▪ Credit / supply / sale / reserve funds contract; ▪ ***Local post-harvest processing;*** ▪ ***Integrating post-production actions through a quality rice policy.***
Crafting institutions	To craft farmers' own institutions and to change from an externally-promoted organisation (co-operatives often are official but useless associations) to sustainable collective dynamics.	▪ Water fees : transparency, real cost, clear collection rules; ▪ Rules and sanctions clearly defined and actually applied; ▪ Support for co-operative self-management; ▪ Sharing of responsibility and decentralisation towards grass-roots organisations; ▪ Supra-scheme organisation for small schemes.

Note: The six practices reviewed in this paper are shown in bold italics.

3. Illustrations of successful practices––six examples

We have selected six examples of these organisational practices at the scheme level (shown in italics in the table above). They illustrate three issues of collective irrigation schemes: planning of production at scheme level, scheme maintenance and processing of production. They all show different ways for co-operatives to acquire new skills and to face challenges from transfer.

The summary below follows a standardised format: objectives, description, context, assessment and evaluation. Detailed implementation and complete economic evaluation are not provided here, since they would be too long.[2]

[2] For more information, please contact the IPTRID Secretariat.

3.1 Good practices in production planning at the scheme level

Practice 1-1: Organisational practice for agricultural planning

Location

This practice was observed on two irrigated schemes very different in size, but tackling the same principle:

- Nakhlet, a small basic scheme in Mauritania.
- Boundoum, a large sophisticated scheme in Senegal.

Description

The co-operative aims to create favourable production support for the farmers, by:

- reconciling individual and collective interests;
- ensuring an operational link between farmers and the technical and economic environment.

Before the cropping season, farmers are informed of the advised cropping system (by parastatal agencies like SAED in Senegal). They collectively decide on production planning. The levels at which producers' meetings are held must be such as to allow real commitment by the producers to the decisions reached. For this, meetings should consist of no more than 50 producers. In Nakhlet, PSI-CORAF used the software "CalCul," which gave an approximate cropping calendar for both scheme and farm levels. This facilitates reconciliation among users sharing the same resources (water, labour, agricultural equipment, etc).

Before the cropping season, the farmers' association controls the hydraulic system and negotiates a maintenance contract with service providers. In Senegal, SAED helps to write the invitation to tender. For mechanised operations, the co-operative centralises demands for service, negotiates prices, tests the service quality, and organises planning of operations (e.g., soil preparation planning is adapted to irrigation planning). Farmers remain responsible for direct payment to the enterprise. In the same way, the co-operative centralises input demands, negotiates with providers and controls delivery and distribution of inputs. The co-operative helps to find financial resources: it negotiates credits for the grass-roots organisation to create working capital. In Boundoum, the farmers' association owns a milling machine to process the paddy, which in turn improves sale of rice and cash flow.

Objectives

The objectives of these practices are:

- at the farm level: to increase yields by better respect of agronomic recommendations;
- at the scheme level: to reduce operation costs and to allow double cropping when possible, through a better spreading of the cultivation calendar.

Context and operating conditions

On the two schemes, the following success factors were observed:

- schemes in good condition (new or recently rehabilitated);
- some social cohesion in the farmers' association, and experienced leaders and farmers;
- presence of support providers (parastatal agency like SAED, or project like PSI-CORAF).

On the other hand, failure factors were also present:

- Farmers have difficulties in selling their paddy quickly, so as to pay back credit and place a timely new order for inputs: this fact may induce delay in starting the following cropping season.

- Credit constraints are more present in Boundoum than in Nakhlet, which finances the cropping season with its working capital.

Assessment/evaluation

The respect of a cultivation plan allows better yields and farm incomes. In 1999, the PSI- CORAF support and the use of CalCul in Nakhlet gave significant results: better planning and respect for the outcome resulting in increased yields (Table 2).

Table 2. Improved performance with cultivation planning, Nakhlet, Mauritania, 1998–99.

NAKHLET	Average delay for the first input	Average yield (kg/ha)
Rainy season 1998, planning less respected	14 days	4,500
Rainy season 1999, planning more respected	6 days	7,200

Practice 1-2: Externalisation of hydraulic function on the irrigated scheme

Location

Toula, a medium-scale transferred scheme in Niger.

Practice description

In Toula, hydraulic functions are externalised and delegated to a private design office. A contract is signed between the co-operative and the private operator. The terms of reference describe the sharing of operations between the various stakeholders. Water supply, maintenance monitoring, hydraulic supervision and financial management of irrigation are delegated to a RGE (Water Manager). The RGE is employed by the design office. He presides over a Water Management Committee and is responsible for irrigation operations.

(Note: This delegation takes place within the context of a European project and is still <u>at the test stage</u>. It has been identified as a good practice from the results that already show, but it has not existed long enough to prove sustainable.)

Objectives

To improve maintenance, sustainability, pumping, equity of water supply, respect of irrigation rules and financial management.

Context and operating conditions

Medium or large-scale schemes appear more relevant, because a minimal cropping area is required to pay the RGE. In Toula, the scheme has been rehabilitated and the financial situation was reorganised (reimbursement of arrears, etc). It is now self-managed by a co-operative. However, the training level of farmers does not allow a total commitment in their scheme management.

Assessment/evaluation

Initial observations are that:

(a) there is more equity in water supply;

(b) abandoned irrigated fields are cropped again;

(c) maintenance is better;

(d) conflicts about water sharing decreased.

Water fee collection reaches 95 percent. The lower pumping duration allows electricity savings. Consumption decreased by 16 percent, i.e., 3,000 CFA francs (US$4.3) per hectare, between 1998 and 2000.

Table 3. Water consumption at two schemes in Niger, wet season 2000.

	Toula	Lata
Pumped volume (m^3/ha/season)	13,000	18,000

Toula and Lata are two nearby schemes with similar equipment. In the rainy season of year 2000, a clear difference appears in their water consumption.

Today, the costs of delegating water management to an external manager are still difficult to estimate. They certainly exceed 10,000 CFA francs (US$14.30)/ha/season, but the project aims to decrease this sum.

Conclusion 1: Externalising water services and organising agricultural planning

The PSI-CORAF approach in Nakhlet and the European Project in Toula follow some common objectives: (i) to organise production at scheme level, (ii) to reconcile individual and collective interests, and (iii) to facilitate sharing of common resources (water, labour, equipment). Nevertheless, they show differences in their implementation:

Table 4. Comparison of management practices at Nakhlet, Mauritania, and Toula, Niger.

Organising agricultural planning in Nakhlet	Externalising water services in Toula
- focus on agronomic aspects	- focus on hydraulic aspects
- advice on an ad hoc basis	- externalisation of the function
- association of functions: multidisciplinary approach	- separation of functions: hydraulic function separated and delegated
- use of CalCul more adapted to small and middle-sized schemes	- economically viable for big or middle-sized schemes

3.2 Good practices in scheme maintenance

Practice 2-1: Contract for pumping station maintenance

Location

Kotaka and Diantakaye, small schemes (< 35 ha) in Mali (Mopti).

Practice description

Two partners sign a maintenance contract for the pumping station:

- the committee, representing seven small nearby schemes in the Mopti area,
- the mechanic, trained and recognised by the pump provider.

The 5-month contract defines the responsibilities of each partner:

- The mechanic has to visit each scheme twice a month to assure current maintenance operation. In case of breakdown, he is obliged to move to the scheme the day he is informed.
- The mechanic advises the co-operative to buy fuel, oil, spare parts and teaches the motor-pump attendant to use the equipment (motor cleaning, control of gauges, etc).
- Each co-operative pays the mechanic 15,000 CFA francs (US$21.40) per month (without implicating the supra-scheme committee). It supplies spare parts and other consumable goods.

Objectives

To ensure regular and preventive maintenance and rapid intervention in case of breakdown.

Context and operating conditions

The contract is facilitated by the fact that many nearby and similar small schemes are combined in an association. It could be improved further by the standardisation of pumping equipment.

The free training of mechanics by the equipment seller (HATZ in the Mopti area) is a real advantage. On the other hand, the co-operatives have the necessary skills to manage themselves, thanks to NGO support. For example, they command reserve funds for special expenses.

Assessment/evaluation

The following facts are noted: (a) better maintenance, (b) decrease of breakdown number and (c) reduction of repair costs. The maintenance contract costs about 2,000 CFA francs (US$2.90)/ha, i.e., 2–3 percent of total irrigation charges. For the mechanic, the minimum salary reaches 105,000 CFA francs (US$150)/month, which is relatively attractive.

Practice 2-2: Quality control of scheme maintenance works

Location

Pont Gendarme, 200 ha, Senegal.

Practice description

Maintenance works require different operators: specialised mechanics for the pumping station and service providers using special equipment for the main canal (public or private), collective work for the secondary network and individual producers at farm level.

Diagnosis, supervision and finished work inspection are often neglected. In Pont Gendarme, a small topographic unit (private operator) ensures these functions.

Objectives

To avoid maintenance deficiency, particularly canal degradation due to inadequate cleaning out by inexperienced farmers, and to maintain the hydraulic specifications of the network.

Context and operating conditions

- Appropriation by producers: they are ready to pay for the sustainability of their scheme.
- Presence of private operators for topographic operations.

Assessment/evaluation

The co-operative adopted this practice because deficient canal cleaning by farmers had led to degradation of the hydraulic network. Over-excavation and counter-slope disturbed the water distribution. The intervention of the topographic unit has permitted restoration of the characteristics of the network and assured equity in water supply.

Conclusion 2: Contract for pump maintenance and quality control of maintenance works

The common objective of the two previous case studies is to reach a sufficient level of maintenance in quantity as well as in quality, in order to guarantee the sustainability of the scheme. The main differences found are presented in Table 5.

Table 5. Comparison of Practices 2–1 and 2–2.

Quality control of scheme maintenance works	Contract for pumping station maintenance
- focus on scheme infrastructure - audit and diagnostic: short-term contracts - contract between one team and one scheme	- focus on pumping equipment - maintenance completely delegated during one season - contract between one mechanic and a group of schemes (economic viability)

3.3 Good practices in production processing

Practice 3-1: Integrating post-production through a policy to promote quality rice

Location

Pont Gendarme, 200 ha, Senegal.

Practice description

The co-operative owns post-harvesting processing machines: mini-rice-mill, screening and bagging machines. It uses a variety that is easy to decorticate and gives its whole attention to the drying and screening conditions. The equipment chain allows the processing of big volumes. Different rice qualities are obtained: 100 percent raw broken, melting or whole rice (without bran, with low broken rate and good polishing). Different packagings exist: 5 or 50 kg sacks.

These various products have different target markets. The 100 percent whole rice in 5-kg sacks is directly sold to groceries in Dakar, where it supplies the market demand for quality rice.

Objectives

- The co-operative takes on the post-production to gain the processing added value and to derive benefit from milling residues (rice bran).
- The mini-rice-mill allows good processing yields and low raw broken rate. Operation costs remain similar to those of small milling machines.
- Thanks to the different rice qualities, the co-operative diversifies its market outlets. It can quickly sell part of the harvest (at least fees in kind) and finance a new cultivation season.

Context and operating conditions

- Medium to large-scale scheme (> 200 ha) with sufficient production in terms of quantity and quality (homogeneity of variety), and a large part of this production sold;
- a reliable electric network;
- spare parts supply and qualified mechanics;
- equipment credits (in this case, they are not always easy to obtain).

Assessment/evaluation

- Mini-rice-mills allow production of better quality rice than small milling machines;
- The marketing strategy facilitates product sale and credit reimbursement;
- The co-operative gains the added value of processing;

- To recover the initial investment (7,000,000 CFA francs (US$10,000) for the complete installation), the co-operative must mill 1,200 tons of paddy. This is feasible in 5 years if the co-operative processes only the paddy received as fees. In reality, it also provides processing services to farmers, which allow the co-operative to reimburse its credit in less than 3 years.

Practice 3-2: Local post-harvest processing

Location

Kotaka and Diantakaye, small schemes (< 35 ha) in Mali (Mopti).

Practice description

- In the Mopti area, rice-growing is characterised by small schemes with low input intensity, mechanised or manual cropping and numerous varieties. A cheap paddy, with heterogeneous quality, is produced in low volumes on each scheme.
- Small milling machines, despite low output, allow cheap processing thanks to low investment and operation costs. Manifold operators (rural associations, women's groups, and private promoters) allow proximity processing in a competitive market, which decrease transport charges. They produce low-quality rice.
- Production is sold on small nearby rural markets, where cheap low-quality rice is demanded.

Objectives

Compared to industrial rice mills, local post-harvesting processing is characterised by better processing yields (pre-processing treatment allows for 10 percent increase of processed yield) and lower costs. The processing scale is more compatible with the small volumes produced on small collective schemes. The local community assumes responsibility for post-production and gains processing added value. For women, local processing is a remunerative activity, which relieves them from housework. It also improves availability of husked rice on the local market.

Context and operating conditions

Deficient industrial post-harvest processing, rice market liberalisation, CFA franc devaluation, and NGOs' support promoted local processing. On the other hand, milling machine owners sometimes meet difficulties in finding spare parts and qualified mechanics. They must obtain supplies in distant towns, which increases maintenance charges.

In Mopti, food preference is oriented to low-quality rice (Variety RM40 with 40% raw broken).

Assessment/evaluation

For processing operators, decorticating local paddy is attractive and profitable.

For co-operatives, low processing costs facilitate competition with cheap imported rice, and allow easier sale of paddy. Moreover, these lower processing costs result in a better added value of rice production. Negotiation that is facilitated between farmers and processors, who often belong to the same community, results in more equitable sharing of this added value. Therefore, the paddy price paid to farmers increases.

After devaluation of the CFA franc in 1996, the paddy price increased from 71 to 125 CFA francs/kg (10 to 18 US cents/kg). This rise was partly due to the rise of rice price from 129 to 183 CFA francs/kg (18 to 26 US cents/kg), but also to lower processing costs and facilitated negotiations between farmers and downstream stakeholders (Tandia 1999).

Conclusion 3: Local post-harvest processing and quality rice policy

These last two good practices aim at the following common objectives: (i) to integrate post-production activities, (ii) to lessen processing costs in order to reach a correct selling price, and (iii) to fix locally the added-value of processing. However, they differ in their implementation.

Table 6: Comparison of Practices 3–1 and 3–2.

Integrating post-production operations through a quality rice policy in Pont-Gendarme	Local post-harvest processing in Mopti
- Production and processing strategies oriented towards urban market and demand for high-quality, more expensive rice - Post-production internalised - Co-operative do the processing and sale - Minimal dependence of the co-operative on external downstream stakeholders	- Production and processing strategies oriented towards small market and demand for cheap low-quality rice - Post-production externalised - Local communities do the processing - Strong social links between farmers and processing stakeholders

4. Recommendations

The 26 good practices identified by the project should not be considered as recipes to improve scheme performances. A "good practice" is strictly linked to a scope of application, where it was designed for the context and showed good results. Even if a good practice is not to be directly disseminated, some lessons, or principles, can be extracted and applied to other schemes, provided they are adapted to these new local conditions. The added value of such good practices is that they illustrate these well-known principles with successful case studies and give further ideas about their implementation and results on the field.

The four recommendations presented below illustrate some of the principles that contribute to sustainable management transfer. Defining the role of each stakeholder and their co-ordination is essential in order to improve irrigated schemes' performance. In particular, farmers' associations have to become efficient in their negotiations with private-sector and public institutions, but also have to become active partners in agriculture extension. This requires maturity and skills, which can only be learned with assistance. This introduces the question of transfer without abandonment, and the role remaining with the State.

4.1 Principles towards organisational maturity of farmers' associations

Few schemes, in spite of their different organisational and institutional set up, demonstrate a relative organisational maturity, and manage to reconcile individual and collective interests to ensure the irrigated schemes' sustainability. This requires the following various principles:

- dialogue and transparency;
- rules and sanctions actually applied;
- clear sharing of responsibilities;
- decentralisation toward financially independent grass-root organisations;
- different levels of organisations, including supra-scheme organisation.

Dialogue is required in current management as well as in extraordinary situations. In Nakhlet, three general assemblies per season are planned to organise cultivation. To reduce organisational constraints, producers can however delegate part of their decision power to the co-operative board, which in turn reports all actions. Transparency is also essential, particularly in financial aspects. Accounts have to be discussed after each season. That implies that producers are educated enough to understand the calculation. For example, in Mali, the VRES project proposes concrete basic training (writing, reading, counting), directly usable by farmers in the management of their scheme.

A clear institutional framework is essential and responsibilities must be clearly defined: sharing of decision, execution and control functions between individuals, grass-root organisations, technical committees, co-operative boards, and supra-scheme organisations (see Figure 1). The subsidiarity principle consists in delegating tasks to the lowest level of organisation that is technically and financially viable. The co-operative must also decide the tasks to be delegated to external professional services and the ones it should carry out. Among these latter tasks, it has to define which are paid and which are not.

The example of Boundoum (Senegal) is particularly relevant (see Table 7). Despite a scheme of 3,100 ha with 2,300 farmers, the co-operative manages to reach a recovery rate of 100 percent for hydraulic fees and a cropping intensity of 150 percent, while the co-operative management costs remain under 6,000 CFA francs (US$8.60) per ha per cropping season.[3] The organisation of the farmers is certainly a major factor explaining these good results. Decentralisation of dialogue, credit access and fee collection toward grass-root organisations is an important point. Farmers gather in small groups (fewer than 30 persons) according to common interests (not necessarily according to hydraulic sectors). These groups constitute the counsel level, which allows a real producer's commitment. They are financially independent: they contract joint credits and are liable for fee collection. Therefore, financial difficulties in one grass-root organisation do not affect the whole co-operative.

Irrigating farmers have to craft their own institutions and should not simply copy existing models. This requires a strong commitment of producers, but it is essential for ensuring sustainable transfer of irrigated schemes.

Figure 1. Principles guiding the sharing of functions among stakeholders.

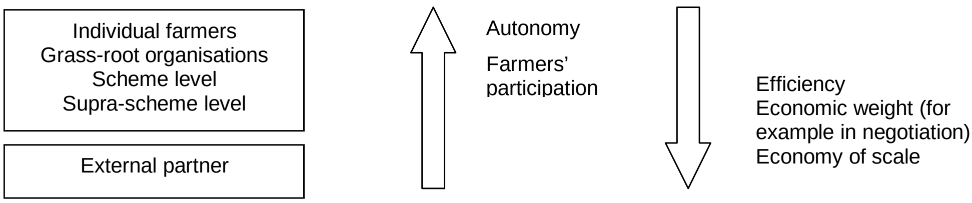

Table 7. Sharing of functions in the co-operative of Boundoum (Senegal).

STRUCTURE	COMPOSITION	FUNCTION
Grass-root organisations	About 30 farmers with common interest	**Level for discussion and decision** • Inputs supply, joint credit, fee collection
Technical committees	Representatives of each grass-root organisation	**Level for execution** • Cropping and irrigation planning • Operation and maintenance of agricultural / processing / hydraulic equipment • Assistance to grass-root organisations in negotiation with service providers, inputs suppliers, credit agencies
Co-operative board	President, secretary, treasurer, accountant elected by farmers	**Level for control** • Account follow-up • Control of decision execution • Arbitration

[3]Co-operative management costs include salaries, telephone, transport, mission stationery etc. On the 12 studied schemes, they vary between 1,000 and 85,000 CFA francs (US$1.4–121.4)/ha/cropping season, with an average of 20,000 CFA francs (US$28.6)/ha/season.

4.2 Necessary integration and professionalisation upstream and downstream of production

In West Africa, after the sudden withdrawal of the State from irrigated production, a few farmers' associations have tried to influence the decision-making process at all production levels, regaining control of their production systems and getting actively involved in input supply, financing and marketing networks.

In the field, co-operatives experience good organisational and financial practices, which allow decreasing upstream and downstream production constraints. These practices follow different principles:

- Up- and down-stream (or commodity chain) integration and active involvement of farmers in production. In reality, two strategies were observed:
    - The co-operative directly ensures new tasks, downstream or upstream of production. Thus, it becomes more independent from external constraints. For example, in Pont-Gendarme, the co-operative processes and markets its paddy by itself.
    - The farmers' association strengthens its negotiation abilities with its partners, for example, through contracting their dealings. On the small schemes in Mali, negotiations with processing stakeholders are facilitated because they come from the local community. In Toula (Niger), a contract was signed between the different partners of the production system: farmers' group, bank, input providers, and paddy trader.
- Different organisational levels. When the supra-scheme level is representative of grass-root organisations, it can be a single interlocutor which exerts weight in decisions. In Mopti area (Mali), a supra-scheme organisation deals with inputs supply and pump maintenance. In Senegal, they have lobbying functions and can influence national policies.

4.3 The need for new service providers, including extension workers

After State withdrawal from scheme management, farmers' associations have to implement some tasks, but they lack the required competence. The maintenance of the pumps and of the hydraulic network, the planning of cropping calendar at scheme level, financial management and accountancy, and negotiation of contracts are various examples of these new tasks, which are sometimes different from the previous work of a farmer. New capacities are, therefore, needed in the irrigation system. This requires the establishment of external services, which can be provided in two different ways:

- The necessary tasks requiring skills that farmers lack, can be totally delegated to an external partner. This is the case of the externalisation of hydraulic functions to a private design office, as has been tested in Niger.
- The external partner can act as an extension worker, providing advice, training, diagnosis or control to assist farmers' associations in acquiring necessary skills. These training and extension services need to be demand-driven and to encompass agronomic, hydraulic, and socio-organisational aspects.

Various experiences are being conducted in the sub-region, either in the form of advice on an *ad hoc* basis or by the externalisation of certain irrigation tasks. They have already led to interesting results, even if it is still too early to draw conclusions.

PSI-CORAF (Legoupil et al. 2000) has developed various tools to facilitate decision-making and management as regards agricultural and hydraulic planning at the scheme level (see the example of Nakhlet above). The PGI-FED (Ducret 2001) is currently testing in Niger a new approach to hydraulic management, whereby most hydraulic functions are delegated to a private body (see the example of Toula above). The PCPS (Traore 2001) in Mali has mostly focused its intervention on accounting and juridical back up and the structure in charge is directly under the control of farmers' associations (farmers recruit their agents).

Most of these experiences have proven their interest either through higher yields, reduced water consumption, higher hydraulic fees recovery rate, higher transparency and mostly farmers' empowerment, since they pay for the service they need. They have also learnt that the emergence of service providers, particularly private ones, is strongly linked with the capacities of farmers. Farmers, whether organised or not, have to learn to drive the demand for advice and to negotiate the services provided by their new partners. The definition of roles and links of these two new partners, farmers' associations and private service-providers, need therefore to be assisted, by NGOs or projects (as in the three previous examples) or, why not, by the State.

4.4 Government policy and new roles of parastatal agencies

The State withdrawal from irrigated schemes means a redefinition of the tasks of Government and parastatal agencies in a new institutional framework.

The first role of government policy will certainly be to set up a favourable framework for these new actors to emerge. For example, legislation should recognise and establish the existence and rights of farmers' associations. The notion of "transfer without abandonment" is also important. Farmers are confronted by new challenges, for which they were not prepared. They lack the required capacities to manage non-agricultural functions. When they deal with external partners, they do not always control negotiations. The State could facilitate the transfer to users in different ways:

- Education: The VRES project, in Mopti area (Mali) gives a successful example of self-management initiation of farmers. But education also concerns new private actors, who will support farmers in the future.
- Legislation: Official contract recognition, conflict resolution (between farmers and co-operative, or co-operative and private partners, etc.).
- Institutional support: to set-up co-operatives, to draft regulations and contracts. For example, in Senegal, the SAED, a parastatal agency for irrigation along the Senegal River, helps to write the invitation to tender.

5. Conclusions

In sub-Saharan countries, the transition from public to private management of irrigation has been very quick, and actually quicker than in many Western countries (France, for instance). Although irrigating farmers are facing many problems, the dynamism characterising some of these schemes must be highlighted, be it either from individual farmers, co-operatives, projects or some parastatal agencies. Breaking with a pessimistic vision of irrigated agriculture in Sahelian Africa, some irrigating farmers demonstrate their ability to fit into a fast-changing institutional and economic environment.

Disseminating these success stories will certainly accelerate the development of private irrigation. But the emergence of new actors, able to use this information on the schemes, has not been achieved. Many projects are testing the implementation of service-providers with different approaches: delegation of hydraulic functions, multi-disciplinary support, and accounting audit. It will be interesting to follow these experiences, and to evaluate and disseminate their results during the coming years.

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Acronyms

AMVS	Autorité de Mise en Valeur de la Vallée du Sourou (Burkina Faso)
AFAR[TCT]	Action pour la Formation et l'Autopromotion Rurale, Technique, Conseil pour l'autogestion du Terroir (Mali)
CFA	Communauté Financière Africaine
EIER	Ecole Inter-Etats des Ingénieurs de l'Equipement Rural (Burkina Faso)
IPTRID	International Programme for Technology and Research in Irrigation and Drainage
NGO	Non-Governmental Organisation
PCPS	Projet Cellule de Prestation de Service (Mali)
PGI FED	Programme Grande Irrigation (Niger) – Fonds Européen de Développement
PSI-CORAF	Pôle Régional de Recherche sur les Systèmes Irrigués soudano sahéliens – Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricole
RGE	Responsable Gestion de l'Eau (Toula, Niger)
SAED	Société nationale d'Aménagement et d'Exploitation des terres du Delta du fleuve Sénégal et des vallées du fleuve Sénégal et de la Falémé (Sénégal)
SENAGRHY	Société d'Etudes en Environnement, Agriculture et Hydraulique (Niger)
SPFS	Special Programme For Food Security of FAO
VRES	Projet de Valorisation de la Ressource en Eau de Surface (Mali)

Annex 1

Practices that can enhance yields and incomes (Summary from draft final report)

Agronomic practices at farm level

1 Weed control by pre-irrigation and soil preparation
2 Low-labour intensive technique to compost rice straw on farm
3 Land preparation and levelling with a rotary harrow
4 Banana trees on irrigation plot borders

Agronomic practices at scheme level

5 Co-operative involvement in quality seeds production
6 Locally centralised rice nurseries
7 Eucalyptus plantation on rice-oriented schemes
8 Organisational practices for agricultural planning
9 CalCul: software to formulate an estimated cropping calendar for irrigated rice

Hydraulic practices

10 Controlling weeds in canals with herbicides
11 Automatic hydraulic regulation
12 Externalisation (Out-sourcing) of hydraulic functions on irrigated schemes
13 Contract for pumping station maintenance
14 Collective works for maintenance
15 Quality control of scheme maintenance works

Practices for better integration of pre- and post-production (inputs, processing, marketing, finance, etc)

16 Reserve funds for special expenses
17 Creation of working capital
18 Credit / supply / sale / reserve funds contract
19 Local post-harvesting processing
20 Integrating post-production through a quality rice policy

Social organisation

21 Water fees: transparency, real cost, clear collection rules
22 Rules and sanctions clearly defined and actually applied
23 Support to co-operative self-management: functional education
24 Organisation and management principles: sharing of responsibilities, decentralisation toward grass-root organisations
25 Supra-scheme organisation (Federation) of small schemes
26 Physical, organisational, financial rehabilitation of irrigated schemes

L'irrigation privée dans le Delta du Fleuve Sénégal: Evolution et perspectives

Private irrigation in the Senegal River Delta: Evolution and prospects

Ibrahima Dia

Résumé

Cet article passe en revue les forces et les faiblesses liées au développement de l'irrigation privée dans le Delta du fleuve Sénégal. D 'une part les initiatives privées ont contribué considérablement à l'expansion des superficies aménagées et ont eu des impacts économiques significatifs en facilitant l'insertion des jeunes, des femmes et des urbains dans l'agriculture irriguée. D'autre part, l'auteur montre que ces performances restent très fragiles et sensibles aux chocs extérieurs et aux limites techniques internes. Sont également abordées des contraintes et des opportunités liées au transfert des responsabilités de gestion des grands périmètres irrigués aux organisations paysannes de divers types. Enfin, l'auteur souligne que ces organisations doivent évoluer vers une véritable professionnalisation et développer un vrai esprit d'entreprise pour pouvoir réussir dans l'environnement économique libéral actuel.

Abstract

This paper reviews the strengths and weaknesses related to the development of private irrigation in the Senegal River delta. On one hand, these initiatives have made important contributions to the expansion of irrigated area, and have had significant economic impacts notably by encouraging the entry of youth, women and the urban population into irrigated agriculture. On the other hand, the author shows that such performance is fragile and difficult to sustain, being susceptible not only to external shocks but also to internal technical limitations. Constraints and opportunities related to the transfer of management responsibilities of large-scale irrigation schemes to farmer organizations of different types are also discussed. Finally, the need for these organizations to develop professionalism and entrepreneurship in order for them to succeed in today's liberal economic environment is underlined.

1. Introduction

Le delta du Fleuve Sénégal est dans le département administratif de Dagana au nord-ouest du Sénégal (région traversée par le fleuve Sénégal) et qui couvre une superficie de quelques 6087 km^2 soit 14 pourcent du territoire national.

Cette zone apparaît comme la plus dotée en potentiel en terres irriguées (49700 ha en 1997) soit 63 pourcent des superficies totales aménagées dans la vallée du Fleuve Sénégal. Les privés ont réalisé 52 pourcent des aménagements contre 48 pourcent par l'Etat. Avec le transfert de la gestion des grands périmètres aux organisations paysannes c'est 5000 ha qui passent en gestion privée.

Ce système qui a pris un essor extraordinaire dans les années 90 connaît à présent de véritables problèmes qui amènent à s'interroger sur sa viabilité et sur les conditions de la durabilité du développement de l'irrigation privée ou de l'irrigation par les privés dans le delta du Fleuve Sénégal.

2. Analyse du contexte historique d'émergence de l'irrigation privée dans le delta

La décision des pouvoirs publics de développer l'irrigation dans le delta du fleuve Sénégal date de la période coloniale. En effet depuis la Mission d'Aménagement du Sénégal (MAS) en 1939, la création de l'Organisation Autonome du Delta (OAD) en 1960, et enfin la SAED[1] depuis 1965, l'Etat a planifié

[1]Société d 'aménagement et d 'exploitation des terres du Delta du Fleuve Sénégal et des vallées du Fleuve Sénégal et de la Falémé.

et réalisé le développement de l'irrigation en fonction de ses visions et objectifs prioritaires notamment la satisfaction des besoins nationaux en riz. Ainsi jusque dans les années 80 l'initiative est restée étatique et quelquefois communautaire sous l'impulsion des organisations non gouvernementales (ONG) ou des services étatiques dans le cas des périmètres irrigués villageois (PIV).

Entre 1984 et 1993, l'Etat a mis en oeuvre les réformes du secteur agricole avec la Nouvelle politique agricole (NPA) dont certaines mesures vont contribuer à l'émergence d'un secteur irrigué privé dynamique dans le Delta:

- D'abord la loi 84 qui permet de créer des groupements d'intérêt économique (GIE), structure souple et moins contraignante que les coopératives, permettant à des ménages et des individus de s'associer librement quel que soit leur nombre sans considération d'appartenance villageoise ou autre, et à disposer d'un outil d'intervention pour accéder aux crédits.
- La seconde innovation a trait à l'ouverture de la CNCAS[2] en 1987 à Saint-Louis avec des modalités d'accès aux financements très souples par rapport aux systèmes classiques.
- Enfin la réforme la plus décisive a été la décision de l'Etat de transférer la gestion de toutes les terres du domaine national aux conseils ruraux du delta. Les zones dites pionnières sont reversées dans les zones de terroir.[3]

A ces mesures s'ajoute l'opportunité que constitue la disponibilité de ressources humaines de qualité mis brusquement sur le marché par l'Etat avec les nombreux déflatés et départs volontaires forcés dans le cadre des Programmes d'Ajustement Structurel. La SAED passe de 955 agents en 1988 à 293 agents en 1993.

La conjugaison de tous ses facteurs que sont la gestion du foncier par les populations, les reformes institutionnelles et les ressources humaines composées de personnes extérieures aux structures traditionnelles avec un esprit d'entrepreneuriat explique le développement rapide de l'irrigation privée dans le delta du Fleuve Sénégal.

En effet le personnel déflaté de la SAED et de l'ISRA[4] qui comprenait des techniciens, des encadreurs et des gestionnaires ayant eu de solides relations avec le milieu, s'ils ne sont pas issus de ce milieu, vont jouer un rôle de catalyseur car comprenant bien les enjeux et préoccupés par l'accès à de nouvelles sources de revenus. Une alliance entre ces acteurs et les jeunes ruraux issus du mouvement associatif va aboutir à la création de plusieurs GIE qui vont se fédérer dans des associations à l'échelle départementale.

Ces associations dont quatre principales vont émerger (UGIED,[5] UGIEN,[6] AFEGIED,[7] ASSESCAW[8]) seront les principaux instruments d'accès au foncier pour les non autochtones (urbains), les jeunes et les femmes. Les conseils ruraux, en particulier celui de Ross Bethio, vont jouer la carte des fédérations d'organisations paysannes pour contourner les contraintes traditionnelles et institutionnelles (la loi sur le domaine national n'autorise pas l'affectation de terres à des étrangers) en octroyant des centaines d'hectares aux fédérations qui vont les redistribuer à leurs adhérents. Le conseil rural de Ross Béthio a ainsi procédé à l'affectation de prés de 50 000 ha en moins de 5 ans. Avec ces associations des zones jusque là marginalisées par la SAED, parce que ne réunissant pas les conditions techniques souhaitées pour la riziculture, vont être aménagées par les privés. C'est ainsi que la zone du lac de Guiers, dont les terres ne sont pas aptes à la riziculture, commence à être exploitée pour les cultures de diversification.

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[2] Caisse nationale du crédit agricole du Sénégal.
[3] La Loi foncière a classé les terres du domaine national en deux catégories dont la première appelée zone pionnière est gérée par l 'Etat pour assurer la mise en valeur par des investissements publics alors que la seconde constituée des zones de terroirssont gérées par le Conseil rural organe élu des villages.
[4] Institut sénégalais de recherches agricoles.
[5] Union des groupements d'intérêt économique du Delta.
[6] Union des groupements d'intérêt économique du Nord.
[7] Association des fédérations des groupements d'intérêt économique du Delta.
[8] Association économique, sociale et culturelle de l'amicale du Walo.

Les aménagements ont couvert 22 000 ha pendant cette période soit un rythme d'aménagement de 4000 ha par an, de loin supérieur à celui des aménagements publics. La production du delta qui avoisinait 50 000 tonnes de paddy en 1987/88 a connu une évolution rapide pour atteindre 115 000 tonnes en 1990/91 avec 70 000 tonnes venant des aménagements privés.

3. Caractéristiques du système irrigué privé

3.1. L'aménagement

La superficie moyenne des périmètres privés est de 30 à 50 ha. Ces aménagements, conçus pour la riziculture, comprennent:

- un groupe moto pompe (GMP) de moteur diesel bi-cylindre de 15 à 30 CV avec un débit de 350 à 700 m^3/h. Ce GMP est placé en bordure d'une voie d'eau accessible (fleuve, défluent, canal etc.)
- un canal d'amenée construit à la niveleuse sans compactage
- des parcelles juste raclées à la niveleuse et non planées
- pas de drains; le drainage se fait par évaporation ou infiltration
- pas ou peu d'ouvrages maçonnés comme dans les PIV (bassin de dissipation, prises)

L'investissement se situait en 1993 à environ 100 000 FCFA par ha aménagé, le GMP non compris.

3.2. Le système de production

Le système de production correspond à un modèle mécanisé avec une faible intensité de main d'œuvre et un recours important à la sous-traitance. Le système est très dépendant des services mécanisés pour la préparation des sols et la moisson battage. C'est ainsi que plusieurs entreprises de prestation de services vont s'installer dans le Delta pour satisfaire la demande. Parmi ces services, la moissonneuse batteuse est celle qui a joué le rôle le plus important en levant une des principales contraintes que doit confronter le système irrigué privé. Avec des superficies exploitées aussi importante, dans un milieu où la main d'œuvre n'est pas abondante et pour un produit qu'on doit récolter vite pour réduire les pertes (oiseaux, égrenage etc.) la moisson et le battage deviennent des opérations critiques dans l'itinéraire technique.

L'irrigation est conduite de manière approximative en fonction de l'appréciation, de visu, de l'exploitant sur le niveau de l'eau dans les parcelles mais surtout de l'état des canaux car les ruptures de canalisation sont une préoccupation permanente dans la gestion de l'eau dans les périmètres.

Compte tenu des contraintes de main d'œuvre pour un tel système, le semis est fait à la volée avec des semences pré-germées sur un sol pré-irrigué. Avec les problèmes de planage, l'enherbement devient une donnée permanente qui est contrôlée par une utilisation intensive d'herbicides.

4. Performance du système

Le développement rapide de l'irrigation privée dans le Delta a montré que les initiatives privées peuvent contribuer de manière très rapide à suppléer aux insuffisances du secteur public si l'environnement est favorable. En effet l'implication du secteur privé a permis de faire passer les superficies aménagées de 16 900 ha en 1988 à 42 600 ha en 1993. Au même moment les superficies cultivées passaient de 12 900 ha à 24 400 ha. Cette augmentation est due essentiellement aux périmètres privés qui ont fait passer le volume de crédit de 149 millions de FCFA en 1988 à quelques 2500 millions de FCFA en 1993-94. Ce développement a eu un impact significatif dans l'économie locale par le développement d'activités en amont et en aval: fournisseurs d'intrants, unités de prestations mécanisées, unité de transformations etc. Son impact économique a permis d'atténuer très fortement la pauvreté et surtout les risques de basculement d'un nombre important de ménages urbains et ruraux, victimes des politiques d'ajustement, qui ont ainsi pu trouver une alternative pour leur insertion économique.

Cette performance est malheureusement très fragile du fait d'une très forte sensibilité aux chocs extérieurs et des limites techniques internes au système.

4.1 La sensibilité aux chocs extérieurs

Avec la dévaluation du FCFA intervenu en 1994, on assiste aux premiers signes de vulnérabilité du système d’irrigation privée. En effet avec un système de production très fortement mécanisé et coûteux en consommation intermédiaire, les périmètres irrigués vont être confrontés au renchérissement des coûts de production. C’est ainsi qu’ils devront payer 30 pourcent de plus pour les services mécanisés et 60 à 90 pourcent de plus les intrants et l’eau.

4.2 Les limites internes du système

Les périmètres réalisés sans étude, sans plan, ni travaux de topographie ne permettent d’obtenir des bons rendements que pendant 2 à 4 ans. Les rendements élevés du début (5 à 7 tonnes de paddy par ha) se répètent rarement deux fois de suite car les insuffisances de l’aménagement ne vont pas tarder à se traduire dans les résultats de production.

Les défauts de planage et la mauvaise utilisation des tracteurs entraînent des enherbements de plus en plus difficiles à gérer qui poussent certains à abandonner une partie des parcelles. D’autre part l’absence de drains provoque une accumulation du sel avec ses conséquences que sont les chutes de rendement et quelques fois l’abandon de certaines parcelles. Les parcelles abandonnées continuent de retenir les eaux de pluies qui s’évaporent et renforcent l’acidification. D’autre part l’utilisation incontrôlée et abusive des herbicides pour endiguer l’enherbement constitue un danger pour l’environnement avec les risques de pollution du fleuve, des défluents et des nappes.

On assiste ainsi progressivement à une catastrophe écologique avec des centaines d’hectares de terre salés dans le Delta. Une évaluation faite en 1999 sur l’état des périmètres irrigués du Delta montre que seuls 46 pourcent de ces périmètres sont dans les conditions normales pour être mis en valeur.

La baisse des rendements conduit les producteurs privés à adopter un mode de mise en valeur de plus en plus extensif. C’est ainsi qu’on constate que malgré la baisse des surfaces cultivées qui passent de 14 000 ha en 1990/91 à 11 500 ha en 1992/1993, et à 6 000 ha en 1999/2000, les aménagements privés ont augmenté de 8 000 ha entre 1990 et 1993 avant de connaître une pause. Cela montre que les gens se déplaçaient sur de nouvelles terres et font, en même temps, du marquage foncier avec toujours le minimum d’investissements d’autant plus que la CNCAS qui commençait à connaître des impayés avait décidé de réduire l’octroi des prêts en attendant d’assainir la situation.

5. Les grands périmètres transférés

Le transfert des aménagements s’est opéré entre 1988 et 1993 sous les injonctions des bailleurs de fonds, en particulier de la Banque Mondiale, dans le cadre du Programme de réhabilitation des périmètres du Delta intitulé «Irrigation IV». Cette décision s’est faite sans préparation des acteurs et sans négociation avec les bénéficiaires.

Le préalable de ce transfert a été la mise en place d’Unions paysannes chargées de prendre la relève de la SAED dans la fourniture des services d’irrigation. Elles vont signer un contrat de rétrocession sur la base d’une note d’entretien et de gestion (NEG) rédigée par la SAED dont le contenu n’a pas fait l’objet de négociations.

Les paysans ont dû d’abord réformer leurs organisations pour les adapter au nouveau contexte en mettant à leur tête des jeunes dont la plupart avaient un niveau scolaire élevé en remplacement des vieux qui n’avaient pas les mêmes capacités de négociation et de transaction que les jeunes. Ensuite des GIE avec le nom d’Unions hydrauliques ont été créés à la place des Coopératives en tenant compte des relations sociales de pouvoir entre les villages concernés et compte tenu de la taille des périmètres à gérer.

Avec la dénomination d’Unions Hydrauliques qu’on leur a donnée, ces organisations avaient une fonction de service de l’eau dont la tâche consistait à gérer une station de pompage électrique neuve (ou réhabilitée) et à récolter les coûts hydrauliques pour payer les charges et constituer un fonds d’amortissement. En général les Unions vont réussir cette fonction, aidées en cela par la CNCAS qui prélève directement sur le crédit accordé aux producteurs le coût hydraulique placé dans le compte dépôt à terme de l’Union. Les Unions ont aussi amélioré la gestion de l’eau avec la systématisation de l’irrigation nocturne, la rationalisation des prélèvements des exploitations privées riveraines qui pirataient le réseau pendant la gestion de la SAED etc. Elles vont également prendre des initiatives de diversification, quelques fois malgré l'opposition de l'encadrement et sans crédit.

Très vite les Unions se rendent compte qu'elles ne peuvent ignorer les autres fonctions d'organisation de l'exploitation des parcelles notamment l'harmonisation des itinéraires techniques, le calendrier cultural, etc. C'est ainsi que certaines Unions vont intégrer l'achat groupé d'intrants et de semences sélectionnées dans leur programme. Contre l'avis de la SAED certaines Unions vont puiser sur le compte d'amortissement pour financer des producteurs qui avaient des problèmes ou pour pré-financer certaines campagnes quand la CNCAS tardait à accorder le crédit (c'est la cas du périmètre de Pont gendarme.)

Les premiers résultats de la réhabilitation des Unions se traduisent par une augmentation de la production. Mais les Unions seront confrontées aux problèmes de commercialisation et aussi aux coûts des intrants et services mécaniques. Elles se rendent compte de leur faible performance externe et engagent des actions de rétention de stock et de boycott des opérations mécanisées. En 1993, elles constatent l'inefficacité de ces stratégies et mettent en place une alliance de toutes les Unions gérant des aménagements transférés avec la création de la FPA (Fédération des périmètres autogérés).

Au lendemain de la dévaluation du FCFA, les périmètres autogérés ont connu de véritables problèmes de rentabilité, d'autant plus que le contexte était marqué par une multitude de réformes dont la libéralisation de la commercialisation du riz. Pendant deux ans le riz de la vallée va connaître des problèmes de commercialisation avec une forte concurrence du riz importé. Sans crédit, on note une chute brutale des emblavures.

La CNCAS va mettre en place, à partir de 1997, un plan de relance en accordant des moratoires et de nouveaux crédits aux producteurs des périmètres autogérés. Depuis cette date on note une relance avec des superficies cultivées qui passent de 27 300 ha en 1997/98 à 31 200 ha en 1999/2000. Les rendements ont aussi augmenté avec une moyenne de 5 tonnes par hectare. La recherche y a fortement contribué avec de nouvelles variétés (ex. variétés Sahel) diffusées par l'Association pour le développement de la riziculture en Afrique de l'Ouest (ADRAO).

Aujourd'hui, les Unions se professionnalisent et adoptent des comportements conséquents d'acteurs privés. La principale contrainte demeure la commercialisation du riz, leur principal produit et la spéculation adaptée aux sols (lourds et salés) et pour laquelle ces périmètres ont été conçus. Elles développent diverses stratégies en mettant en place des minirizeries pour transformer sur place leur riz ou en nouant des relations avec des associations de femmes pour créer des réseaux indépendants de distribution qui échappent aux commerçants.

Le périmètre de Pont Gendarme parvient à transformer dans sa minirizerie le paddy des producteurs du périmètre et a mis sur le marché des sachets de riz long de qualité parfumée en relation avec les supermarchés de la capitale. Le périmètre compte mettre l'essentiel de sa marge sur ce segment de marché.

Parallèlement à ces initiatives, les Unions sont maintenant conscientes qu'il leur faut engager un vaste mouvement de lobbying en relation avec les autres organisations de périmètres privées qui n'avaient pas les mêmes avantages de disposer d'aménagements sur fonds publics. C'est ainsi qu'il a été créé depuis le début de 2001 une Confédération des Organisations Socioprofessionnelles de Dagana (CORDE). Cette organisation envisage de porter les questions stratégiques et de mettre en oeuvre une dynamique de concertation de tous les acteurs.

6. Conclusion

L'analyse des performances de l'irrigation privée et de la gestion des aménagements étatiques transférés en gestion privée communautaire montre que la question de la maîtrise de l'environnement économique et la dynamique sociale sont des facteurs critiques pour développer, de manière durable, l'irrigation privée. Il apparaît que si les forces sociales porteuses des initiatives privées sont responsabilisées et appuyées, et si l'environnement ne présente pas trop d'incertitudes, notamment en matière de commercialisation, l'irrigation privée constitue une alternative viable.

Il apparaît aussi nécessaire de veiller à établir des normes techniques et environnementales sans lesquelles le développement est éphémère.

Dans le contexte libéral actuel, c'est aux organisations paysannes de faire pression sur les pouvoirs publics pour que des mesures favorables soient prises, aidées en cela par les chercheurs et organismes spécialistes des questions agricoles. La récente décision des pays de l'UEMOA[9] d'établir une taxe unique sur la TVA à 18 pour cent sur les produits utilisés par l'agriculture et sur les produits agricoles est un exemple de mesures qui n'incite pas le développement de l'irrigation privée et de l'agriculture en général. Nos gouvernements doivent être sensibilisés sur les résultats des politiques sur l'agriculture dans l'espace communautaire.

Dans le delta du Fleuve Sénégal, les conditions sont aujourd'hui remplies pour relancer l'irrigation privée sur de nouvelles bases en tirant les leçons des expériences et avec des acteurs devenus plus conscients des enjeux notamment environnementaux. Il s'agit, par un processus participatif, d'amener les acteurs déjà organisés à élaborer des programmes d'appui au développement de l'irrigation dans le Delta.

[9] Union Economique et Monétaire Ouest-Africaine.

From government to farmer-managed smallholder rice schemes: The unresolved case of the Mwea Irrigation Scheme in Kenya

Le transfert de petits aménagements rizicoles: Le cas non-résolu du périmètre irrigué de Mwea au Kenya

Charity Kabutha and Clifford Mutero

Abstract

The Mwea rice irrigation system covers about 12,000 ha, north-east of Nairobi. The system was constructed between 1953 and 1973. From 1967 to 1998 it was managed by a government agency, the National Irrigation Board. The agency applied a strict system of management, under which the farmers had very little freedom of choice or control in crop management, marketing, land tenure, and other economically significant aspects. These policies of the government agency caused increasing discontent, leading ultimately to a takeover of the system by an organisation of the farmers in 1998. The takeover was accompanied by violence, and important assets are now not in the hands of the effective managing organisation. The paper describes these events, presents the findings of a recent survey of the opinions of various participants, and seeks to identify a possible way ahead for this scheme.

Résumé

Le périmètre irrigué de Mwea, d'une superficie d'environ 12 000 ha et situé au nord-est de Nairobi, a été réalisé entre 1953 et 1973. De 1967 à 1998 sa gestion a été assurée par le Bureau national d'irrigation, une organisation gouvernementale. Sous le régime strict de gestion appliqué par le bureau, les exploitants avaient très peu de choix ou de contrôle concernant des pratiques culturales, l'écoulement des produits, la foncière, et d'autres aspects d'importance économique. La politique du bureau a donné lieu à du mécontentement et a conduit, en 1998, à une prise de pouvoir violente de la part des exploitants. Du fait, une importante partie du patrimoine n'est plus sous le contrôle de l'organe effectif de gestion. Cette communication, tout en décrivant ces événements, présente les résultats d'un sondage récent d'opinion de divers participants en vue de tracer une possible issue pour cet aménagement.

1. Introduction

Large-scale rice schemes the world over have had centralised modes of management, characterised by minimal involvement of farmers. This scenario has however greatly changed during the last two decades in response to a global wave of economic and political change that has raised farmers' awareness of their rights and entitlements. The change is reflected in increased demand by farmers for greater involvement in matters related to operations of the schemes. The Mwea rice irrigation scheme in Kenya, operated under this kind of system for over 40 years, is undergoing similar change.

This study traces the history of the scheme and management under the Ministry of Agriculture and the National Irrigation Board (NIB) and now the farmer co-operative. The study addresses conflicts between the farmers and the Board and analyses the current management by farmers.

1.1 History

The Mwea irrigation scheme, located at the foothills of Mount Kenya, is about 100 km to the north-east of Nairobi. Although only 6,000 hectares is under irrigation, the entire scheme covers 12,000 hectares (30,000 acres) and supports a population of over 50,000 people, organised in approximately 3,242 farm families living in 36 villages. It is the largest rice scheme in Kenya. The irrigated area is divided into five sections, namely Tebere, Mwea, Thiba, Wamumu and Karaba, covering 1,330, 1,260, 1,220, 1,165 and 1.070 hectares, respectively. Mwea and Tebere are the oldest and the largest while Karaba, located at the lowest end of the scheme, was the last to be developed in 1973. The scheme gets its water from two rivers, the Nyamindi and Thiba.

The scheme was developed using captive Mau Mau labour after the declaration of a state of emergency in Kenya in October 1952 (Njihia, 1984: 4, quoted in Turner et al. 1997). (The Mau Mau were Kenya's freedom fighters through whom the country gained its independence from the British). The scheme was managed by the British colonial government until 1963, when Kenya gained its independence, after which it was handed over to the Ministry of Agriculture. After the establishment of the National Irrigation Board (NIB) in 1967, this Board immediately took over its management. In 1998, a farmer co-operative, the Mwea Rice Growers Multi-purpose Co-operative Society (MRGM) took over the scheme's management. The MRGM had been formed in 1993 through a split of the farmers' giant organisation, the Mwea Amalgamated Rice Growers Multi-Purpose Co-operaive Society Limited.

During its tenure, NIB's Board membership excluded genuine farmer participation. For example, the membership consisted of Directors of Agriculture, provincial representatives (from the provinces in which the scheme exists) appointed by the Minister of Agriculture but proposed by the Provincial Agricultural Board, the Director of Water Development, Chairman of the Water Resources Authority, Permanent Secretaries of the Ministries of Finance, Treasury and Economic Planning, and three Ministerial appointees with expertise considered useful to the Board. Although the provincial appointees could in principle be assumed to represent the interests of the farmers, the farmers had no say in their selection.

Management of the scheme by the Board was guided by the Irrigation Act of 1967, Chapter 347 of the Laws of Kenya (Government of Kenya 1967) and reinforced by management regulations of 1977 (Government of Kenya 1977). The system that evolved from this legal structure was dictatorial and harsh. Because there was no real farmer representation in the Board, these regulations were implemented almost in full.

Mwea farmers responded to this exclusion through establishment of farmer lobby groups such as the Mwea Irrigation Tariff Co-operative Society (1964) which later changed its name to Mwea-Tebere Co-operative Savings and Credit Society Limited. In 1967, a sister society, the Mwea Farmers Co-operative Society was formed. Until 1981, the management and membership of these two associations remained the same. During that year, the two split, with each establishing its own management. In 1983, the two societies joined and formed a banking section under the name Mwea Amalgamated Rice Growers Co-operative Society Limited. In 1993, the giant society split again to form what is currently the Mwea Rice Growers Multi-purpose Co-operative Society Limited (MRGM) and the Mwea Rice Growers SACCO Society Limited. Although the two operate under two different sets of management, they work closely and may soon be amalgamated because they believe that it was the Board that kept them fighting (MRGM; Tsurruchi and Waiyaki 1995). The MRGM is the farmer body that took over the running of the scheme after the farmers took over the management of the scheme.

The areas of conflict between the Board and the farmers were myriad but key to these were the low producer prices, high cost of irrigation-related services such as seeds, fertilisers and chemicals, land tenure system that treated farmers as tenants and exclusion of farmers from the scheme management. Finally, the farmers radically and forcefully took over the running of the scheme in 1998. The takeover was marked by confrontation between the farmers and the Board, leaving behind destruction of infrastructure and loss of life. This study traces the historical events fomenting the radical change and analyses the current management system, its challenges and opportunities to forge ahead.

2. Study methodology

The study methodology was both participatory and consultative using diverse information sources. Key stakeholders included rice farmers from three sections, Mwea, Karaba and Thiba, including women, men and young people, the Central Committee of the Mwea Rice Growers Co-operative (MRGM) and the technical staff, the National Irrigation Board (NIB) management and the field managers, rice millers and rice merchants.

Criteria for selecting the study areas included age of the section of the scheme and access to irrigation-related services such as water. On the basis of these criteria, Mwea, Thiba and Karaba sections were selected. Both Mwea and Thiba are well watered while Karaba is most disadvantaged in terms of access to irrigation water. In terms of age, Mwea scheme was the first to be established (1952), while Karaba is the latest (1973).

Within the sections, discussions were held with mixed groups of men, women and young men. This was contrary to the original design that envisaged group discussions with men, women and young people separately. Rice farmers rejected this format on account that all information relating to this change was public information and all individuals, irrespective of age and gender had a voice in this matter. Perhaps not so explicitly stated was the fact that they were suspicious of outsiders and the suggestion of working with different groups was seen as "divisive." To the satisfaction of everybody, the suggested system worked out well.

3. Management of the scheme by the National Irrigation Board (NIB)

3.1 Summary of issues as perceived by the NIB

Consultations were held with the NIB senior management of the scheme and technical officers. The managers acknowledged the undemocratic mode of management, which, although perhaps viewed as necessary at the beginning, had failed to change with the times. A senior manager did however indicate that discussions on possible changes had gone on within the Board for quite some time. For example, the Board had considered, as early as the 1980s, reviewing the Act to increase farmers' participation. As part of this initiative, workshops were held with stakeholders to define the areas of change, but this was never concluded.

3.2 The Irrigation Act and Regulations

The National Irrigation Board, established in 1967 through an Act of Parliament, Chapter 347 of laws of Kenya (GOK 1967), managed the Mwea Irrigation Settlement Scheme up to the end of 1998, when the rice farmers took over its management. Through the Act, the Board was supposed to conduct research, co-ordinate and plan settlement on irrigation schemes, and manage the production and marketing of crops produced in the schemes. In addition, the Board was mandated to impose a cess on all or any agricultural produce grown on a national irrigation scheme. According to the Act, the *"cess shall only be levied for the purpose of meeting the cost of services provided in the relevant scheme, and for which services no other direct charges are available or payable."* However, the cess levied in Mwea was in some cases used to subsidise other national irrigation schemes in the country, mainly Ahero and Perkerra. This transfer of rice profits from Mwea to other schemes was among the main sources of conflict between the Board and the farmers.

To support the Board in the implementation of this Act, Parliament developed regulations now contained in a Kenya Legislation of 1977, Legal Notice 68 (Government of Kenya 1977). The regulations were needed to help sustain the Board, which as a parastatal, had to be financially self-sustaining and had to do this through recouping its overhead costs from the farmers.

The regulations were harsh. The farmers were expected to comply with all instructions given by the manager on crop husbandry, branding, dipping, inoculating, herding, grazing or watering stock production and use of manure and compost, preservation of fertility of the soil, prevention of soil erosion; to deliver the crop after harvest and to manage the planting, felling, stumping and clearing of trees and vegetation and the production of silage and hay.

Farmers did not have permission to use equipment and machinery other than that provided by the Board, were provided with housing and were not allowed to erect own houses.

Any farmer who failed to observe these regulations would be *"guilty of an offence and could be liable to have his licence terminated by the minister on the recommendation of the manager (after confirmation by the committee) and the minister's decision will be final."* The Board specifically was responsible for flooding the paddy fields, rotavation (land preparation) of the fields using MIS tractor, providing seeds, supervision of production of seed by selected farmers, provision of fertilisers and determining the amount and timing of application, direct application of chemicals on the crop, clearing of canals, collection of rice after harvest, milling, and marketing at a price set by the Board.

To enforce these rules, the Board put in place necessary structures. For example, it maintained guards at strategic points within the scheme to screen farmers to ensure that no rice was smuggled out of the scheme (farmers were officially allowed 12 bags of 75 kg per year for home consumption). These rules and regulations generated resentment and hostility between the Board and the farmers.

The farmers considered the management of the scheme by the Board harsh for a number of reasons. Confiscation of land for what was considered poor management, harassment of farmers for attempting to retain more rice than allowed and highly priced services were some of the areas of concern.

3.3 The socio-economic situation at Mwea

The socio-economic situation of the people of Mwea did not improve during the NIB tenure, as reported by farmers and corroborated by a 1995 NIB/JICA socio-economic survey that indicated that farmers never managed to meet their basic household~~s~~ needs from the rice proceeds. The results of the survey indicated that an average farmer obtained a total yield of 83.5 bags per 4-acre (1.62 ha) plot. Of these, 10.5 bags were consumed by the family and the remaining 73 sold to the Board. From the expected income of KSh 75,150, the farmer finally received KSh 35,229 after deductions of KSh 31,420 (cost of materials) and KSh 8,501 for wages of hired labour[1] (Tsurruchi and Waiyaki 1995).

By the time of the survey, activity within NIB had been reduced to the minimum. The rice mill manager referred to the rice mill related activities as *"dead."* As a result of this inactivity, there were plans to send home on unpaid leave 75 percent of the 120 workers. At its peak, the rice mill had a staff complement of 120 regular staff and a similar number of casual workers.

4. Factors underlying conflict and takeover by farmers

As recorded elsewhere, farmers' dissatisfaction with the centralised mode of management of the scheme is not new. Efforts by farmers to participate effectively in the management of the scheme are reflected in formation of farmer organisations since Kenya's independence in 1963. The relationship between the farmers and NIB was never cordial and the final takeover was radical, confrontational and therefore not legal. The factors and events that fomented the takeover included low prices, land tenure, lack of farmer representation in the management of the scheme, and, as described by farmers, the Board's lack of respect for farmers. Details of some of the farmers' grievances are captured in this paper.

The 1990s marked the height of NIB / farmer confrontations. In 1996, for example, there was a major confrontation precipitated by the Government's move to get the farmers sign new tenancy agreements that required them to deliver all rice except 10 bags, much less than in earlier tenancy agreements (12 bags). The 10 bags were supposed to meet the family needs for an entire year. A confrontation, led by 300 women, ensued, leading to police intervention and heightened riots. Young men hurled stones at the police, who moved away from the scene to avoid bloodshed (Nthiga, 15 July 1996, p.2; cited in Turner et al. 1997). This hostility continued, culminating in the 1998 takeover of the scheme.

An attempt to understand this confrontation better reveals that, on one hand, the farmers had genuine grievances such as low prices and the high-handedness of the Board, but on the other hand, farmers' actions were facilitated by a more open political environment brought about by the advent of the multi-party politics and liberalisation of many sectors including agriculture. This was a period when dissent was tolerated and Kenyans could speak openly without fear of detention and harassment. This too was a period of free information flow and interaction. For example, through the joint GOK/JICA research project in Mwea, farmers were trained on how to experiment with new crops such as soya beans. Farmers had also acquired skills on pricing and alternative market outlets. Those who produced soya beans and sold the crop directly to buyers (not through NIB) reported making KSh 270 per kilogram against KSh 27 per kilogram when sold through the Board.

[1] Average bank exchange rate of the Kenya Shilling (KSh) in the years covered by this paper were: in 1995, US$1 = KSh 51.62; in 1996, KSh 57.17; in 1997, KSh 58.92; in 1998, KSh 60.54; in 1999, KSh 70.42; and in 2000, KSh 76.28.

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This was the background that led to refusal by farmers to deliver the 1998 crop and destruction of some of the key infrastructure such as the rice collection centres, leading to serious confrontation with the police and resulting in the death of two men. At the forefront of this change were young people, born and bred in Mwea. These young people had lived in poverty and misery and for them, the past was a bad dream and time for change had come. A young man of 23 years from Thiba proudly showed the study team new houses built by young men along the main Nairobi highway. The houses were said to have been constructed using proceeds from the *"jua kali,"* or unauthorised rice plots (building of houses and opening new land for rice were illegal during the tenure of the Board). During the take-over, this young man was said to have mobilised youth groups, personally commandeered a NIB lorry full of paddy and shared it out to Mwea residents. In his words, days of slavery were over. The following issues precipitated this takeover by farmers.

4.1 Land tenure and land pressure

Forty years after settlement in Mwea, farmers are still tenants. The farmers contest this status on two grounds. One, they have been in the scheme long enough to graduate from tenants to landowners and two, the farmers claim that this was never Government land. The land is said to belong to the nine clans of the Agikuyu people who live on the foothills of Mt. Kenya and they consider Government's claim on the land illegal. They see this land as rightfully theirs, a demand supported by the Central Province Parliamentarians, who are by and large in the opposition. This situation is further aggravated by Kenya's Succession Act, which does not recognise "*tenancy status"* currently held by Mwea farmers.

As a reaction to this discontent and land pressure, farmers have opened up new land bordering the Mwea Scheme for rice production, using the water system servicing the "official" scheme. There is genuine land pressure as the 4 acres (1.62 ha) allocated to families long ago in 1953 are no longer adequate for the growing size of families. The unauthorised rice fields are popularly known as *"jua kali,"* which literally means "hot sun" and applies to local informal and low-technology industries in which many Kenyans engage.

4.2 Small, poor and highly priced housing

The farmers live in small houses built for them by NIB, some as far back as the early 1960s. Because the scheme regulations do not allow farmers to build their own houses, the current family sizes have overstretched the current space. The regulation states that no farmer is allowed to *"construct buildings or other works of any kind on the holding or elsewhere in the scheme without prior consent in writing."* Farmers have been unhappy with this set up because the houses are too small, are of poor quality and overpriced. The houses have mud walls and tin roofs. The houses had a cost of KSh 12,972 ($160) and the farmers were expected to make these payments to the Board in instalments of KSh 432.40 per year for a period of 30 years.

4.3 Water use restricted to rice production

The scheme regulations restrict irrigation water to rice production, although rice is not a high-valued crop when compared to horticultural crops such as tomatoes. The manager of the scheme had powers to destroy other crops if grown with water from the scheme. The regulation states that *"the manager shall have the power to order the destruction of any crops planted in contravention of his instructions or of the provisions of these regulations. All costs incurred during the destruction would be recovered from the rice delivered by the respective farmer."* In the latest petition to the Attorney General for repeal of the Act, this issue is underscored. Farmers complain that they *"are chained and tied up to rice farming all their lives as they devote their full personal time and attention in the cultivation of a crop ordered by the Board."*

Issues of transparency in use of water were raised. For example, it was said that horticultural production upstream using irrigation was taking place with full knowledge of the NIB management, and that the management was in fact collecting fees from those farmers who were pumping water from NIB canals. Besides, NIB had on a pilot-trial basis introduced a second crop of soya beans, grown in the off-season and at one point had expanded this program to 500 acres (200 ha).

4.4 Farmers lack of control over their product, rice

According to the regulation, families could only retain 12 bags of unprocessed paddy (75 kg each) after harvest. This amount was expected to feed the family for a whole year. To ensure that the regulation was adhered to, the Board engaged guards to screen the farmers as they left the fields. Contravention of this regulation saw many farmers in police cells. One woman from the Mwea section graphically narrated her ordeal in police cells for allegedly "smuggling" 4 kg of rice. As an illustration of farmers' desperation, they smuggled rice for home consumption in gum-boots and tea flasks on their way home from the farms. There were however many security checks and it was not easy to escape them.

4.5 Regulations against livestock rearing

Rearing of livestock in the rice scheme was prohibited. The regulation states that *"a licensee shall not keep on his holding any stock other than those specified in his licence"* otherwise the manager had authority to confiscate and sell such additional stock. This regulation was, however, not very aggressively pursued and herds of cattle and other small stock are a common sight in the area.

4.6 Sons over 18 years to leave the scheme

One of the regulations required that sons over 18 years of age leave the scheme. Although this regulation was never implemented, the farmers are still very incensed by its very presence in the Act. They saw it as a way of undermining the culture and the family unit, which places a high premium on sons who inherit family assets to ensure continuity of the family name.

4.7 Low prices and subsequent poverty

In 1998, the price paid out to farmers for paddy stood at KSh 17.50 per kilogram. In 1998 (at the height of the conflict), the farmers had demanded an increase to KSh 20.00 per kg. Once processed, rice fetches KSh 65-70.00 per kg.

4.8 Management of the rice mill

The rice mill is jointly owned by NIB (55%) and the Farmer Co-operative (45%). The farmers, however, claim that NIB has been running the mill for many years without dividends to the farmers and in their view, it is time for them to run it for a similar period. However, as the situation stands, the mill is fully in the hands of NIB and it is one of the assets farmers have no access to.

5. Management of the scheme by the farmer co-operative: changes and challenges

The farmer co-operative has been in operation for close to 2 years now, during which period, management changes have been instituted while new challenges have emerged as the analysis below reveals.

5.1 Changes

On taking over, the society moved fast to relax some of the contentious regulations used during the tenure of NIB. Unlike the time of the Board, when farmers could only retain 12 bags of paddy, they now were now free to keep anything in excess of the mandatory 40 bags of paddy that must be taken to the co-operative to meet the cost of services rendered. They can sell the rest directly to the millers for quick cash if they choose. The many barriers and policing of rice movement are things of the past. A few farmers have also experimented with two crops of rice in a year although the results have not been encouraging. A new weed, similar to the water hyacinth, has taken root in some canals within the Mwea section. The technical staff attributes this to double cropping.

5.1.1 Governance

The management structures are more democratic than during the period of the Board. The top management of the society consists of a Central Committee of nine members democratically elected by the farmers, staff members and unit leaders. The nine members represent the five sections of the scheme i.e., Tebere, Mwea, Thiba, Wamumu and Karaba. In order to maintain an odd number of members for voting purposes, each of the four sections is represented by two members while one section has one representative (the section with one representative will in the next round have two members). A critical concern in this constitution is the high level of gender inequity as this committee has only one female member despite the fact that women are the key rice producers.

Reporting to the nine section leaders are 68 unit leaders distributed through the five sections. In terms of numbers, Tebere has 17 unit leaders, Mwea 17, Thiba 12, Wamumu 10 and Karaba 10. Again, out of these 68 unit leaders only 3 are women.

The unit leaders are the frontline workers who link farmers with the both the management committee and the technical teams. They monitor views, needs and constraints for onward transmission to the section leader and finally to the society. As a back-up, each section has a technical officer, employed by the society. It is important to note that a few of the technical staff are “defectors” from NIB who have had years of experience in operating the canal system.

Included in the structure is an Agricultural Sub-Committee which handles technical issues and is co-ordinated by the Scheme Manager. This sub-committee consists of Agricultural Officers and Irrigation Engineers.

What the farmers considered as very different from the time of NIB was transparency in the running of the society. For them, this was central to its survival and sustainability. To maintain this transparency, farmers had put in place appropriate mechanisms. One such mechanism was a “*shadow management committee”* in each of the five sections. The committee checks and evaluates the work of the official central committee and has, on the basis of this evaluation, dismissed one committee member for non-performance in the last 2 years.

5.1.2 Better incomes and improved welfare

Price for paddy stood at KSh 17.50 per kg in 1998, but at the time of the survey the price had increased to KSh 30 per kg. Other indirect gains included reduced cost of services provided by the co-operative. Farmers and millers in Wang’uru town indicated that the change had brought with it improved incomes not just for the farmers, but also for other actors within the industry. Some of the proxy indicators for this improvement included better dressing, ability to pay school fees, and improved housing. One man from Mwea section showed off a suit he was wearing, a suit he said was his first since settling in Mwea over three decades back. He attributed his ability to buy such a suit to the change of management. Similarly, young men from Wamumu section of the scheme (who had fully participated in the riots) showed off their new houses, which they had never dreamt of owning.

For the millers, this new change has transformed their livelihoods. In Wang’uru alone, there are more than small 100 mills operating either independently or leased by the MRGM. The millers charge KSh 1 per kg of paddy milled, and in addition retain the bran from the paddy. This bran is used in the manufacturing of animal feeds and fetches a good price for the millers. The millers admit that life has changed in Mwea and Wang’uru. Farmers interviewed in late 2000 felt that most people were now able to generate some income for themselves, an aspect said to have reduced thuggery and insecurity to a minimum. However, by May 2001, there was less optimism in the new management as some farmers had not been paid for their rice deliveries of two seasons.

5.2 Challenges and opportunities

While certain things have worked well, the society knows that there are daunting technical and financial challenges ahead of them. The human capacity is overstretched, they have limited equipment and machinery and virtually no capital for operations. Banks are also unwilling to advance the MRGM loans in view of uncertainties on the future of the scheme.

5.2.1 Maintenance of the scheme

One of the remaining greatest challenges is effective management of the scheme. The level of financial and technical resources needed to keep water running, canals clean and plots watered to the right levels is prohibitive. Because NIB holds a substantial part of these resources, the hands of the society are somewhat tied up. Some of the specific challenges are discussed below.

5.2.2 Inadequate human capacity

The Co-operative Society has an extremely small technical workforce, which is way below the threshold for effective maintenance of the scheme. Each irrigation block/section has only one officer and none of them has an office. Certain key functions, such as water management and research, have not been established. The absence of systematic research, which is necessary to ensure regular supply of good seed, threatens the very foundation of the scheme. Plans for water distribution (particularly during periods of shortage) and for maintenance to allow equitable water distribution are necessary and need to be prepared by well-qualified staff.

5.2.3 Equipment

The society is very thin on equipment since NIB took away essential equipment such as tractors and excavators. Research equipment is still at MIAD but out of reach of the society. Some of the commendable efforts by the society in this regard include acquisition of 20 new tractors and subcontracting out some of the essential services to individuals outside the scheme as discussed below.

Sub-contracting tractors

The society was sub-contracting out services to independent contractors to supplement its internal capacity. The society pays for the service but deducts the cost from the farmers' proceeds. In the process of this struggle, the society has learned that it is cheaper and more efficient to contract out this service than to manage it.

Leasing of rice mills

At the time of this survey (August 2000), the society had no functional rice mill of its own. To mill the rice delivered by farmers, it leased rice mills from independent contractors. At peak time, it leased over 100 rice mills. The Society saw this arrangement as a contingency while awaiting the installation of a 3-ton per hour rice mill it had just acquired. The society also revealed its plans to acquire more mills if the stalemate over the jointly owned rice mill was not quickly resolved. The society confirmed that this was one service it was going to manage in order to maintain high quality of rice. The current quality of rice from the small mills is much lower than what was produced by NIB, a situation that automatically creates a marketing problem, particularly since imported rice of good quality is freely available at competitive prices in the local market.

5.2.4 Production of seeds

This is a highly specialised area. During the NIB tenure, a number of farmers had been contracted to multiply seed for distribution to the rest of the farmers during planting season. This ensured uninterrupted supply of good quality seed. When the society took over the running of the scheme, they used the same "seed-bulking" farmers for the 1999 crop. However, the farmers are no longer producing seed, leading to non-availability of good seed and increased use of lower quality seed.

5.2.5 Research

This emerged as one of the weakest areas in the current management. The society fully recognised this fact and was making efforts to address the matter. The acquisition of 20 acres freely made available by farmers for field trials was a demonstration of this commitment.

5.2.6 Working capital

Running the irrigation scheme is an expensive undertaking. The co-operative requires a minimum of KSh 300 million upfront to run the scheme. These funds are needed to meet the cost of fertiliser (70 million), land preparation (30 million), pest control and gunny bags (20 million) and farmers' payments amounting to close to 150 million.

Consistent efforts by the society to get credit from commercial banks have not been successful. The society attributes this to interference by the Government. In the midst of these financial difficulties, the society has occasionally managed to negotiate some workable options. For example, in 1999, the society identified a rice buyer who paid KSh 200 million when the crop was still in the field, with the promise of further payment when the crop was harvested. By doing this, the buyer was able to counter competition over a high-demand commodity. This agreement helped the society to meet some of its financial obligations.

5.2.7 Human health

Malaria and intestinal schistosomiasis (bilharzia) are common diseases in the Mwea irrigation scheme. The NIB used to have a surveillance team to monitor and ensure that the two diseases did not attain epidemic proportions. This was partly achieved through treatment of irrigation canals with molluscicides to kill carrier snails of bilharzia, and the provision of health credit facilities. Currently there is no organised treatment of canals with anti-snail chemicals. Transmission of bilharzia might, therefore, rise again to the high levels common before NIB instituted regular control measures. This has major implications on productivity.

6. Conclusions and recommendations

6.1 Conclusions

A change of management has occurred at the Mwea Irrigation scheme. The National Irrigation Board is currently almost non-functional despite the capacity it commands in terms of technical expertise, facilities and political support. There are however divided assessments on the nature of this change. According to the farmers, this change is final and there is no going back. The use of the term "divorce" to illustrate this change is enough to conclude the position of the farmers. The Government, while acknowledging this change, still sees its role in the scheme and considers itself the *"de jure"* manager.

The Government continues to control assets that are core to the operations of the scheme, e.g., the rice mill, the research facilities at MIAD and the paddy collection centres, while the Irrigation Act is yet to be repealed. It is, therefore, clear that while the farmers are functionally in charge of the scheme, Government still has a strong hold on the critical elements of the scheme.

Despite the challenges faced by MRGM, some substantial positive changes have taken place. The management system is apparently more democratic and sensitive to the plight of farmers, prices paid to farmers have almost doubled, while opportunities for farmers and the people of Mwea have increased (farmers can sell the bulk of their paddy to independent rice millers, thus creating a new category of beneficiaries within the scheme). In addition, farmers have opened up new land for rice on their own initiative. On the whole, the socio-economic status of the entire area is reported to have improved.

While performance in certain areas has been commendable, there are major challenges. The society's technical team is inadequate, lacks badly needed operational capital and facilities for research and seed multiplication, has limited milling capacity and lacks critical machinery and equipment such as excavators that are meant to keep the canals free of weed and silt. Innovation and flexibility has however helped the society in the face of these constraints. For example, the society has leased small rice mills from independent contractors and has contracted out services such as rotavation to supplement its 20-tractor capacity.

What is clear is that there is unfinished business between the Board and the farmers. The farmers continue to put pressure on the Attorney General to review the Irrigation Act while demanding the handover to them by the Board of the jointly owned rice mill and the idle infrastructure at the scheme (paddy collection centres, the MIAD Research Capacity). These emerge as clear areas of dialogue.

6.2 Recommendations

1. Both MRGM and the Ministry of Agriculture need to initiate meaningful dialogue to resolve pending issues such as the review of the Irrigation Act. At the functional level, matters relating to joint assets such as the rice mill and the paddy collection centres among others should be resolved.

2. Review and appropriately strengthen the current capacity of the farmer co-operative society. While this should be preceded by a clear analysis of core functions and capacity requirements, visible gaps include equipment and machinery, operational capital and staffing.

3. The society needs to develop a strong operational system to improve the efficiency of the farmer co-operative. The society has embarked on certain aspects of this such as computerisation but more needs to be done.

4. Strengthen the already initiated democratic process to ensure effective farmer representation and equity in terms of gender and other social characteristics.

7. Researchable areas

1. **Technical.** A new weed that resembles water hyacinth has taken root in some canals in Thiba. Although not currently a threat, it is important to establish its nature and implications.

2. **Socio-economic changes.** It is important to empirically establish the nature and scope of socio-economic changes that are said to have occurred since the farmer co-operative took over the running of the scheme.

3. **Organisational systems.** While the current management system has assisted the society to begin, a more rationalised system in terms of strategic direction and support systems is key to effective management. To be included in this process are the computerisation of the system and management capacities at different levels.

Acknowledgement

The authors of this study acknowledge inputs and support from different individuals and groups. A number of groups are identified here for special mention. They include the rice farmers of Mwea, Thiba and Karaba, who without inhibition, narrated the story of Mwea rice scheme and changes that had taken place during the last 40 years. The team also received support from the Management Committee of the Mwea Rice Growers Multi-Purpose Cooperative Society and the Mwea Irrigation Settlement Scheme team in the field. Both groups provided us with details on the history of the scheme and the technical and operational details. A very relevant source of information comprised individual rice millers who took us round their mills and explained to us the changed environment and what it meant to the people of Mwea.

This study was funded by the International Water Management Institute (IWMI).

ACRONYMS

FO	Farmer Organisations
GOK	Government of Kenya
ICIPE	International Centre for Insect Physiology and Ecology
IFPRI	International Food Policy Research Institute
IWMI	International Water Management Institute
MIAD	Mwea Irrigation Agricultural Development Project
MIS	Mwea Irrigation Settlement Scheme
MRGM	Mwea Rice Growers Multi-Purpose Co-operative Society
NIB	National Irrigation Board
PMC	Project Management Committee
SACCO	Savings and Credit Co-operative

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Impact of irrigation management transfer on the performance of irrigation systems: A review of selected experiences from Asia and Latin America

Impact du transfert de gestion de l'irrigation sur les performances des périmètres irrigués: Quelques expériences tirées de l'Asie et de l'Amérique latine

Madar Samad

Abstract

The paper reviews evidence about the impacts of management transfers from specific irrigation systems in six countries: Sri Lanka, India, Indonesia, Nepal, Mexico and Colombia. The comparisons are in some cases based on serial data (before and after transfer) and in some cases on parallel data (with and without transfer). Results are compared in regard to changes in: government expenditure; farmers' expenditure; quality of irrigation services; standards of physical maintenance; crop yields; and crop intensities. The findings are generally mixed and the evidence for improvement in any of these parameters is not strong. The evidence for reduction of government expenditure may be the most persuasive item. In conclusion, the author argues that, while the findings should not be seen as denying the potential value of irrigation management transfer as a policy, they show that better monitoring of outcomes is needed in such programmes, and better analysis of factors that may contribute to success. It is also stressed that there is a need for more research on appropriate institutional adjustments to accompany the implementation of such programmes.

Résumé

Cet article examine l'impact du transfert de gestion de quelques périmètres irrigués dans six pays: le Sri Lanka, l'Inde, l'Indonésie, le Népal, le Mexique et la Colombie. Dans certains cas on compare les situations avant et après le transfert, alors que dans d'autres il s'agit des comparaisons avec et sans transfert. Les changements intervenus dans des domaines suivants servent de base de comparaison: les dépenses de l'Etat, les dépenses des exploitants, la qualité des services d'irrigation, le niveau de maintenance des infrastructures physiques, les rendements, les intensités culturales. Les résultats sont généralement mixtes et aucun de ces paramètres n'affiche une amélioration significative ; la réduction des dépenses gouvernementales est peut-être l'élément le plus persuasif. En conclusion, l'auteur souligne que ces résultats ne doivent pas être interprétés comme une mise en accusation de la politique de transfert de gestion de l'irrigation mais plutôt comme un appel en faveur d'un meilleur suivi et évaluation des résultats des programmes de transfert. Une meilleure analyse des facteurs contribuant à la réussite du processus de transfert est également nécessaire. Le besoin de davantage de recherche pour mieux cerner les ajustements institutionnels devant accompagner la mise en œuvre de tels programmes est également souligné.

1. Introduction

During the last two decades, countries with sizeable irrigation sectors have been transferring the management of irrigation systems from government agencies to water user associations or other local non-governmental organisations. The programme is being implemented under a variety of labels: management transfer, turnover, self-management, participatory irrigation management and so on. A common objective of the various programmes is to curtail the role of government agencies in irrigation management and give farmers more control and responsibility for managing irrigation systems. In most instances, governments pursue management transfer programmes to reduce their recurrent expenditures on irrigation, enhance agricultural productivity levels and stabilise deteriorating irrigation systems (Vermillion 1997).

A question often asked is whether the irrigation schemes that were transferred to farmer management performing better than under state agency management? Although there is extensive literature on irrigation management transfer, no clear analytical paradigm has yet emerged. The writings are a disparate collection of definitions and methodologies from which it is difficult to deduce general conclusions or policy implications. Many analysts show a bias in favour of transfer programmes, apparently on philosophical grounds. With a few exceptions most reports that attempt to address this question are qualitative and hard to validate. It is important that impacts of management reforms are carefully analysed and understood, not only to set the record straight, but more crucially because of the significance of such analyses for policy decisions pertaining to the irrigation sector.

This paper synthesises the most significant evidence about the impacts of management transfer programmes. The analysis is based primarily on the findings of case studies conducted by the International Water Management Institute in Sri Lanka, Indonesia, Nepal, Maharashtra State in India, Mexico and Colombia. The paper also draws on evidence about impacts of management transfer on irrigation performance from other case-studies carried out in the region.

The paper begins with an overview of government policy on irrigation management transfer (IMT) in the selected countries. This is followed by an analysis of the impact of the management reforms on the irrigation performance in terms of impact on government's recurrent expenditures for irrigation, the quality of the irrigation service and agricultural productivity levels.

2. An overview of irrigation management transfer policies

In most of Asia management transfer entails only a partial devolution of responsibilities. Governments tend to retain some control over operation and maintenance (O&M) plans and continue to contribute to the financing of O&M. In most cases governments also remain committed for future rehabilitation and modernisation of the transferred schemes. Most transfer units are sub-sections of irrigation systems that are managed by farmer organisations while the main system continues to be managed by a government agency. Typically, post-transfer management organisations tend to be water user associations (WUA). The scope of responsibilities transferred to the WUAs and the institutional elements under which transfers have been launched have varied among countries. In Sri Lanka, Nepal and Indonesia the management of all smaller schemes was transferred to WUAs.[1] Larger schemes are usually under joint management with WUAs in charge of sub-sections of schemes (distributary and field canals) and government agencies continuing to manage headworks and the main canal system. With some exceptions (e.g., tubewells in Bangladesh and Pakistan, and pumps in Laos) turnover does not confer ownership of the irrigation infrastructure and other assets to WUAs. In almost all countries in the region where transfer programmes are underway, neither the post-transfer management entities nor individual farmers have clear water rights (Vermillion 1997).

The formation of WUAs is central to IMT programmes throughout the region. In Indonesia, following the transfer three types of WUAs have been developed:

- a single organisation whose members and jurisdictions fall entirely within a single village area;
- a federated organisation responsible for a scheme with its service areas located in more than one village. The federation is composed of WUAs representing each village in the service area;
- WUAs in irrigation schemes which serve multiple villages but have not been federated. Under this arrangement, representatives of WUAs of each village co-ordinate with each other to manage O&M (Frederiksen and Vissia 1998).

In most cases WUAs are legal entities and are essentially single-purpose organisations concerned mainly with O&M of the irrigation facilities. They are vested with the authority to formulate O&M plans and budget, and to set water fees, and have the right to contract and raise funds (Vermillion et al 2000). The government retains responsibility for major repairs and emergency maintenance in the transferred scheme. The ownership of the irrigation facilities rests with the government. Water rights are also vested with the government. Legal provision exists for licensing water use but it is not applied to irrigation. Farmers are said to have first rights to water based upon historical use.

[1] Small systems in Sri Lanka are those with a command area of less than 80 ha. In Indonesia, schemes smaller than 500 ha were earmarked for management transfer. In Nepal it involved schemes that were less than 500 ha in the hills and 2000 ha in the plains (*terai*). In Indonesia, the new reform policy proclaimed in 1999 covered all schemes. However, not all structures would necessarily be transferred. Major headworks may be retained under government management, secondary canals were to be transferred to farmer management (Bruns 1999).

In Nepal, the government retains ownership of the irrigation facilities, but vests the right to use the facilities to WUAs as part of the Memorandum of Understanding (MOU) on transfer (Frederiksen and Vissia 1998). The ownership of surface and ground water is also vested with the government. The MOU does not contain statements about water rights. The new Irrigation Policy adopted in 1996 provides detailed guidelines for irrigation services fees and authorises WUAs registered with the government to collect fees to cover the cost of O&M of facilities for which they are responsible. In the jointly managed schemes, the rates are determined jointly by Department of Irrigation (DOI) and the WUA. In these systems the total fees collected are shared by the DOI and WUA in proportion to the facilities for which they are responsible. It is envisaged that in the schemes under the Irrigation Management Transfer Programme (IMTP) the irrigation service fee would cover the full O&M costs.[2]

In Sri Lanka, the main function of the WUAs or farmer organisations (FOs) as usually referred to, is to deal with irrigation matters, but statutory provisions permit FOs the right to formulate and implement agricultural programmes for their area, market farm produce and distribute production inputs. When legally registered, FOs have the authority under the Irrigation Ordinance to formulate rules on maintenance, conservation, and management of irrigation infrastructure under their jurisdiction, to devise procedures for distributing water within the area under their command, and to impose and levy fees to recover the O&M costs (IIMI/HKARTI 1997). The ownership of the irrigation facilities remains with the government. However, a policy statement issued by the government in 1988 states that it would enact legislation to transfer the ownership of the irrigation network to FOs when they are found ready to take on that responsibility. To date there has been no such transfer of ownership of irrigation facilities.

In Sri Lanka, all water bodies except those which are entirely within the boundaries of private property are considered as public water resources. Legislation exists for issuing permits for water use but it is not strictly enforced. Water use for irrigation is exempted from the permit provisions. In 1984, the government introduced a cost recovery programme for O&M in the larger irrigation schemes through the imposition of irrigation service fees. Even in the initial years only about 50 percent of the targeted amount was recovered. Due to questions about the legality and also political pressure, the cost recovery programme was abandoned 4 years later. Although FOs are expected to incur the full costs of their O&M responsibilities, in many cases, the government continues to subsidise O&M by financing maintenance contracts let to FOs. However, FOs often mobilise additional labour and other resources for maintenance from their membership.

In India, irrigation management transfer is being implemented under the broader framework of participatory irrigation management. As irrigation is constitutionally a responsibility of the states, not the central government, there are considerable variations in the institutional framework relating to participatory irrigation management between the various states. These range from cosmetic changes in Haryana where farmer involvement is only below the outlet, to more comprehensive efforts in Maharashtra and Gujarat where WUAs are vested with the responsibility of managing minor canal commands of 500 ha.[3] The most far-reaching irrigation management reform programme is being implemented in Andhra Pradesh where the Andhra Pradesh Farmers Management of Irrigation System Act of 1997 provides for the formation of WUAs in all surface irrigation systems in the state. The WUAs are vested, *inter alia*, with the responsibility of operation and maintenance of the irrigation system, water distribution, conflict resolution, and collection of water fees. The WUAs are also authorised to mobilise funds through bank loans, levy fees and generate revenue by engaging in commercial activities (Raymond Peter 2000a). The most significant feature of the Act is that officials of the Irrigation Department are made accountable to the WUAs.[4]

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[2] In reality this is not the case. In the smaller schemes (e.g.,*Khageri and Panchakanya*) irrigation fee contributions amounted to only about 25 percent of the O&M cost in1995/96. In the larger schemes the share was less than 5 percent (Nepal Management Transfer-Brief, 1998, duplicated).

[3] Detailed accounts of IMT polices in the different states of India are given in Brewer et al. (1999a) and Raju et al. (2000).

[4] An authoritative account of the irrigation management reforms in Andhra Pradesh and key provisions of the supporting legislation, the Andhra Pradesh Farmers' Management of Irrigation System Act, 1997, is given in Raymond Peter, 2000a and 2000b.

IMT in Mexico is generally considered as one of the most ambitious and successful reform programmes in the world in terms of the area affected and the speed of its implementation. It was a part of a broader effort at macro-economic adjustments and institutional reforms. The programme was launched in1989. By December 1996, almost 2.92 million hectares had been transferred to 372 WUAs representing 90 percent of the area served by the 80 irrigation districts in the country (Kloezen et al. 1997). The Mexican programme is built around the creation of irrigation modules operated by WUAs. Modules cover a specified service area based on hydraulic, social and economic considerations (Johnson III 1997). The main objective of the programme was to reduce public expenditure on irrigation O&M while promoting greater user participation in the management of irrigation districts. The programme also provided assistance, such as on-farm development initiatives, to enhance farm-level productivity and water conservation. A further objective was to restore economic growth by using a system of pricing water, based on international prices, marginal costs, or scarcity value (Kloezen et al. 1997).

The irrigation management transfer programme in Colombia adopted in 1990 involved only a partial devolution of management to water users. The government maintained considerable advisory influence over the districts for several years, exercising some control over O&M plans and budgets, and resisting district attempts to release large numbers of staff. With The Land Development Law adopted in 1993, this control has been relaxed considerably as districts gained almost complete control over management. However, powers devolved do not include a formal water right or ownership of irrigation scheme infrastructure. Also, the government has not made it clear whose responsibility it will be, and under what terms and conditions, to finance possible future costs of rehabilitation (Vermillion and Garcés-Restrpo 1998).

3. Impacts of Irrigation Management Transfer

This section synthesises available evidence about the performance of irrigation schemes that have benefited from irrigation management transfer. The analysis is based primarily on case studies conducted by IWMI about the impacts of management transfer on performance of irrigation schemes in Sri Lanka, Indonesia, Nepal, India Mexico and Colombia.[5] Performance is measured from several perspectives: the costs to government and to farmers of operating and maintaining irrigation systems, the quality of the irrigation service, and agricultural productivity. The main aim of the analysis is to determine whether there have been noticeable changes in performance of the schemes after management transfer.

3.1 Financial impacts

Financial impacts were assessed in terms of government's recurrent expenditures for irrigation and the cost of irrigation to farmers.

3.1.1 Impact on government expenditure

One of the main reasons governments promote transfer programmes is to reduce the financial burden of irrigation management (Vermillion 1997). It was expected that, following transfer, the farming community would take on the responsibility to finance fully, or to share, the cost of operating and maintaining irrigation systems. This proposition was tested in all four countries selected for the study.

In Sri Lanka government expenditures on O&M were analysed for 50 schemes over a 10- year period – 5 years before transfer and 5 years after. The schemes selected were categorised into four groups:

a. schemes that were rehabilitated and transferred (with IMT)

b. schemes that were transferred (with IMT) but not rehabilitated

[5] Details of the respective case studies are given in: Samad and Vermillion, 1999 (Sri Lanka); Vermillion et al. 2000 (Indonesia); Brewer et al. 1999b (India); Samad et al. 1999 (Nepal); Kloezen et al. 1997 (Mexico), and Vermillion and Garcés-Restrepo, 1998 (Colombia).

c. schemes that were rehabilitated but not transferred (without IMT)

d. schemes without either of the two interventions (without rehabilitation, without IMT)

A piecewise linear regression model was fitted to analyse trends in government expenditure over two time periods: before IMT (1985-90) and after IMT (1991-95).[6] The aim was to determine whether the O&M expenditures incurred by government showed a particular linear trend from 1985 up to 1990, the year of transfer, but a different trend thereafter.

The results indicate that there has been a statistically significant decline in government's recurrent costs for irrigation during the pre-IMT period (1985-90) across all categories of schemes, irrespective of whether IMT programmes were introduced or not. There was no change in the declining trend in the post-IMT period (1991-95). The results do not fully support the contention that IMT leads to a reduction in government expenditure for O&M.

In India, data collected from selected minor canals in two schemes (Mula and Bhima) in Maharashtra showed that there was no reduction in government expenditure on operations and maintenance in the transferred minor canals. In one location (Mula) the average annual amount spent by government during the period 1987/88 to 1995/96 is higher in the transferred minor canal than in the non-transferred canal. This was due to repair costs incurred by government in accordance with the transfer agreement (Brewer et al. 1999b).

In Nepal, empirical evidence from West Gandak shows that there was a reduction in the government budget allocation for O&M after transfer. Similar observations were made in the case the Bhairawa Lumbini Groundwater schemes, which were transferred to WUAs (Samad et al. 1999).

In Mexico, results of IWMI's field studies in the Alto Rio Lerma Irrigation District (ARLID) showed that IMT resulted in the increase in financial self-sufficiency from around 50 percent in the years preceding transfer to around 120 percent in the post-transfer years. This is mainly due to the ability of the WUAs to achieve fee collection rates of over 100 percent. Moreover, all modules at ARLID hired highly professional administrative staff and used good computer software to handle daily financial administration. This resulted in improving the financial transparency of the WUAs (Kloezen et al. 1997).

In Colombia, research results in two sample districts showed that the government achieved its objectives of significant reduction of government expenditures for irrigation management (Vermillion and Garcés-Restrepo 1998).

3.1.2 Cost of irrigation to farmers

In Sri Lanka, irrigation water has traditionally been supplied free to farmers. Attempts made by government in the past to levy a fee from farmers were largely unsuccessful. The "costs" of irrigation to farmers are primarily the contribution of voluntary labour for canal maintenance, and in some instances payments made in kind to persons (*Yaya Palaka)* employed by the agency to oversee the distribution of irrigation water. With the introduction of participatory management the government expected farmer organisations to recover the cost of O&M from farmers. In a survey carried out in two schemes (Nachchaduwa and Hakwatuna Oya) farmers were asked to compare irrigation costs after transfer with costs of irrigation before transfer.

Three kinds of irrigation costs were assessed: cash payments, payments made in kind, and the number of person days of family labour contributed for canal maintenance. About 90 percent of farmers in both schemes claimed that there was no cash fee on irrigation before transfer. After the transfer of O&M functions to FOs, some organisations charged a modest fee for canal maintenance. The survey results showed that only a minority of farmers paid the maintenance fee. In both schemes, the irrigation cost to farmers is primarily unpaid family labour contributions for canal maintenance, and payments in kind to the person employed by the FO to distribute water. In both locations well-defined procedures for cost recovery have not yet been established. Data from the two schemes do not provide sufficient evidence to suggest an increase in the cost of irrigation to farmers following the introduction of participatory management.

[6] The regression model used and the details of the methodology are given in Samad and Vermillion (1999).

In the two Maharashtra schemes studied, farmers pay to the government (both before and after transfer) crop-area water rates, which are fixed by the state, and some additional fees. Therefore, these irrigation costs to farmers are not attributed to IMT. Data indicate that the cash cost of irrigation has increased. But, as water fees are collected by WUAs, the indications are that transaction costs associated with the payment of water fees have decreased, and thereby reduced the actual cost of irrigation to farmers (Brewer et al. 1999b).[7] More recent evidence from Andhra Pradesh indicate that with the introduction of irrigation management reforms there has been a three-fold increase in water charges (Raymond Peter 2000a).[8] This was done to augment the financial resources of the WUAs. In addition, farmers are liable to pay fees levied by the WUA (Raymond Peter 2000a). Thus there has been an increase in the cost of irrigation to farmers after IMT. But field studies carried out in the state suggest that there is not much resistance from farmers to paying higher water charges, as long as they have a dependable water supply (Jairath 1999). Moreover, even with the enhanced water rate the cost of irrigation water amounts to only 5 percent of the cost of production.

In the small-scale irrigation systems in Indonesia, water charges paid to the village or water users' associations are normally paid in kind (paddy) rather than in cash. Samples of farmers from the selected schemes were interviewed about their perception of changes in the costs related to irrigation before and after turnover. The percentage of farmers reporting no change in the amount of water fees paid in kind varied from 38 percent to 85 percent. In two schemes (Planditan and Cipanumbangan) 35 percent and 60 percent, respectively, reported an increase in the fee after turnover. Generally, farmers did not express concern about the reported increases or decreases being worrisome or too dramatic.

In the West Gandak scheme in Nepal, irrigation cash costs to farmers are higher in the transferred minors than that in the non-transferred minor. Unpaid labour contribution in IMT sites, on average, is not different than that in the non-IMT sites. In the groundwater schemes, pumping charges for irrigation in the IMT schemes are higher than those in the non-IMT schemes. Unpaid labour contribution in IMT schemes is lower than that in non-IMT schemes because the data in non-IMT sites include the labour contributed in rehabilitation works.

In Mexico, IMT has not resulted in an increase in the cost of water to farmers. Although the cost of irrigation to farmers remains low after transfer, WUAs find it very difficult to convince farmers that irrigation fees should be increased to keep up with inflation. Furthermore, none of the modules created a contingency fund for future emergencies or basic repairs. In Colombia, transfer resulted in variable effects on the cost of irrigation to farmers. In one district, where the total cost of irrigation was relatively high (due to two-stage pumping), at transfer, farmers exerted pressure on their new board to contain costs.

3.2 Quality of irrigation service

A key assumption of irrigation management transfer programmes is that, as farmers have a vested interest in the irrigation service, involving them directly in irrigation management would lead to improvements in the quality of the service. This section examines whether the introduction of participatory irrigation management resulted in an improvement in the quality of irrigation service. Changes in the quality of irrigation service were assessed in terms of farmers' perceptions of adequacy, timeliness and fairness of water distribution, and the incidence of irrigation-related conflicts among farmers before and after transfer.

A survey carried out in two schemes in Sri Lanka showed that a majority of farmers in both schemes claimed that water supply in both the wet and dry seasons was adequate before and after transfer. In one scheme (Nachchaduwa) about one-third of the farmers in the head-reach and about 25 percent of those in the middle and tail-end areas reported that water supply had worsened after transfer. Farmers attributed the worsening of water supply to the poor quality of work done during rehabilitation, prior to management transfer. The responses of a majority of farmers in both schemes

[7]Transaction costs are costs such as travel costs and the time involved in visiting the agency office to make the payment.

[8]The Government of Andhra Pradesh transfers 90 percent of the revenue from water charges to WUAs (Raymond Peter 2000a).

were similar with regard to the timeliness of water supply, fairness of distribution and the frequency of conflicts over water distribution, namely, that these had not changed significantly after transfer. What was negative or positive before remained so afterwards.

In the Mula and Bhima schemes in Maharashtra, IMT has been beneficial for water distribution. Although field data indicated that there was no difference between transferred and non-transferred minor canals, in terms of the amount of water delivered per hectare, farmers in the canals transferred to WUAs clearly believed that water distribution had improved following transfer and that they had better access to water when needed; whereas, a majority of farmers in the non-transferred minors were dissatisfied with the irrigation service (Brewer et al. 1999b). The differences in farmer perceptions between the transferred and non-transferred canals clearly indicate that the adequacy, reliability and fairness of water distribution have improved after transfer.

In Nepal, in both the surface irrigation systems and the groundwater schemes, farmers reported that the adequacy and timeliness of irrigation water was better in transferred minors. In both locations a higher proportion of farmers in the transferred minors reported that water distribution is much fairer now than before. Farmers in the transferred minors face less difficulty to get assistance of WUAs.

The responses of farmers in the Indonesian study sites gave a mixed picture of the impact of IMT on the quality of irrigation service. In three schemes a majority of farmers interviewed reported no change in water adequacy after turnover, some farmers saying it was adequate both before and after turnover, and others claiming it was inadequate before and afterwards. In one scheme (Kaliduren) the majority of farmers reported an improvement in water adequacy after turnover. Farmer perceptions about the fairness of water distribution were more positive. A majority in all four systems perceived that water distribution was either fair before and after turnover or was unfair before turnover but had become fair afterwards. In all four systems, between 60 percent and 80 percent of farmers interviewed perceived that the frequency of water-related disputes among farmers in the system had decreased after turnover. Only a very small number of farmers in any of the systems reported a worse situation after turnover. Regarding timeliness of water deliveries, the majority of farmers reported no change. In one scheme (Kaliduren) 55 percent of farmers reported an improvement in the timeliness of water delivery after turnover. Another 40 percent reported satisfactory timeliness before and after turnover.

The results from the Mexican case studies showed that that there has been very little impact on water management and use as a result of irrigation management transfer in ARLID. This is because the water allocation and irrigation scheduling practices have not changed since the WUAs took over these tasks from the agency (Kloezen et al. 1997). Similarly the results from the Colombian schemes showed that management transfer by itself did not bring about any clear and significant changes in the quality of irrigation operations (Vermillion and Garcés-Restrepo 1998).

3.2.1 Maintenance of irrigation facilities

The outcomes of maintenance investment after transfer were assessed by detailed field inspection of the full length of main canals, a sample of distributary canals in each scheme, and all structures along these canal reaches. Field inspections were carried out in the two schemes in Sri Lanka, in the selected minors in the two Indian schemes, and in the four systems selected for study in Indonesia. In Nepal the impact of IMT on maintenance was assessed in terms of farmer perceptions of the conditions of canals before and after transfer.

Field inspections in the two schemes (Nachchaduwa and Hakwatuna Oya) in Sri Lanka where IMT programmes had been implemented showed that only 5 percent of all structures in both locations were dysfunctional. In both schemes more than 60 percent of the dysfunctional structures at the distributary level had been dysfunctional for less than one year. In one scheme 72 percent had been in that state for less than 2 years; in the other location this was 94 percent. There were no indications of significant long-term deferral of maintenance by farmer's organisations in Hakwatuna Oya. However, in Nachchaduwa, 5 of the 18 dysfunctional structures (28%) had been dysfunctional for 3 to 4 years. Farmer perceptions of the quality of maintenance are more negative in Nachchaduwa than in Hakwatuna Oya. In Nachchaduwa nearly 60 percent of all farmers interviewed felt that the functional condition of the canal system was worse after management transfer. This implies extensive farmer dissatisfaction with the rehabilitation, which was done without farmer participation.[9] In Hakwatuna Oya farmers were more evenly split in their views about whether the functional condition of canal infrastructure was better or worse after management transfer.

In the two Indian sites the physical condition of the transferred canals was better than that of the non-transferred canals. The non-transferred canals were found to have more defects than the transferred canals. This is attributed to the fact that the maintenance needs are identified by the farmers who use the canals daily, and also because WUAs handle only one canal they are able to put in more management attention (Brewer et al. 1999b).

In the West Gandak scheme in Nepal, field inspections revealed that the transferred minors were better maintained than the non-transferred canals. Similarly the condition of structures and pumps in the transferred tube wells systems were better than the non-transferred systems.

Evidence from the Indonesian sites indicates that after turnover farmers have not begun to invest in the long-term maintenance of the irrigation systems. The conventional pattern of farmers deferring some maintenance costs until the government might return with external assistance for rehabilitation has apparently not been overcome by turnover. Water user association leaders interviewed in all four systems reported to researchers that they expected that the government would return within 5 years time to finance another rehabilitation of their system.

In Mexico, one of the most positive impacts of the IMT programme in ARLID has been the considerable improvement in maintenance services, especially at lower system levels. This is attributed to a better match between actual expenditures and farmers' perceived needs, especially in the field of maintenance since the implementation of IMT (Kloezen et al. 1997). The results from the Colombian case studies show that, with some exceptions, the transferred schemes' maintenance standards are satisfactory and the schemes appear to be physically sustainable.

3.3 Agricultural productivity

The relationship between IMT and agricultural productivity levels is less direct than the other performance measures considered earlier. But the ultimate test of any intervention in the irrigation sector is that it should lead to improvements in agricultural production. It can be argued that, with the implementation of IMT, the shift of primary responsibility for water distribution to WUAs leads to improvements in the quality of the irrigation service, and results in improved cropping intensities, while encouraging farmers to use more inputs due to greater confidence in the irrigation service, which in turn would lead to higher yields.

3.3.1 Crop yields

In Sri Lanka, the trend in paddy yields in 50 schemes over a 10-year period 1985-95: 5 years before and 5 years after were analysed using a regression equation with paddy yield per hectare as the dependent variable. The analysis was done separately for rehabilitated and un-rehabilitated schemes, with and without IMT.

The results indicate that, in the pre-IMT period, paddy yields in the rehabilitated schemes, irrespective of whether they have been transferred or not, showed a declining trend. In the post-IMT period, there is a statistically significant upward shift in paddy yields in the group showing the effects of both rehabilitation and management transfer. There were no significant changes in trend in the schemes that had been rehabilitated but not transferred, or those that had been transferred but not rehabilitated. In the post-IMT period, paddy yields in the group without either form of intervention show a statistically significant declining trend when compared to the pre-IMT period. The conclusion that emerges from the analysis is that there has been a significant improvement in yield in the schemes that have undergone both management transfer and rehabilitation. Paddy yields in schemes with only one type of intervention, and those with neither of the two forms of intervention show a significant declining trend.

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[9] Construction activities under the rehabilitation programme were carried out by private contractors. Farmers claimed that the contractors were inadequately supervised by agency personnel.

Evidence from the Indian case study relating to improvements in agricultural productivity is mixed. Results show that farmers in the transferred minor canal (Minor 7) in the Mula scheme had realised improved crop yields. They had also increased the irrigated area and also shifted to higher value crops (sugar cane). Whereas in the non-transferred minor canal (Minor 6) there has been a decrease in the irrigated area and no significant changes in yields or cropping pattern. In the Bhima scheme, there was no significant difference in crop yields between the transferred and non-transferred minors.

The evidence from the Nepali study sites is also mixed. Yields of wheat and paddy in the transferred Palhi minor have been increasing over the last 3 years and sugarcane is not grown at all. There are no significant differences in aggregate yields of major crops in transferred and non-transferred minors. In the Indonesian schemes too there was no difference in the trend in paddy yield between transferred and non-transferred schemes.

In Mexico, yields of major winter crops (wheat and barley) had been increasing before IMT and that continued in the post-transfer period. The increasing trend was attributed not merely to IMT *per se* but to a combination of other macro-economic policy reforms, especially the price polices that were introduced in the 1980s. In Colombian study sites there were no appreciable change in yields of major crops following transfer.

3.3.2 Cropping intensities[10]

Regression analysis of the trends in cropping intensities in the 4 groups of irrigation schemes in Sri Lanka indicates that there are no significant differences in the trends in cropping intensities in any of the four groups of schemes in the periods before and after transfer.

In the Indian schemes cropping intensity in the transferred minor canal in the Mula command had shown an increase whereas it had declined in the non-transferred minor canal. In the second location (Bhima) there were no changes in the cropping patterns in either the transferred or non-transferred minors.

Field studies conducted in two schemes (Cinangka II and Cipanumbangan) in Indonesia showed that there was no significant difference in cropping intensity before and after IMT (Vermillion et al, 2000). Similarly in West Gandak in Nepal, which had been brought under joint farmer-agency management in the 1990s, cropping intensity had been static from 1992 –1996 the period for which data are available (Samad et al. 1999).

In Colombia only one scheme (RUT) had significant improvement in cropping intensity at the time of transfer and afterwards. The cropping intensity rose from 110 percent to 160 – 170 percent after transfer. In the other schemes there was a slight downward trend in the post-transfer period.

4. Conclusions

For the last two decades IMT has been a major policy in most Asian countries. Although there is a vast literature on the subject, no clear paradigm has yet emerged about the impacts of the efforts made to date. This paper is an attempt to obtain insight into the impacts of IMT on the performance of irrigation schemes.

The analysis suggests that there is not enough unequivocal evidence regarding the extent of change. The main change has been a gradual decline in government financing of O&M of irrigation systems. In some cases (e.g., Sri Lanka), there was a decline in the trend in government's recurrent expenditure on irrigation before IMT and the same trend continued after transfer. There are also indications that, at present, WUAs are making only a modest contribution towards maintenance. This raises concerns about the long-term sustainability of the irrigation systems in the absence of adequate investments to ensure that the systems remain functional.

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[10]Cropping intensity here is defined as the ratio of the actual area cultivated under irrigation and the irrigable area that was considered to be the design area.

There is no discernible evidence of the impacts of IMT on system operations and agriculture production. Evidence relating to agricultural productivity is mixed. The Sri Lankan study suggests that significant effects on agricultural productivity levels can be observed only where both management transfer and rehabilitation occur. But a paucity of data limits our ability to make a compelling analysis and generalise about IMT impacts. In Mexico and Colombia, management transfer prompted a number of managerial changes aimed at improving management efficiency and staff accountability in the districts. Transfer resulted in a significant shift in the burden of cost from the government to farmers, which has generally been accepted by farmers. But transfer has not had substantial impacts on the performance of operations and maintenance, or on the agricultural and economic productivity of irrigated land or water – neither improving negative performance nor causing detriment where performance is positive.

The evidence from Mexico and Colombia suggests that it may be relatively easier for governments in richer countries with a more prosperous agricultural sector to implement IMT programmes. Farmers in these countries are able to bear the additional costs of financing irrigation services and are able to put in place institutional arrangements that are more effective than government management systems. Turkey is another recent example of this category of countries.

There is a clear need for comprehensive and long-term monitoring of the impacts within the framework of IMT, requiring collaborative effort involving the direct stakeholders, governments, international financing institutions, and local and international research organisations. More systematic research methods need to be applied with enough commonality to permit conclusions about impacts and to specify policy and institutional conditions under which IMT programmes could be expected to succeed or not.

There are signs that IMT has lost the momentum of the early 1980s. One of the primary reasons, as identified by Easter (2001) in a recent article, is the high transaction cost of implementing an IMT programme on an extensive scale. The more recent success stories are those, which were financially supported by international donor agencies. Where external support is absent the progress of implementing IMT has slowed.

This should not discount IMT as an appropriate institutional intervention for improving the performance of irrigation schemes. At the same time one should not be evangelical about the merits of reform, but rather find ways to implement IMT programmes in a more cost-effective way. Research is also required to develop appropriate institutional arrangements which are compatible with socio-economic contexts, foster inter-sectoral linkages, safeguard the interests of disadvantaged groups and provide effective accountability and incentives for management.

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Commercial irrigation farming
L'agriculture irriguée commerciale

A. A. Gyamfi

Abstract

Commercial irrigation farming in Ghana can be better understood to involve farming companies or group farmers, able to produce on a continuous and sustained basis under irrigation and to supply their markets regularly, rather than by reference to the number of hectares irrigated. The large-scale farmers operate not more than 400 ha each for fruit crops like pineapples, papaya and banana; while the more popular scale is 25 ha and below, dominated by vegetable producers. Commercial irrigation is gaining ground in Ghana because of the attraction of the export market and its foreign exchange earnings, and the gradual improvements in local markets as a result of demand from agro-processors and expanding restaurant and catering businesses. Investment in commercial irrigation, however, is slow because of constraints such as high interest rates, land acquisition, high cost of investment in machinery and equipment, poor road network and the absence of providers of irrigation equipment and services in the country. Under the constraints, however, some companies such as Jei River Farms Limited and Volta River Estate Limited, have managed to operate successfully. The public and private sectors need to come together to resolve problems quickly to facilitate more investments in commercial irrigation.

Résumé

L'agriculture commerciale au Ghana peut être mieux décrite en termes de la capacité des entreprises agricoles ou des groupes d'agriculteurs de produire et de satisfaire les besoins de leurs marchés d'une manière continue et soutenue, plutôt qu'en termes de nombre d'hectares irrigués. Les plus grandes exploitations qui produisent des fruits tels que l'ananas, la papaye et la banane ne dépassent pas les 400 ha ; mais la taille de la plupart d'exploitations maraîchères est inférieure à 25 ha. On assiste à une croissance de l'agriculture commerciale au Ghana attirée principalement par les possibilités d'exporter et de gagner les devis étrangers mais aussi encouragée par une expansion des marchés locaux, conséquence des fortes demandes de la part des secteurs de la restauration et de l'hôtellerie et de l'industrie de transformation des produits agricoles. Cependant, les investissements dans l'irrigation privée restent lents en raison de nombreuses contraintes : taux d'intérêts élevés, insécurité foncière, coûts onéreux d'équipement, mauvaise infrastructure routière, et absence des services d'appui conseils en irrigation. Malgré ces difficultés, certaines entreprises comme Jei River Farms Limited and Volta River Estate Limited, ont réussi. Il est donc important que les secteurs public et privé se mettent ensemble pour aborder et résoudre ces problèmes et de promouvoir plus d'investissements dans l'irrigation commerciale.

1. Introduction

The non-traditional export crop industry embraces small, medium and large producers. Some of them have had to install various systems of irrigation to ensure maximum, sustained, quality production to satisfy market demand and make a good return on investment. The increasing number of medium to large irrigated commercial farms is the result of exposure to the overseas market and the expanding local market. However, the export market and the emerging agro-processors are the major attractions for investment in commercial irrigation.

To satisfy demand and various requirements of the markets, irrigation is adapted to:

- Achieve high on-farm performance.
- Ensure sustainability of crop production.
- Ensure production of quality products.
- Ensure consistent and timely delivery to the market.

- Attract, enter and maintain favourable and reliable markets;
- Sustain the business as a whole.

There would have been many more irrigated medium to large-scale farms, but for several major constraints (e.g., land and infrastructure) encountered by investors, which will be the main target of this paper.

2. Crops and markets

2.1 Crops

In the 1980s several Ghanaian entrepreneurs undertook studies of the overseas markets for possible entry into them. The effort was purely private initiative, a trend which has continued until now. The contribution from the public sector has been minimal. The studies led to the identification of a limited number of crops which are currently being produced primarily for export, and for the local market. The leading crops are pineapples, papaya, bananas and vegetables and coming up are mangoes, cashew and passion fruit.

2.2 Export market

The attractiveness of especially the European Union market is luring local and foreign investors into the export crop business on regular basis. Importers are also interested in Ghanaian produce because of price competitiveness and freshness. The nearness of the West Coast of Africa to Europe offers short shipment transit period, hence lower freight costs, shorter storage period, and longer shelf life of produce. Ghana has many advantages over several of her competitors and must, therefore, make the best of the opportunities available. While the private investor is working hard in this direction, there is the urgent need for the provision of appropriate public support, for full realisation of the potential benefits available.

2.3 Local market

The local market for export crops is expanding daily as a result of:

- Increasing population and urbanisation;
- Expanding business in trade and tourism;
- Growing demand for restaurant and catering services;
- Establishment of agro-industries.

The two markets, export and local, serve as good incentives for investors to put their money into irrigation projects.

3. Irrigation systems

Furrow, flood, sprinkler and drip irrigation systems are being used by farmers in Ghana. While the first three have been in practice for a very long time, the drip system was introduced toward the end of the 1980s and gained popularity in the 1990s.

Individual investors install systems best suited for their crops. However, the drip has turned out to be the most popular of all the systems because of the far better economic returns it offers farmers. The standard sprinkler types are also giving way to mini- or micro-sprinklers. The relatively high initial cost of installation of drip and mini-sprinkler systems has, for now, made commercial farmers the only ones patronising these types. The small-scale farmers continue to use the old systems.

4. Commercial farmers

It is not all the major commercial farmers in the export sector that use irrigation. The big operators belong to the pineapple and papaya groups. Since plastic mulch was introduced in pineapple production those who used irrigation on that crop, e.g., Gabro, have stopped. Tongu Farms, however, continues to irrigate its pineapples. The companies using irrigation can be divided into two major groups, namely fruits and vegetables. The fruit-producing companies such as Jei River, Paradise, Denlarry and Pawpaw Farms have papaya as their major crop, but some also handle crops such as passion fruit. All of them use the drip system. Some farming companies doing vegetables on commercial scale are Tacks, Param, Sweat, Vitanova, Motherwell, Gabro, Villa Dev and Debs Farms. Among these it is only Tacks and Gabro who use drip irrigation. The rest use standard sprinklers. The only banana producer, Volta River Estates uses mini-sprinklers.

The leading producer of papaya is the Jei River Farms. The company is so successful that, in addition to papaya it also accounts for about 30 percent of total pineapple exports. In 1999 Ghana exported 33,400 tons of pineapples worth US$13 million.

Jei River Farms has achieved the leadership as a result of high financial investment in the farm and high level of managerial capability. Similarly Volta River Estates has also distinguished itself as the only producer/exporter of bananas. Volta River Estate might have done better if the issue of the EU market quotas had not placed restrictions on the company's exports earlier on.

5. Investment in commercial irrigation—constraints

The experiences and successes of the pioneers in commercial irrigation continue to inspire potential investors. With irrigation Ghana would have:

- Exported about twice the current volume of fresh produce;
- Earned more than three times the value of the exports in foreign exchange;
- Had many more people gainfully employed;
- Alleviated poverty among a fairly large population, and realised several other benefits if the problems discussed below could have been resolved.

The major impediments to medium/large-scale irrigation are many. The more important ones are:

- High cost of capital;
- Accessibility to land;
- Technical and managerial capability;
- Roads;
- Supportive infrastructure;
- Provision of irrigation services;
- Marketing.

5.1 High cost of capital

The high interest rates on agricultural loans have been discussed so often that it is mentioned here only to serve as a reminder. Investment in an irrigation project requires long-term financing. The high cost of finance readily puts off potential investors. Loan facilities from foreign sources which are operated in hard currency are attracting some exporting companies to make investments through such funds. However such foreign loans are not easily accessible to the average Ghanaian farmer.

5.2 Accessibility of land

Access to land is a very important constraint for investors in most areas of agriculture, from farmlands to sites for agro-industries. Getting a suitability large parcel of land with a reliable source of water is not easy. When the land has been identified and selected as suitable for the project, then comes the issue of acquisition of the land. The intricate processes one must pass through to get land registered in one's favour have been a nightmare to many potential investors. Enormous difficulties are encountered in dealing with the land-owners (chiefs and family members), lengthy time delays, inflated fees to be paid to current users of the land, tips supposedly required to move things faster and the eventual paper work at the lands department. Many potential foreign investors have abandoned their projects in the course of acquiring land.

The steps being taken by the Government of Ghana to acquire and establish land banks will go a long way to solve these problems. Ghana can take note of the significant role foreign investment has played in the rapid growth of Cote D'Ivoire's agricultural exports, because it is much easier to acquire land in that country. It is hoped that the issue of irrigation will come foremost in the selection of sites for the land banks.

5.3 Technical and managerial capability

Many irrigated commercial farms do not have personnel with the requisite skills to operate and manage the farms. Irrigation requires specially trained field personnel; however, they are not available for several of the companies mentioned above. Farms operating with people without training are estimated to produce about 30 percent less than the more productive farms. The well-organised farms either bring in trained personnel from elsewhere or have the irrigation service-provider train them.

In addition to irrigation is the actual management of the farm as a business. The agricultural institutions need to lay more emphasis on farm management as well as having business management as part of the agricultural training curriculum.

5.4 Feeder roads

Most of the irrigated commercial farms are sited near Accra, for getting products either to the airport or the harbour on time and minimising damage due to the poor feeder-road network. The feeder-road system in the country places a major constraint on access to some of the best crop producing areas. Poor quality roads make transportation difficult for serious investors to reach those areas in the middle belt and northern part of Ghana, where better soils and more favourable ecological conditions for production exist. Developing more and better-quality feeder roads could positively influence investors in the development of more irrigation projects.

5.5 Supportive infrastructure

In addition to roads, fresh-produce farmers require trade support, infrastructure and services to handle their products efficiently. Many investors, especially foreign ones, have had to abandon their projects because of the absence of such facilities as cold chains (to increase shelf life between harvest and sale), and adequate and efficient port handling facilities. For example, the export shed at the airport is so small that all the handling of highly perishable fresh produce is done in the open and at the mercy of the elements.

5.6 Provision of irrigation services

Apart from Dizengoff, there are no companies selling irrigation equipment and servicing it on a regular basis. Investors usually buy the systems from abroad. The supplier comes down to do the installation and goes back to his country after training some personnel on the farm to operate the system. The absence of dealers in irrigation equipment on the scene makes it difficult, especially for local investors, to peruse their proposed projects and to service systems already installed.

5.7 Marketing

Companies like Jei River Farms, Volta River Estates, Paradise Farms, etc., are making steady progress because they sell on good and reliable markets. These companies are well connected on the market because they:

- Employ high levels of professionalism in their operations;
- Export good quality produce;
- Maintain consistency in supply;
- Are able to deliver on time.

On the other hand commercial farmers especially in the vegetable sub-sector are making very slow progress and in several cases retrogressing because of difficulties encountered in marketing. Firstly, the absence of a cold chain (a series of field heat extractors, refrigerated vans and cold storage facilities) to reduce the rate of spoilage after harvest restricts producers from dealing with the more reliable buyers who normally insist on handling produce through such a system.

Secondly, the serious buyers, e.g., packers for supermarkets, generally are large volume dealers. Individually none of the vegetable producers is able to satisfy such buyers. Unfortunately, however, each company prefers to export on its own. Attempts to have them come together to generate the critical mass required for entry into this type of market have so far not been successful. The commercial vegetable producers are, therefore, reduced to exporting to importers who supply the small street corner shops. Many of these importers are unscrupulous and have very doubtful payment records. The vegetable exporters have lost and continue to lose high amounts of precious earnings through the offer of very low prices, short payment and non-payment by their importers.

6. Conclusion

The advantages of irrigation are obvious to every farmer and by now larger areas of land should have been under irrigation. It is a combination of the constraints enumerated here which may prevent an entrepreneur from investing in irrigation, and may restrict the expansion of some of the existing facilities. To enhance investments in commercial irrigation the private and public sectors must sit together to address these problems. Jei River Farms, Volta River Estates and others have amply demonstrated that success can be achieved in commercial irrigation in Ghana. The rest of us can follow their example.

A case study of the Volta River Estates Limited (VREL), Ghana

Etude de cas du Volta River Estates Limited (VREL) Ghana

S. K. Agodzo and A. K. Blay

Abstract

Irrigation system performance of Volta River Estates Limited (VREL) was assessed, based on the objectives of production and productivity, profitability, sustainability and enhancement of the quality of life. Under the Dutch-based Fair Trade Labelling Organisation (FLO) International, VREL produces banana for the European market. The method of irrigation changed from high pressure, raingun sprinklers through to micro-sprinklers. A drip system was experimented but discontinued. Banana yields average about 9,000 tonnes/annum covering an area of 280 ha. Currently about 10—15 percent of production goes to the local market. Productivity of water is high: in crop terms, 3.56 kg/m^3, and in gross product value terms, 167 US cents/m^3. Profitability could not be determined due to privacy of certain information, but there are indications that the venture is profitable. The fair trade price for the banana is about US$8.50 per carton of approximately 18 kg, attracting a premium of US$1.75 per carton, which goes into a fund managed by workers and management representatives for mutual benefit. Economic sustainability of VREL will depend on a favourable national macro-economic environment and continued operation of the fair trade system in favour of relatively small operations as this. At the current borrowing rate of up to 50 percent for agricultural production ventures in Ghana, access to capital is difficult. Social sustainability under the fair trade concept guarantees that workers receive their due benefits from such a venture. The concept provides for enforcement of environmental conservation measures. VREL has contributed to satisfying certain non-agricultural objectives, such as improving the quality of life of participants and providing social amenities for local communities.

Résumé

Les performances des périmètres irrigués de Volta River Estates Limited (VREL) sont évaluées selon les critères de production, productivité, profitabilité, durabilité, et amélioration de la qualité de vie. VREL produit des bananes destinées aux marchés européens en conformité avec les normes de Fair Trade Labelling Organisation (FLO) International du Pays-Bas. La méthode d'irrigation a évoluée de l'aspersion à haute pression vers les micro-asperseurs. Un système d'irrigation goutte-à-goutte a été testé mais a du être abandonné. Les rendements de banane varient entre 9000 tonnes par an sur une superficie de 280 ha. Actuellement environ 10 à 15 pourcent de la production arrive sur le marché local. La productivité de l'eau est élevée : 3,56 kg/m^3, soit US$1,67/m^3. Il n'a pas été possible de déterminer la profitabilité en raison de la nature confidentielle de certaines informations mais toutes les indications font croire que l'entreprise est profitable. Le prix de banane est d'environ US$8,50 par carton de 18 kg et il attire une prime de US$1,75 par carton qui est versée dans un fonds de solidarité géré par des représentants des travailleurs et des gérants. La durabilité économique du VREL est tributaire d'un climat macro-économique favorable et du fonctionnement continu du système 'fair trade' en faveur d'entreprises relativement modestes comme celle-ci. Des entreprises de production agricole ont d'énormes difficultés d'accéder au capital d'investissement étant donné le taux d'emprunt actuel très élevé d'environ 50 pourcent. Cependant, le concept 'fair trade' offre aux travailleurs le garanti de pouvoir tirer leur part des bénéfices générés par de telles entreprises et encourage l'adoption de mesures de conservation de l'environnement. VREL a également contribué à la réalisation d'objectifs non-agricoles tels l'amélioration de la qualité de vie des participants et la mise en place des infrastructures sociales au bénéfice des communautés locales.

1. Introduction

Irrigation schemes in Ghana cover a wide range of sizes, technologies and organisational arrangements. In terms of size and as with most schemes in West Africa (Sally 1994), the schemes may be classified as small (< 50 ha), medium (between 50 and 500 ha) and large (> 500 ha). Furthermore, they could be gravity schemes (e.g., Bontanga, Sata) or pumped schemes (e.g., Tanoso, Weija) and to a large extent, reservoir-based (e.g., Dawhenya, Tono). These examples are the formal-sector, modern forms of irrigation, with more sophisticated forms of water control. The statistics are that these cover only about 10,000 ha (Agodzo 1998) of the nation's farmland, even though the irrigation development potential could be even up to 500,000 ha (Agodzo and Bobobee 1994).

But there are also traditional, private-initiated forms of irrigation (e.g., Anloga, Bawku, Ada), developed with local resources and materials over a long period, and with partial or no degree of water control. Lately, some of these traditional schemes are receiving very limited external support but such support could well be described as insignificant. There are hardly any statistics on the extent of informal irrigation activities in Ghana.

There is also another group of irrigation practitioners that are engaged in more modern and highly sophisticated forms of private-sector, export-led irrigated farming of non-traditional export crops, an example of which is the irrigated banana estates of Volta River Estates Limited (VREL) in the Asuogyaman District of the Eastern Region of Ghana.

Defining performance as the degree of achievement of desirable objectives, the performance of an irrigation system cannot be meaningfully carried out unless its objectives have been clearly defined (Sally 1994). The objectives may be diverse and will vary depending on the perspective of all the stakeholders in question. General long-term national objectives such as attaining food self-sufficiency, contributing to food security and reducing poverty are well known but these objectives are often not explicitly translated to measurable system-level targets such as total annual production, productivity of land and water, cropping intensity, farmers' income and the like (Sally 1994).

Even though actual system-level objectives would depend on the specific physical, economic and social environments, Abernethy (1989) proposed that irrigation system performance could be assessed based on the objectives of *production and productivity, profitability, equity, sustainability and the enhancement of the quality of life*. Crop yields per unit area or per unit volume of water used are the most frequently used indicators of production and productivity. Profitability suggests whether the value of the outputs is commensurate with the costs of material and management inputs needed to produce them. Equity also suggests whether all stakeholders are deriving benefits from the irrigation on a fair basis. Economic, social and environmental sustainability are also required if the system will keep running for a long time. An irrigation system can also contribute to satisfying certain non-agricultural objectives, such as improving the quality of life of all participants.

In view of the discussion above, this paper, therefore, seeks to assess the performance of the VREL in terms of its production and productivity, profitability, sustainability and its enhancement of the quality of life.

2. The study

2.1 Study methods

The study methods included a desk study involving the review of relevant literature, the interview of key stakeholders of the project, and physical observations at the farm and the fruit handling and packaging unit. In addition to assessing the total irrigation water applied, the energy required to deliver the water and the labour costs of the operations were also assessed.

2.2 The study area: Background and natural resource base

VREL was established as a private, Ghanaian-Dutch joint venture in 1988 with the assistance of the Dutch Financiering Company (FMO). It was developed under the Ghana Government Medium Term Agricultural Development Programme (MTADP), which was initiated as part of the Structural Adjustment Programme (SAP) to promote the export of non-traditional goods, especially in the agricultural sector.

After VREL was established in 1988, its operations collapsed in 1990 as a result of *black sigatoga* disease. It was restarted in 1993 under a new management and with loans from the Agricultural Development Bank and later the Dutch Development Bank/FMO. The company is now a Ghanaian/Netherlands partnership, with holdings in the proportions of 35: 65 approximately. The 35 percent Ghanaian holding is shared between the workers (25%) and the local private sector (10%). All profits are repatriated to Ghana to pay off loans, but up to 15 percent of total earnings are retained abroad for purchasing and importing items necessary for the company's operations.

The company began to export again in 1994 under its own *Ghanapack* label and only then discovered that it had to pay a licence fee to access the EU market. In 1996, VREL established contact with the Dutch NGO *Solidaridad,* which had played an important part in establishing the *Oke/ Max Havelaar* foundation, under the umbrella organisation Fair Trade Labelling Organisation (FLO) International, for promoting fair trade of developing-country products.

Located in the Asuogyaman district of the Eastern Region of Ghana, VREL largely operates a total landholding of 280 ha (2000 figure) of banana plantations at four sites, namely:

- Atimpoku (30 ha).
- Akwamufie (60 ha).
- Senchi (90 ha).
- Akuse (100 ha).

These are located on the banks of the Volta river, which provides a reliable source of water for irrigation. The average climatic conditions based on Akuse conditions (1961-1990) are summarised in Table 1.

Table 1. Average climatic conditions at Akuse, 1961-1990.

Month	Average temp. (°C)	Relative humidity (%)	Wind velocity (km/day)	Sunshine (hours/ day)	Solar radiation ($MJ/m^2/day$)	ET_o (mm)	Rainfall (mm)
January	27.7	69	78	6.5	17.7	111.6	13.7
February	29.3	70	112	6.8	19.2	123.2	51.3
March	29.4	73	121	6.7	19.8	142.6	89.9
April	29.0	76	104	6.7	19.8	135.0	125.3
May	28.1	80	86	6.8	19.3	130.2	147.3
June	26.0	81	86	5.1	15.6	102.0	195.9
July	26.0	82	121	4.5	16.1	105.4	90.1
August	26.0	80	112	4.5	17.0	108.5	52.9
September	26.6	81	104	5.0	19.3	108.0	135.4
October	27.1	82	78	6.8	19.4	124.0	127.2
November	27.6	80	69	7.5	17.8	120.0	79.4
December	27.1	75	60	6.8	17.3	114.7	24.5
Mean/Total	27.5	78	94	6.1	18.2	1,425.2	1,132.9

Source: Ghana Meteorological Services Department; Kwedza (1998).

Monthly estimates of dependable rainfall, by Kwedza (1998), are shown in Table 2.

Table 2. Dependable monthly rainfall at Akuse.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.0	17.9	56.9	68.7	89.5	131.4	40.6	13.5	81.1	89.1	46.7	8.7

Source : Kwedza 1998.

Apart from the Akuse site, the natural vegetation at the other three sites consists of riverine forest vegetation. The soils are the heavy dark clays usually referred to as the Akuse series, with high water-holding capacities of up to 220 mm per meter depth of soil and average dry bulk density of about 1.0 g/cm^3. Even though average wind conditions cannot be described as strong, occasional storms can result in the destruction of farm produce.

3. Performance of VREL

3.1 Production and productivity

VREL is a Ghanaian registered commercial plantation company that has been producing bananas for the European fair trade market under the *Oke/Max Harvelaar* label since 1996. It currently has 280 ha under production, employing 720 full-time workers and staff.

Principal data about the inputs of water, labour and expenditure in year 2000 are shown in Table 3.

For year 2000, total available water (irrigation plus effective rainfall) for the growth period ranged from nearly 1,300 mm at Akuse to as high as nearly 2,000 mm at Senchi. At Senchi nearly half came from rainfall and the other half from irrigation. Irrigation requirements for year 2000 were highest at Akwamufie (1,000 mm) and lowest at Atimpoku (700 mm). The method of irrigation varied from high pressure, rain-gun sprinklers through to micro-sprinklers. Nkansah (2000), in an energy audit study of VREL, computed total electrical energy cost for the pumping operations as nearly ¢60,000/ha/week (1999 figure).[1] Two types of centrifugal pumps are used for the supply of water and have the following characteristics: 140 m^3/hr discharge and 65 m head; 190 m^3/hr discharge and 70 m head. A drip system was also experimented but was discontinued.

Banana yields, as indicator of production and productivity, average at about 9,000 tonnes/year from the area of 280 ha. This is equivalent to 32,100 kg/ha. The average irrigation water supplied at the four sites (Table 2) is 902 mm, or 9,020 m^3/ha. The productivity of water, in crop terms, is therefore 3.56 kg/m^3.

The value of the bananas (price received by the company) is $8.50 for a carton of18.14 kg, which means 46.9 US cents/kg. The gross product value obtained per cubic metre of irrigation water delivered is thus 3.56 x 46.9, which is 167 cents/m^3, a high figure for financial productivity of agricultural water according to current international comparisons.

An additional 60 ha is to be put under production before the end of 2001 as organic production using under-canopy sprinklers. If successful, this organic pilot will pave the way for conversion of the entire estate to organic farming. For the 2000 production year, total labour cost per ha per annum could be as high as ¢396,000 at Akuse. Minimum wage stands at about ¢8,300 per day, additional to payment of taxes, social security benefits and free medical care. Currently about 10–15 percent of the banana produced goes to the local market.

Table 3. Irrigation water, rainfall, labour input and labour cost for year 2000.

Farm Site	Irrigation water (mm)	Effective rainfall (mm)	Total available water (mm)	Labour input (hrs)	Labour cost (¢/ha)
Atimpoku	708	696	1,404	19,022	396,293
Akwamufie	1,009	738	1,747	21,656	225,584
Senchi	988	972	1,960	26,798	243,374
Akuse	904	355	1,259	31,868	284,559

Source: VREL Records; Blay (2001).

Management comprises a management team made up of the General Manager (Agriculture) and the Director of Operations, a Chief Accountant, Quality Control Manager, four Farm Managers, Personnel Manager and an Export Manager. Production and export sites are divided into plots under a plot headman. The plot headman is under the farm manager. Each site has its own packing station, with cableways to facilitate harvesting. Harvesting, packing and shipping are done once a week throughout the year, with cartons palletised onto refrigerated 40-foot containers that are shipped from Tema. The journey to Europe takes up to 25 days. This is because the only available shipping

[1]The average bank exchange rate of the Ghanaian *cedi* (¢) in recent years was approximately as follows: in 1999, US$1 = ¢2,750; in 2000, US$1 = ¢5,410; in 2001, US$1 = ¢7,265.

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vessel calls at various West African ports before reaching Rotterdam, the final destination of the cargo. This causes quality problems. The volume of bananas does not justify the use of reefer vessels which would reduce costs and voyage time. But VREL has installed pre-cooling systems to improve quality. Air-freight could further reduce voyage time but the costs are much higher and uneconomical for the current volume of banana exported.

VREL's focus on banana exports reflects the government's policy of agricultural diversification and promoting non-traditional exports, which has led to a rise in cassava, yam and pineapple as well as Asian vegetable exports. Exports do not attract duty, and agricultural companies are VAT exempted. Exporting companies have preferential depreciation rates and can also import capital items tax-free.

3.2 Profitability

Due to the privacy of certain key information, it may not be possible to assess the profitability of VREL in this paper, but indications are that it is a profitable venture. Once a producer is registered with the FLO-Banana Register, one of which is the *Max Havelaar* Foundation, it can sell to an importer that has a licence to use a fair trade label. In the case of VREL, it sells to *Agrofair* that markets fair trade bananas under the *Oké* label. Under the fair trade system, the International FLO-Banana Register sets a country FOB price based on what it costs producers to operate profitably while meeting pre-set social criteria for the workforce. For Ghana, the fair trade price *Agrofair* must pay to VREL is US$8.50 per carton, of approximately 18.14 kg or 40 lbs.

The retail price of bananas on the fair trade market is typically higher than the mainstream market, sometimes by as much as 50 percent. This is partly due to the minimum price producers are guaranteed, and partly because consumers pay a premium of about 9.6 cents per kg (US$1.75 per carton). The premium goes into a fund managed by a committee comprising workers and management representatives, with workers having higher voting.

At the time *Max Havelaar* foundation was starting the *Oke* label for fair trade bananas in the Netherlands, *Solidaridad* was unable to get import licences for bananas from Latin America because licence holders feared this would open the door to dollar bananas. At the same time, VREL was looking for efficient ways to lobby the EU, something that *Solidaridad* and *Max Havelaar* foundation were already doing for fair trade. As a result VREL was able to supply non-Latin American bananas and *Solidaridad* was able to help with lobbying and VREL was thus registered as a fair trade supplier in November 1996. In 1993, the company had 23 workers, 140 ha of partly uncultivated land and a host of labour and local problems. By the end of 1997, after a year of selling to the fair trade market, it had 280 ha under production, largely resolved its labour problems and was employing 900 workers. Workers of the company have a 25 percent stake in the company, being held in trust by *Solidaridad.*

However, the domestic economic situation does not favour private-sector agribusiness such as VREL. Access to credit is a common constraint to agriculture including the export sector. Only 20 percent of GADB (Ghana Agricultural Development Bank) loans are made to the agriculture sector, and for other banks the figure is even less. Loans are typically for one year or less, interest rates nearly 50 percent. Development bank loans are also difficult to access because of strict guarantee requirements, and the interest rates are often higher than could be obtained from European commercial banks using a collateral scheme such as that operated by the SGS (Société Général Surveillance). The high interest rates by the Ghanaian banks are as a result of the depreciation of the *cedi* and high inflation rate.

3.3 Sustainability

Registering as a fair trade banana producer requires that VREL meet the social and environmental criteria of the International Fair Trade Banana Producers' Register. These criteria are intended to provide a core package of social and environmental standards that will promote sustainable banana production. The social standards include rights to freedom of association and collective bargaining; anti-discrimination and equal remuneration; non-use of forced labour and child labour; defined minimum social and labour conditions of workers; health and safety. The environmental standards include protection of natural areas (biodiversity); coherent policy and practice of prevention of erosion and water pollution; controlled and reduced use of pesticides and coagulants; controlled and reduced use of chemical fertilisers; control of waste and optimisation of recycling; and environmental education.

These standards are elaborated for each producer through consultation between FLO, management and workers. The operation is then monitored by FLO, which conducts an annual in-country assessment as well as periodic monitoring operations by a local social monitor. FLO encourages continual improvement in labour and environmental performance, and also encourages plantations to implement social development programmes and worker shareholder schemes. The measures put in place by VREL to meet the social and environmental standards are explained as follows:

3.3.1 Social strategy

VREL workers are represented by the Ghana Agricultural Workers Union (GAWU), under a closed shop arrangement, where 2 percent of workers' monthly wages are deducted for union fees. There are eight union representatives per site. They have fortnightly meetings. From them, an apex committee is elected to hold discussions with senior management. Each site also has a women's representative. Workers also receive interest free loans and subsidised rice grown on VREL land as part of a Solidarity Fund set up by the company on each site and managed by the workforce. VREL provided capital for the loan funds and pays the wages of workers on the farms.

3.3.2 Environmental strategy

In addition to monitoring by the FLO, VREL is subject to environmental impact monitoring by the Environmental Protection Agency (EPA) of Ghana. It is VREL's policy to reduce chemical use. Weeding is done by hand, which accounts in part for the high number of field workers per hectare. Insecticide-impregnated plastic bags are not used to cover bunches. Chicken manure and potash is used for fertiliser. A 60 ha organic pilot is presently being established, which if successful will pave the way for the total conversion of overall production into organic. The fungicide *thiobendazol* is used on crowns prior to packing, but otherwise all cleaning is done with water using a circular (recycling) system.

3.4 Enhancement of the quality of life

VREL has created 720 (2000 figure) permanent jobs in an area where income opportunities are seasonal and limited. The vast majority of employable hands within the project area do not have the required special skills, but priority has been given to people in the vicinity of the plantation sites. It is indicative of the attractiveness of the opportunities for certain people that even those with relatively large landholdings (>1 ha) have joined the workforce. Twenty percent of VREL's workforce is women.

In line with national law, the company gives 6 weeks paid maternity leave and women are allowed back on to the sites with young children. Workers also receive an initial 21 days' annual leave, increasing incrementally after the first three years. Regular wages mean that health and education costs of family members are more likely met. VREL provides a health clinic staffed by a trained nurse for each of its sites, and refers more serious cases to the Volta River Authority Hospital at Akosombo. Workers must pay for hospital treatment and are then reimbursed by the company. This is to prevent misuse. The health service at present is exclusive to workers, because there is concern that it would be over-burdened if extended to family members. VREL is, however, considering putting up a hospital and hence would be in the position to provide free health care for spouses and a limited number of children. Workers are provided with boots and protective clothing. Each site has treated drinking water and sanitation facilities. VREL provides both formal and informal training to its staff on a regular basis.

Union representation is an important element of fair trade plantation initiatives, and all plantation workers must join GAWU under Ghanaian law. GAWU is independent of VREL management although the two have worked together, for example, on the workers' protest against EU banana quotas in Accra. A collective bargaining agreement has been in place since the beginning of 1994, and there are formal procedures for worker organisation and negotiations with management. Some may question the emphasis the fair trade movement places on unionisation, but one needs to compare the conditions of VREL workers with those on non-unionised multinational-owned estates such as in Côte d'Ivoire.

The fair trade consumer interest in bananas largely stems from the working conditions on such estates. Even prior to fair trade accreditation, VREL had a fully unionised workforce, and participation in the union has increased the responsibility and experience of many workers. Through the union and through weekly management-site worker meetings, the workforce and management have reached a reasonable level of dialogue and there is a degree of transparency that is not typical of many private companies in Ghana.

As part of enhancing the quality of life for the people, VREL also provides some social benefits for some of the communities in the project area, for example, a school for Kpong township and a computer centre for Akwamuman Secondary School.

4. Concluding remarks

VREL is the only exporter of bananas from Ghana, and in terms of the multinational-dominated global market, it is a small operation. It is also one of the two initiatives serving the fair trade market in Ghana; the other being the *Kuapa Kokoo* smallholder cocoa initiative based in Kumasi. Economic sustainability of VREL will depend, first and foremost, on a favourable macroeconomic environment of the nation and the continued operation of the fair trade system in favour of relatively small operations as this. The VREL example suggests that plantations can increase livelihood opportunities for certain groups of people without negatively affecting the natural resource base. Production for export has complemented government policy, and has been supported by various tax and other concessions. Both the estate policy decisions and the global market have favoured VREL. Nonetheless, there have been numerous failed attempts to establish large agricultural schemes in the area but VREL has at least been able to operate for 10 years. As discussed earlier, VREL workers are well placed in livelihood and income terms compared to workers in comparable positions in the area.

VREL has adopted a system of cultivation that minimises negative impacts on the environment, while increasing the productivity of the land through irrigation and crop choice. The normal problems associated with disease such as nematode attack also apply here. Wider environmental impact is monitored externally and has not been deemed negative. It is possible that VREL serves as a model for increasing the productivity of the natural resource base on a sustainable basis. Indeed, a private sector agribusiness as VREL benefiting from the technology of irrigation for banana production has, for the past 10 years, made a significant contribution to the economy of Ghana and this is worth noting.

Acknowledgements

Mr. Moïse Sonou, Senior Water Development Officer of the FAO Regional Office for Africa, commissioned this paper, for which the authors are grateful. The authors are most grateful for information provided by the VREL management for this paper.

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Micro-irrigation and the poor: A marketing challenge in smallholder irrigation development

La micro irrigation et les pauvres: Le défi du marketing lié au développement de la petite irrigation

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Abstract

The paper presents observations made during visits to three states of India (Madhya Pradesh, Gujarat and Karnataka) and to Nepal, to review micro-irrigation programmes of the NGO International Development Enterprises (IDE). These programmes focus on introducing micro-irrigation to poor and small-scale farmers, and on developing supply chains and equipment markets so that the technology will be sustainable even at the level of very poor people, including women farmers. There were varied patterns of adoption and application of the technology in the four areas. In Nepal they found eager uptake of standardised bucket or drum kits by women vegetable farmers, whose household incomes had risen substantially; but they also found concerns that local markets for irrigated vegetables would be easily saturated, bringing risk of failure through price collapse. In Gujarat two situations are noted: poor women, economically similar to the Nepali groups, but unable to utilise the technology because of greater water scarcity; and relatively new commercial lemon-growers taking it up rapidly. In Madhya Pradesh and Karnataka users grow cotton and mulberry, on a small-medium commercial scale. In both places the commercial interest has attracted other equipment suppliers into the market, which is now developing dynamically. Some (largely negative) impacts of government subsidy policies, and of “official” approval of equipment brands offered in the market, are discussed.

Résumé

Cette communication rapporte les résultats des missions réalisées dans trois états de l’Inde (Madhya Pradesh, Gujarat et Karnataka) ainsi qu’au Népal en vue d’évaluer les programmes de micro-irrigation mis en œuvre par l’ONG International Development Enterprises (IDE). Le point focal de ces programmes est l’introduction de la micro-irrigation aux petits exploitants de moyens modestes, et la mise en place de chaînes de distribution et de fournitures pour ce matériel pour que la technologie soit à la portée des personnes à très faible revenu et des femmes. Les modèles d’adoption et d’application varient selon les régions. Au Népal on observe beaucoup d’enthousiasme chez les femmes pour les petits kits d’irrigation de goutte-à-goutte ; beaucoup d’entre elles ont vu une amélioration de leurs revenus. Mais on note aussi des inquiétudes que des marchés locaux risquent d’être saturés des produits maraîchers avec effondrement des prix et la menace de faillite. Au Gujarat il existe deux situations : des femmes pauvres, dont le niveau économique est semblable à ceux de leurs consœurs au Népal, mais qui n’arrivent pas à utiliser la nouvelle technologie en raison des difficultés d’approvisionnement en eau; d’autre part, des exploitants commerciaux ont immédiatement adopté la technologie. Au Madhya Pradesh et au Karnateka la technologie est surtout utilisée sur des petites et moyennes exploitations de coton et de mure. Le potentiel commercial a suscité l’intérêt d’autres fournisseurs de matériels et le marché de micro-irrigation se développe de manière dynamique. Les impacts (surtout négatifs) des politiques gouvernementales de subvention et de l’approbation ‘officielle’ de certains marques de matériels en vente aux marchés sont également abordés.

1. Background

This paper describes the observations made by the authors during visits to sites in India and Nepal. The visits were undertaken on behalf of International Development Enterprises (IDE), which is an NGO that originated in the United States and has a substantial presence in both India and Nepal, with an emphasis of putting micro-irrigation in reach of poor smallholders. The purpose of the visits was to form some ideas about the scope for development and marketing of micro-irrigation equipment, specifically targeted towards poor smallholders, and about possible strategies for increasing the uptake of these technologies by such people.

Micro-irrigation technologies (drip- and sprinkler-based systems), first perfected in Israel during the 1960s, have spread to many other parts of the world, especially the USA. These methods seem particularly suited to conditions in water-scarce regions such as western and southern India and North China. However, since it was first introduced in the 1970s, the total area under drip irrigation in India has expanded to just around 60,000 ha, against the ultimate potential of 145 M ha. Of this amount, 40,000 ha is in the state of Maharashtra, where it is extensively used in grape and orange orchards; the bulk of the rest is in the states of Tamilnadu and Karnataka (Sivanappan 1994).

Drip irrigation of citrus and orange orchards and grape in Maharashtra is a big success; of coconut in Coimbatore, Tamilnadu, and of mulberry in Kolar, Karnataka, it is very effective. However, despite active promotion by a growing private irrigation equipment industry and subsidies provided by governments, the appeal of these technologies has remained confined to "gentlemen farmers." Common perception that have held sway over the popular mind are that drip and sprinkler irrigation require a great deal of capital, that they are difficult to manage and labour-intensive, and that they are appropriate only for commercial crops raised on scientific lines.

In recent years, there have been efforts to promote a nearly opposite notion: that these technologies are particularly suited to very small, resource-poor farmers; that, for small plots, they require surprisingly little capital; they are easy to manage and, in fact, save labour; and most importantly, can significantly enhance productivity of land and water, quality of produce, and the farm income of the adopter household.

In various countries, pioneering efforts have been made in this direction by Chapin, a US business, Netafim, a major Israeli irrigation equipment company, IDE, and some others. All these have developed and launched "miniaturised" versions of drip and sprinkler systems, adapted to small vegetable gardens. Best known are bucket and drum kits, promoted by Chapin mostly in Southern Africa and by IDE in India, Nepal and several African countries. Particularly with IDE, the focus has been on cutting the cost of the technology to the minimum so that poor men and women farmers can afford it without subsidy. By one estimate, some 13,000 IDE bucket and drip kits were already in use by smallholders in Asia and Africa; and the potential seems great. A larger global initiative is already in the making for "scaling up poverty-oriented micro-irrigation by creating a global dissemination network" (Heierli and Polak 2001).

This paper attempts an initial assessment of the potential of the technology, its social impacts, and issues in "scaling it up," based on a month's fieldwork by the authors in the states of Gujarat, Karnataka and Madhya Pradesh in India, and three hill districts in Nepal. The paper is not intended to be definitive, but to present the authors' impressions in the manner of "field-notes." IDE's micro-irrigation programme is barely 5 years old; and in many regions adopters have not used the technology for long enough to realise its full benefits and constraints. There is therefore an element of speculation even in the broad qualitative assessment we offer. It will take some more years until the technology to be integrated, and ready for a proper, full-scale assessment.

2. Evolution of the micro-irrigation programme in four locations

In all the four locations, the marketing environments – and therefore, the IDE approach – have evolved differently. In Gujarat and Nepal, the micro-irrigation programme is operating in a developmental mode, with IDE being the only player in the small-scale micro-irrigation market, selling the "concept" of micro-irrigation to small farmers. In Madhya Pradesh and Karnataka, the scene is different. Here, IDE and its partners are amongst several mainstream players in the drip irrigation business; and since they are all marketing custom-built systems, the distinctive aspect of poverty-focused micro-irrigation is somewhat diluted.

2.1 Madhya Pradesh

In the late 1990s, IDE began to work with Maikaal Cotton Spinning Company, an Indo-Swiss Collaborative Company, and its development NGO BioRe, promoting bio-cotton cultivation around the Maheshwar area in the Maikaal region of Madhya Pradesh. In this dry, hilly terrain, cotton has been cultivated mostly with well irrigation. However, with rapid growth in the numbers of wells and pumps, well yields are dropping and in the dry months of summer most wells turn totally dry. Some dynamic farmers had already begun trying out the drip irrigation technology in cotton. In a short co-operation, IDE encouraged Maikaal's member farmers to experiment with the micro-tube technology for drip irrigation on 25 acres (10 ha). For some reason, IDE was moved out of the region soon thereafter; however, the seed of drip irrigation it has sown here has blossomed and borne fruit.

Some 1,500 acres (600 ha) of Maikaal Cotton's bio-cotton area is already under drip. BioRe initiated a scheme to install drip systems on farmers' fields: the advantage to the farmer is, first, that BioRe buys tubes and laterals in bulk to get a good price; second, the farmer gets an interest-free 3-year loan. Many small farmers are taking up the BioRe offer. There are indications all around that the drip technology is being rapidly internalised by farmers and is on the verge of taking off in a big way in this region through commercial channels. The best indicator of this is that the farmers have begun to play around with the material and the design, on their own.

2.2 Karnataka

In Kolar, Karnataka, IDE has been promoting micro-irrigation for nearly a decade. The focus of IDE's promotional effort here is on custom-built drip systems, mostly for mulberry farmers but also for commercial orchards [1]. There is hardly any sale of bucket or drum kits; nor has horticulture emerged yet as a major customer (as probably it has in Andhra Pradesh, which we could not visit). So, in Karnataka, IDE is in a primarily promotional role for the drip irrigation industry as a whole. The costs of IDE products are comparable to those of the mainstream suppliers, though they vary hugely: for horticulture, the cost of laying a drip system is Rs 7,000 to 8,000/acre (Rs 17,250 – 19,750 per ha)[2]; for mulberry, it is Rs 20-25,000 (Rs 49,000 – 62,000 per ha) for paired row system and Rs 20,000/acre (Rs 49,000 per ha) for the pit system. Costs also vary according to manufacturer: KB brand systems made with Jain Irrigation material cost Rs 2,000 – 3,000 more per acre (Rs 4,900 – 6,200 per ha) than Pioneer, Krishi, Telecom and other brands.

Micro-tube technology has been popular and is now becoming increasingly so. Jain and Pioneer, two leading suppliers, have aggressively promoted micro-tube systems for decades, long before IDE came in to promote them. Kolar is a major centre for promoting drip irrigation. It has 70,000 acres (28,000 ha) under mulberry within 40 km radius of Kolar town. In principle, it can be a major thrust region for IDE's micro-irrigation programme. The issue is: to what end. There is some confusion about what exactly is the role of the IDE here. It does not market cheaper systems; it does not market smaller systems; it does not market primarily to the poor; and it is not the only one to promote the micro-tube system. So, "what business are we in" is the key strategy issue for IDE here.

2.3 Gujarat

In Gujarat, IDE's micro-irrigation programme is barely 2 years old; and we found it difficult to find farmers who had completed one full cropping cycle using micro-irrigation technology. It is implemented in the dry region of Saurashtra in the south-west of the state, and in Vadodara and Panchmahal districts of eastern Gujarat. Some 600 bucket and drum kits were in use here. Kits have been moving at a rate of 150–200 per year; but the pace has been accelerating.

IDE's marketing organisation in Gujarat is simple and thin. Until recently, IDE itself acted as distributor and got supplies from a manufacturer based in Nasik (Maharashtra). A distributor has just been appointed. He caters to some eight "assemblers" who are the dealers. The assembler sells ready drum and bucket kits, as well as custom-built systems for individual farmers' specific requirements. Within Gujarat, we found that in Saurashtra, the focus of IDE effort is to promote low-cost, mostly custom-built drip irrigation through the assembler who does most of the extension, promotion and custom-designing. In Chhotaudepur (Vadodara district), on the other hand, the target market is dominated by poor tribal women. Standardised micro-irrigation kits are marketed to them for kitchen gardens.

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[1] In Kolar town, for example, we met Pragathi Enterprises, a dealer who doubles up for Primere Irrigation as well as for KB (Krishak Bandhu) Micro-irrigation. He uses Primere material for building drip systems sold under the KB brand name. He sold 180 acres (73 ha) of drip irrigation systems for mulberry to 80 customers and 400 acres (160 ha) of "vegetable systems" to 50-100 farmers, essentially for mango and coconut orchards. In his 80 mulberry customers, 5-6 are large; but 75 are *relatively* small farmers with 1 to 1.5 acre (0.4– 0.6 ha) under drip-irrigated mulberry.

[2] The annual average bank exchange rate of the Indian rupee in recent years has been approximately as follows: in 1999, US$1 = Rs 43.2; in 2000, US$1 = Rs 44.9; in 2001, US$1 = Rs 47.3.

2.4 Nepal

Nepal's micro-irrigation programme is focussed squarely on the poorest segments and on standardised drum and bucket kits. An early assumption of the programme managers here was that costs of drip technology could be cut drastically by having the farmers shift the pipes around (i.e., by installing fewer pipes, so that to irrigate all parts of the plot pipes have to be moved from place to place inside the plot). But the promotional work with farmers suggested that they did not quite like shifting the pipes. Indeed, a Unique Selling Proposition (USP) of drip technology is that it saves labour and on-farm water management effort. If a drip system is designed so that it has to be frequently shifted, this USP is lost. So ultimately IDE Nepal designed and put on the market a proper drip system in three sizes. IDE Nepal has grounded some 3,200 kits in around 450 villages in the Nepal hills. They have also launched the micro-sprinkler, which is probably becoming more popular in the Nepal hills as well as in Himachal Pradesh on the Indian side of the Himalayas.

2.5 Summary

Overall, then, the micro-irrigation programmes at Chhotaudepur in Gujarat and in Nepal have evolved quite differently from those in Saurashtra, Kolar and Maikaal. The former has been engaging primarily with very small holders, mostly women farmers; the latter has primarily reached the middle-peasantry. The former is heavily into promoting 2–3 standard configurations of bucket and drum kits; the latter is primarily into custom-built systems. In the former, IDE is primarily playing a development NGO with little or no sign of other market players on the horizon trying to get a cut in the business. In the latter, the playing field is dominated by mainstream players, and the distinctive role of IDE as well as of micro-irrigation technology awaits sharper definition.

3. Impact on livelihoods, water productivity, and environment: Early impressions

The beneficial impacts of drip and sprinkler irrigation in water-stressed regions have been widely studied in Israel, US and many other countries. In India, several researchers have highlighted the benefits of the technology. Sivanappan (1994) suggests that, based on field trials at Indian agricultural universities, micro-irrigation reduces water application by 40–70 percent, and raises crop yields by 200 percent for many crops. It permits efficient saline irrigation, since salt gets accumulated only at the surface periphery of the wetting zone, without affecting crop growth.

In a survey of 160 farmers in Maharashtra, Narayanmoorthy (1996b) found that drip irrigation cuts costs of cultivation, especially in inputs like fertilisers, labour, tilling and weeding. The yields of drip-irrigated banana and grapes were estimated to be 52 percent and 23 percent higher compared to flood irrigation. The benefit-cost ratio of investment in micro irrigation was estimated to be 13, without taking into account the value of water saved, or 32 if water-saving was accounted for in the calculation. Net profit of drip over conventional irrigation is Rs 100,000 per hectare for grapes and Rs 87,000 per ha for bananas. Unlike flood irrigation, drip irrigation works in undulating topography.

The question is: why is micro-irrigation technology spreading so slowly, despite these advantages? According to Narayanamoorthy (1996b), it is because of high capital cost, absent or inadequate subsidy, poor product quality and lack of farmer awareness and knowledge. Above all, the notion that drip irrigation is appropriate only for large commercial farmers with resources and farm management skills (a belief, which holds powerful sway in the industry,) had led industry leaders to offer relatively expensive products designed only for large commercial farmers. IDE's micro-irrigation programme is a major breakthrough because it has down-sized, simplified and demystified drip and sprinkler irrigation technologies, for targeting them to the ultra-poor.

3.1 Madhya Pradesh and Karnataka

To the commercial mulberry farmers in Kolar (Karnataka) and cotton farmers in Maikaal (Madhya Pradesh), productivity impacts of micro-irrigation – in particular, producing quality crops under extreme moisture stress – were of paramount interest. In Kolar, for instance, the mulberry farmers we interviewed listed a number of advantages of drip-irrigating mulberry versus flood-irrigating it. The advantages these users perceived included:

- water needed for 0.5 acre of flood irrigation will suffice for 2 acres of drip irrigation;
- labour requirement is drastically reduced due to low weed growth;

- drip irrigation itself requires far less labour and management than flood irrigation;
- the plant population and health are better;
- a larger area that can be irrigated from the available power supply.

In many parts of India, shortage of power is the binding constraint, rather than water availability or the cost of pumping, which at the margin is zero for borewell owners under a flat (un-metered) system of electricity tariff. In Kolar, farmers get 4 hours of power during the day and 4 hours in the night; they use night power to fill up their farm ponds and tanks that are used for irrigation during the day time.

Besides these direct, private benefits to adopters, Professor Sundar of the University of Agriculture, Karnataka, enumerated several other indirect, social benefits of drip irrigation:

- it reduces soil erosion and non-point pollution because micro-irrigation water percolates only to 45-60 cm, so fertilisers and pesticide residues do not mix with the water table;
- it promotes more efficient use of nutrients;
- it ensures better and longer moisture retention in the root zone.

According to him, micro-irrigation is a powerful instrument of drought-proofing.

Overall, in Maikaal and Kolar, the gains from micro-irrigation technology seemed convincingly established. The ground is ready for major up-scaling. However, we could not find many of the low-end adopters to whom the IDE programme is targeted. It was only in Nepal that we could make a firm assessment of the livelihood impact of the micro-irrigation programme; and the evidence we gathered here validated the high expectations from the programme in terms of livelihood impacts.

3.2 Gujarat and Nepal

In the IDE parlance, the term micro-irrigation implies drip and sprinkler irrigation technologies down-sized in scale and costs to suit very small and marginal farmers' needs and financial capacity. Studies are beginning to show that all the benefits that commercial drip and sprinkler irrigation confer on their users accrue to small and marginal farmers who take to micro-irrigation.

Bilgi (1999), in a study of IDE's micro-irrigation programme for poor women vegetable farmers in Aurangabad and Bijapur districts of Maharashtra state, concluded that a typical micro-irrigation kit resulted in the following impacts:

- 55 percent reduction in water applied.
- 58 percent decline in labour-days applied.
- 16 percent savings in fertiliser and pesticide use.
- 97 percent increase in output.
- 142 percent increase in gross income.

We wanted to explore whether gains of this scale were experienced by women micro-irrigators we met in Gujarat and Nepal. Gujarat, unfortunately, offered little understanding since most of the micro-irrigation kits were non-operational because of heavy out-migration of tribal families due to drought (see below, section 4.3).

However, our experience in Nepal suggested livelihood gains of the order Bilgi (1999) found in Maharashtra. Women we met in the Nepal hills had all been growing some vegetables earlier; but they used to take only one crop during the rainy season. Many households ate meals without vegetables for days; they grew a few plants, mostly for family consumption. They seldom or never had vegetables to sell on the market. Instead, most used to spend Rs 900–1,200 per year on the purchase of vegetables; and the quality and size of their rainfed crops were far from satisfying.

The drip kit changed all these, and in significant ways. Adopters began to grow drip-irrigated vegetables in winter and summer, while continuing to grow rainfed vegetables during the rainy season.

They all grew a variety of vegetables (Bhindi, bottle gourd, sponge gourd, snake gourd, pumpkin, tomato, chilli). They grew vegetables on a larger *net* area; their crop was better in size as well as quality. Eating vegetables daily became the habit of most families.

Before the drip irrigation came, only four said they sold any vegetables; now, they all became net sellers of vegetables. While their purchase of vegetables declined sharply, their sales increased to Rs 2,000–15,000 per year. The 30-odd adopters whom we met at Kahun have been enjoying an IRR of 300–500 percent on their original investment of Nepal Rs 320 on the purchase of the *Saral Thopa Sinchai*, the name given by IDE Nepal (IDEN) to the bucket-kit system.

Elsewhere in Nepal, we found gross income from sale of vegetables to be Rs 1,500–20,000 per micro-irrigation system, per year, with the modal value around Rs 3,500–4,500. In Tansen, we met farmer representatives from six Village Development Committees and NGO representatives from the LISP project of Halvitas, besides a dealer and the District Agricultural Development Officer. Together, the dozen or so farmer representatives present reflected the experience of over 200 drip adopters in the neighbouring areas. The overall patterns showed little variation. The technology has met with uniform success. The micro-irrigation programme is having a good run in Nepal hills. Many people believe that this run will soon be checked by water scarcity. But it is likely that marketing limitations may do this earlier than water scarcity does. IDE therefore needs to keep working on these second-generation issues which will soon begin to affect the spread of the technology.

Some farmer groups have already begun to work on this. The organised women of Darham Danda, for example, first agreed on a staggered harvesting programme amongst themselves to avoid self-inflicted glut, and then had their president enter into a smart tacit agreement with two local vegetable traders who supply to a large workforce working on a local dam project. The women agreed to offer a stable supply of cabbage and cauliflower at Rs 11 and Rs 13 per kg, respectively; they could sell initially at much higher prices, but as the glut builds up prices plummet. So, instead of taking a myopic view, they made a stable long-term arrangement, and in the process ensured a stable market.

The drip irrigator women of Darham Danda were lucky in having a farsighted president who has figured out that market bottlenecks and water scarcity may seal the fate of her members, especially in a remote location like hers. She is already planning a diversification strategy; she would like, on the one hand, to grow coffee and ginger, both of which are easier to market. To fight water scarcity, she hopes to get support for a rainwater harvesting project that can help them to build a 100,000-litre tank.

The same technology can produce significantly different livelihood impacts in two different communities. Ramadi and Aaboo Khaiseni Yekle Phat, two other villages we visited in the Nepal hills, followed the same broad general pattern as several other hill communities we visited, but heightened the contextual variations. In both villages, we met groups of 15 – 20 drip users – micro-irrigation communities – who were introduced to the technology by IDE, and benefited very significantly from its adoption. Aaboo Khaiseni Yekle Phat consisted of professional vegetable sellers, whose businesses were not very small, and who expanded their vegetable business very significantly after the adoption of the drip kits. Water is not a problem at all with Aaboo Khaiseni Yekle Phat, which has plenty of it. This village is right on the highway and ideally suited for vegetable cultivation for the market. No surprise, then, that IDEN has worked with Aaboo Khaiseni Yekle Phat farmers for nearly 4 years.

The earliest adopter of the drip kit here undertook dramatic expansion in his area under drip and sold Rs 100,000 worth of vegetables last year. Here, every one of the 20-odd adopters we met doubled their vegetable area after adopting drip, and a third of them tripled it. Over half of the drip users sold Rs 10,000–15,000 worth of vegetables. Several bought multiple kits or went for upgrades; the original pioneer installed five large drip kits; even then, he has to shift his tubes once every day.

Factors that have helped the booming growth in the vegetable production and incomes that the drip technology catalysed, include:

- tradition of vegetable cultivation for the market;
- abundance of water;
- IDE's low cost storage tank programme under which these adopters have built their private water storage ranging from 1,000 to 14,000 litres;

- proximity to markets.

However, the 18 women and 4 men we met in Ramadi (a village which has less water, and somewhat less land, than Aaboo Khaiseni Yekle Phat) were significantly poorer. Before they took to drip irrigation, none or few of them grew vegetables to sell in the market. They also experience extreme water stress; and after their first season of drip irrigated vegetables, a majority of them sold Rs 500–1,000 worth of vegetables. The women from Ramadi were concerned that, as their vegetable enterprise reaches a serious scale, water scarcity may catch up with them.

Ramadi would probably not have qualified for IDEN's drip kit programme, but for the fact that it is covered under another project on development of "Mountain Marketshed." The village has only 16 users, of whom 10 had collected to meet us. These women seemed markedly poorer; and their adoption was perhaps aided in some measure by the fact that Social Welfare Center, a local NGO, offered a subsidy of 25 percent of the capital cost to the first group of adopters. They had used the drip kit only for one season; and already there was great interest among others to adopt. Eight non-users had shown up just out of curiosity; they had not joined the adopters so far, either because they did not know or were not sure about whether it will work; and/or because they had trouble raising the cash. Some women felt, correctly, that although there are significant benefits, it takes a higher overall level of effort and engagement in the vegetable enterprise. All of these were now keen to take to drip irrigated vegetables. The adopters all wanted to increase their vegetable area and plant numbers by shifting the pipes around a little more.

What happens to the additional income from sale of drip-irrigated vegetables? In Darham Danda, many women adopters manage their households in the absence of their husbands, who are away working in India. The first charge on the earnings then is sugar, tea and other daily necessities, and school fees. Often, the remittances from husbands are delayed; so these women heads of households are always in need of cash to keep the household going.

Clearly, the micro-irrigation programme in Nepal is attacking IDE's target segments. Even so, in one of our meetings, Tulsi Neupane and D. R. Adhikari of the LISP project of Helvetas shared their major concern, that the low-cost drip technology was penetrating only the middle-poor. It is still not easily accessible to the very poor who have some land on which to grow vegetables. According to them, Rs 900 is not much for a middle-poor household but it is a good deal for a very poor household to spend on a technology they are not certain will work. Their second concern was about sustainability of an irrigation technology whose success depends so critically on the high quality, intensive technical support in drip irrigation technology as well as horticulture that IDEN have so far provided.

3.3 Summary

As of now, Nepal's powerful positive experience is the prime leading indicator we have of the vast potential of micro-irrigation technology for poverty alleviation. In Gujarat, it is still early days for even adopters to experience the full range of benefits of the technology. The experience with the technology in Maikaal and Kolar is very interesting but in a different way. In both these sites, we saw little adoption by the poor vegetable growers; but aggressive adoption by the middle peasantry, and the subsequent spurt in market development, open up unforeseen opportunities for large-scale propagation of the technology to the poor as well.

4. Adopters and adoption behaviour

In the larger backdrop of the subject of "scaling up through market development," one aspect of the programme we explored throughout our field-work was the profile of the adopters and the "adoption behaviour" of micro-irrigation customers. What triggered the first trial of the product by early pioneers? How did the bystanders process their experience with the technology? How did the word spread around? Where early experience with the technology is happy and satisfactory, at what stage does the technology "take off" and begin to spread by itself rapidly?

From past experience and research in drip and sprinkler irrigation in India and elsewhere, there exist propositions about factors that promote or inhibit the adoption of this technology by farmers. In general, it is considered to be the technology for well-off, commercial farmers; farmers take to these not so much to save water but to increase output and incomes and save labour and inputs. For example, Shreshtha and Gopalakrishnan (1993) estimated that over 80 percent of Hawaii's sugarcane farms came under drip irrigation during the 1970s not because it saved over 500 mm (12%) in water application, but because it raised cane yield by 4.2 tonnes per hectare, valued at US$578 at 1987 prices.

Likewise, we know that major barriers to adoption are high capital cost, unfamiliarity, and the high risk of failure; and that adoption tends to build up as early adopters' successful experience gets confirmed and widely known, and as technology becomes simpler and cheaper. In a survey of some 160 farmers in Nagpur district of Maharashtra state, Puranik et al. (1992) found that all the farmers interviewed – adopters as well as non-adopters – found the high initial capital cost to be the major barrier to adoption of drip irrigation technology. Interestingly, nearly as many thought that lack of technical knowledge and awareness and the difficulty of accessing the subsidy were equally important barriers.

In their study of the rapid spread of drip irrigation for sugarcane cultivation in Hawaii during the 1970s, Shreshtha and Gopalakrishnan (1993) concluded that "continued improvements in the technology have made it more applicable and affordable, thus reducing the risk involved with new technology, as well as reducing the cost of information over time." To what extent are these propositions playing themselves out in the micro-irrigation scene in India and Nepal?

4.1 Madhya Pradesh

In Maikaal (Madhya Pradesh) and Kolar (Karnataka), the IDE programme was in direct competition with mainstream players; and hence, we found here a very interesting dynamic. IDE played a pioneering role in introducing drip irrigation among cotton growers in Maikaal and mulberry growers in Kolar; but the adoption is confined largely to middle peasantry; and it is an open question whether IDE does not need to redefine its role, now that the concept is established.

In Maikaal, we met a group of 15–20 cotton growers from 2–3 villages who had gathered in Mohna village. They each had 5–15 acres (2–6 ha) of land, mostly under bio-cotton. All of these were drip irrigators and good cotton farmers. All were using the micro-tube system, although the government subsidy scheme allows only drippers. Only a few large, influential farmers got access to subsidies; most others purchased the material from the open market, and built their own micro-tube based system. One farmer had built a micro-tube drip system with micro-tubes only for one row of plants; this required more lateral, but offered the advantage that he can weed and inter-cultivate without having to shift the pipes around.

The grey market[3] of unbranded products offers limitless opportunities for economising on capital investment here. BioRe (IDE's partner NGO in this state : see section 2.1 above) has been collecting tube and lateral prices from several prominent market centres in Madhya Pradesh, Maharashtra and Gujarat, and the best deal it can offer to farmers is Rs 12,500/acre (Rs 31,000 per ha). But most farmers we met laid their drip systems at Rs 6,000–7,000 per acre (Rs 15,000–17,250 per ha), by assembling them with material bought in the grey market.

BioRe offers only products that have been approved by the Indian Standards Institute (ISI); and farmers buy mostly grey products; but the group we met saw absolutely no quality difference. One farmer quipped: "Big brands charge exorbitant prices and provide uncertain quality; the grey market charges rock-bottom prices and uncertain quality. So who wants big brands?" Their grey-market dealers also offer them written guarantees of 5 years, which they believe would be honoured if invoked. Some farmers who have been using grey products since 1996 were quite happy.

As the drip technology becomes internalised here, the major objective of suppliers is to cut its cost down to the minimum. The farmer's main partner in Madhya Pradesh is the private grey sector. The business has probably recognised that many first-time users will try out drip technology only in a drought to save their crops with little water. They also recognise that their demand is highly price-elastic.

To encourage such small farmers to try out drip irrigation, one innovative manufacturer has just introduced a new product labelled "Pepsy," which is basically a disposable drip irrigation system

[3] "Grey products" are goods that may be copied from mainstream manufacturers, but are sold more cheaply and are usually of more dubious or less reliable quality.

consisting of a lateral with holes. At Rs 1,500 per acre (Rs 3,700 per ha), Pepsy costs a small fraction of the more enduring systems that Maikaal offers to its members at Rs 12,500 per acre (Rs 31,000 per ha); but for small farmers who are trying out the technology for the first time, it offers an important alternative. As one farmer mentioned, “If I can buy a system at the cost of the interest amount, why should I invest capital? Why spend Rs 1,200 on a filter, when a piece of cloth can serve the same purpose as effectively?”

The boom in the private grey trade in laterals and micro-tubes – and the falling prices of parts – suggests that IDE’s ultimate goal of market development is likely to be achieved in this region rather effortlessly.

4.2 Karnataka

In Kolar district, the mulberry heartland of India, we met a similarly dynamic and resourceful group of 20–25 mulberry farmers of all classes and social groupings in Nayatharahally village. We took a quick inventory of our sample which yielded the data of Table 1. These were certainly not the smallest farmers one could find in the area. This group felt that the kinds of drip irrigation systems they use are beyond the resources of small and marginal farmers. The farmers face several barriers to adoption: capital requirement is one; lack of education and awareness is another; but the most important is that small and marginal farmers do not have borewells.[4]

A majority of farmers are too small and poor to take to professional sericulture (production of silk, which is the purpose of mulberry cultivation). The group we met represented only the upper crust. We estimated that Nayatharahally has some 300 farmers, of whom 275 probably raise some silk worms. But 7–10 households, each having at least 7 acres (2.8 ha) plus, have taken to drip and sericulture as their sole or primary enterprise. At the other end of the spectrum, over 100 households with 2 acres (0.8 ha) or less all do some sericulture, but only one has a drip system. This is because only one or two of the marginal farmer households have their own borewells; indeed all the 60–70 borewells in the village were owned by large and medium farmers.

The ownership of a borewell seems a precondition to adoption of micro-irrigation for mulberry. Most poor sericulturists without their own borewell depend upon larger farmers for the supply of mulberry leaves, which has catalysed a vibrant exchange institution in mulberry leaves. Small silk farmers buy leaves on a regular basis at Rs 100 – 150/bag; some also buy water from big farmers on one-third share cropping basis, in which the seller provides water and claims one-third of the mulberry leaf output.

Table 1. A profile of mulberry farmers using drip irrigation in Kolar.

Farmer	Village	Total farm land (acres)	Area under mul-berry (acres)	Area under drip (acres)	Type of drip system	Experience with drip irrigation
Nanjudappa Gawda	Nayatharahally	10	10	2 2 3	Integral Online Micro-tube	4 years
Narayanappa	Thondala	7	2	2	Micro-tube	2 months
Ravakrishnappa	Thondala	20	9	9	Micro-tube	4 years
Muniappa	Thondala	5	5	3	Micro-tube	4 years
Ramappa	Thondala	10	7	7	Micro-tube	4 years
Ramappa	Thondala	1	0	0	0	0
Srirama Reddy	Pumbarahally	12	2	1.5	Micro-tube	3 years
Ranganath	Nayatharahally	5	5	1	Micro-tube	2 months
Govinda Gawda	Nayatharahally	5	5	0	0	0
Venkataramappa	Nayatharahally	5	4	0	0	0
Narayana Gawda	Nayatharahally	10	8	6	Micro-tube	2 years
Sonappa	Gujjarahally	15	8	0	0	0
Siva Reddy	Chikapannahally	3	1	0	0	0

Note : 1 acre = 0.4 ha.

[4] Borewell = shallow tubewell.

The Kolar group of drip irrigators we met were a totally different class from the poor women micro-irrigators we interviewed in Chhotaudepur (Gujarat) and Nepal. These were well-off farmers; more important, they had a dynamism, enterprise and awareness of technology and market conditions that we did not expect to find in the poor women vegetable farmers. For instance, the Kolar group's assessment of the pros and cons of alternative drip technologies reflected their knowledge and experience with drip irrigation. We were told that integral systems have higher chance of clogging; micro-tubes clog less easily but they make inter-cultivation difficult; they are also more prone to damage; women weeders pull out micro-tubes to tie their bundles of forage.

Micro-tube technology is the best and least-cost option, especially for the paired-row planting of mulberry. It provides greater aeration and sunlight to plants; it provides greater moisture retention and better root penetration, making the plants more tolerant to dry spells. The paired-row system also yields more plants: 5,300 per acre, compared to 4,600 per acre in the pit system. As the paired-row system becomes popular, so does the micro-tube technology that the IDE is promoting. All in all, IDE's Kolar story so far has been the affluent-farmer story. But it seems poised at a point where the small mulberry farmer too may take to drip irrigation if he had the right options. Overall, too, the drip sales are set to take off in a big way; and a challenge for IDE, it seems, is to increase its penetration in the smallholder market segment.

4.3 Gujarat

In Gujarat, our sense clearly was that the ongoing drought has been the principal "trigger" for the adoption of micro-irrigation by pioneers. Most adopters we met took to micro-irrigation to cut potentially big crop and capital losses induced by water stress. However the experience and the consequences of the drought were different in the two parts of the state that we visited. The differences seem to be due to the different socio-economic status of the farmers. We record first our observation in the Saurashtra region of the state.

Veerjibhai Metalia of village Lalavadar installed a micro-irrigation system 6 months ago at a cost of Rs 2,500 to save a plantation of 90 papaya, guava, and lemon trees, which is 3 years old but would surely perish due to moisture stress during the current drought. He assembled a micro-irrigation system with the help of the assembler; he pumps water into a tank from his open well some 100 metres away. The tank is connected to the well through a buried pipe, and the drip system is hooked on to the tank. The well can be pumped only once in 2 weeks, and yields just enough water to fill the tank. But these 15,000 litres have apparently saved his plantation. Veerjibhai appeared enthusiastic about the technology. Having adopted it for one reason, he has now discovered many other reasons why he should stick to it. He found moisture retention is better under micro-irrigation than under the flood irrigation system; and his plants are now healthier.

Panabhai in Jasdan taluka installed a custom-built micro-irrigation system at a cost of Rs 1,100 to protect his small plantation of 30 sapota, lemon and other plants. His experience was similar.

In Vinchhia village, we met a community of professional small-scale horticulturists who raised lemon gardens. These were under tremendous moisture stress during the current (2001) summer drought spell as their wells dried up. One of them installed a drip system and found that he could make his plants survive with very little water. Formerly, he pumped his well for 12 hours daily to flood-irrigate his plantation; now he uses 4 drums of 350 litres each (that is, about 1,400 litres of water) to irrigate his 50 lemon trees. Following this experiment, 11 lemon farmers in the neighbourhood all installed micro-irrigation systems. They made a new group-managed borewell to fill up their tanks.

In Saurashtra, then, the current micro-irrigation buying spree is triggered by the drought. The experience has been good; but it will be interesting to see what these adopters do if there is a good monsoon in 2001. Many will probably keep using ithe technology because they see its significant productivity impact. There is much that is common amongst Saurashtra adopters; they are early in their learning curve about what the technology can deliver, besides saving their plantations during the current drought.

If drought triggered micro-irrigation adoption in one part of Gujarat, it induced adopters to fold up their kits and shelve it in another part. In Chhotaudepur area, another pocket of micro-irrigation marketing thrust we visited in Vadodara district, the IDE assembler is Anand Niketan Ashram, Rangpur, a local NGO with high credibility with the tribal communities here. Rangpur Ashram has been aggressively promoting micro-irrigation technology; and the prime purchase motive here was irrigating vegetable gardens in the homesteads. The most popular product was the bucket kit. The promotional message is: it can ensure a steady supply of 500 grams daily of vegetables per household for 3 months a year. Some 450 bucket kits are grounded in 4 *talukas*; in the Rangpur area itself, some 200 have been sold through the NGO.

This is a predominantly tribal area. Bhil tribal people who live here are first generation farmers. The Ashram has been popularising modern agricultural methods here for 50 years. Its experience with promoting some technologies followed the trajectory we expect the micro-irrigation technology will follow. In the 1960s, it installed scores of lift irrigation schemes to promote irrigated farming. It took 8–10 years for the new technology to sink among these communities, used to rainfed, slash-and-burn farming. The Ashram's lift irrigation schemes faced endemic problems of economic viability; and the programme was ultimately folded up; but its purpose of popularising lift irrigation and irrigated farming was achieved. Fed up with the unreliability of community lift irrigation systems, farmers took to private wells and diesel pumps in a big way as the benefits of irrigation were internalised. Now groundwater markets are booming, and pump irrigation is widely used.

Total drought for the second year in a row has however put the tribal agrarian economy under great stress, resulting in massive out-migration. Micro-irrigation kits purchased are mostly out of use, because wells have no water. We could see some kits in operation in Bhekhadia village where hand pumps as well as dug wells had some water. Mostly, micro-irrigation kits are used to sustain small kitchen gardens; however, one farmer also raised a somewhat larger garden with a custom-built kit. There is a tradition of vegetable gardens besides the homesteads in the Bhil households; this is a good augury for the micro-irrigation kit programme. However, domestic water supply systems are traditionally designed to canalise domestic wastewater into the kitchen gardens. No special effort is made to irrigate the garden. So the micro-irrigation kit does not offer a significant water-saving advantage over the traditional system of wastewater irrigation. Our overall sense was that poverty-focused micro-irrigation as a concept is not yet well established in Gujarat; however, in many ways, this water-stressed state offers opportune conditions for it.

4.4 Nepal

In the Nepal hills, on the other hand, the micro-irrigation concept is already firmly established amongst poor women vegetable growers. The trigger for new purchase decisions is not so much water stress but generating significant household income. Some very interesting work has been done here by IDEN in adapting the product to the customer need. IDEN has been steadfast in pursuing the original mission of introducing the micro-irrigation intervention: of designing a product appropriate to the needs of the small farmer household, and promoting it aggressively to that target group with an intensive after-sales support system.

An impressive aspect of the way it has gone about doing it is the adaptive design response to farmer feedback. IDEN began with a set of assumptions about what might cut costs best and yet find favour with the target households; as it went ahead testing out those assumptions, it cast aside those that were not supported, and developed new ones based on feedback from users. This resulted in much ingenious experimentation in design; and all of it seemed driven by user feedback and functionality. A new, improved product has been launched almost every year since inception.

Thus, for example, the 1998 *Saral Thopa Sinchai* (drip irrigation) kit they introduced had a very simple common household filter on the neck of the tank. The 1998 kit was also made available in "very small" size for 40 plants. These were both changed in the 1999 model, which incorporated several new design features. Similarly, in the early models, IDEN used black recycled rubber laterals; but these were found too hard and non-durable; so they used 8 mm green PVC lateral which is better in quality and image. Finally, IDEN has avoided the use of micro-tubes; instead, they have punched fine holes in the lateral itself and fitted it with raffles which, when fitted over the holes, ensure that the water is delivered in a trickle rather than in a sprinkle. This has made frequent shifting around of pipes a major requirement; it has also imposed a tough planting discipline on users; if they do not maintain the same distance as between the holes, the system will mis-deliver water.

The 2000 model of *Saral Thopa Sinchai* kit has fixed nearly all problems the feedback on earlier models pointed out, except the propensity for clogging. But our sense was that farmers have come to terms with this: some problems have to be just lived with.

IDE Nepal has closely followed the development NGO model in promoting the micro-irrigation technology amongst the poor. By supplying micro-irrigation kits to close-knit groups of vegetable growers, along with intensive after-sales support, it has created micro-irrigation communities. It has actively discouraged its dealers from selling kits to isolated buyers, lest they should fail and damage the product image. The Nepal hills have some major clusters of drip kit users, and we saw and interacted with several of these.

On our first day of field visit, we went to Kahun near Pokhara and Bhimad in Tanahu. Kahun is a village of some 600 households (including 56 drip-kit users) with 9 wards; Bhimad is a trifle larger. In Bhimad, we met a sizeable group of some 35 women and 8 men adopters of drip kits. In Kahun, we interacted with a group of women in ward 1; this had 70 households; 40 of these have adopted drip kits; of the remainder, 6 have already placed orders. So it will not be long before this village becomes a 100 percent drip-user village. But such examples must be few; for, if 50 drip kits are grounded per village, IDE Nepal's total kits should be in 60 villages instead of 450–500. So there must be many villages which have isolated adopters of drip kits.

IDEN's distinctive approach, emphasising micro-irrigation communities supplied with intensive technical support in both use and maintenance of drip systems as well as in horticulture, has produced major impacts. Vegetable production increased manifold, and generally surpassed the wildest expectations of the adopters. Average gross income from sales was less in the first year but averaged Rs 4,000–6,000 in the second year. Once they saw they could make real money, women adopters began to learn fast. Soon, IDEN found that farmers with two years of experience could be easily weaned away from the IDEN support system; they have enough experience to carry on their own, and even to guide new adopters. IDEN is now developing a Lead Farmer concept to multiply its technical support capability; and intelligent, dynamic farmers with two years of experience in drip irrigation of vegetables offer ideal candidates for such appointments. Many of these have already upgraded their systems.

The demonstration effect of micro-irrigation communities is already strong. Some of the women we met came to know first about the drip system not from IDE, but from the gardens of some early adopters. But they faced a tough time obtaining the kit, because of IDEN's policy of not selling to isolated buyers. Many intent farmers have to beg existing groups to accept them as members, in order to get the kit and IDEN's technical support cover. Many keen potential adopters also mobilise 15–20 others to form a micro-irrigation community that IDEN would work with. In Darham Danda (wards 1 and 8), this organising role was performed by the dynamic chairwoman of the Jagriti Mahila Samuha, a local CBO. She visited the IDEN office several times but could not connect with the staff, who was mostly in the field. Fed up, she slid a hand-written application for support under the closed door and returned to her village. A marketing officer from IDEN turned up a week later to "process" the application of the women of Darham Danda. This opened a new chapter in the lives of these women.

One consequence of this success is that it has attracted attention of subsidy-providers. Subsidies to the tune of 25–33 percent are already available from local NGOs and even the Agriculture Development Officer's (ADO) office. One representative of a federation of women's groups was in our meeting, canvassing for a regular subsidy programme. The ADO, who has already been offering 25 percent subsidy to 30–40 women, has offered to expand the programme to cover 300 women. He has been asking potential adopters, who are ready to buy the kits, to wait for next year so that he can oblige them. If this subsidy menace grows, it must hit the programme in ominous ways.

Constraints for wider propagation of micro-irrigation kits in the Nepal hills are showing up from two directions: water scarcity and output market glut. Using drip irrigation is not easy for many of these women farmers, since their only source of water in the dry season is the public drinking-water taps. One such tap is available for 15–20 households, and they share the water equally. Most fill buckets and fetch them to fill the drip tank manually; a few lucky ones are close enough to the tap to be able use a hose to connect it to their tank. For many, however, filling the drum may involve from 10 to 30 minutes of fetching.[5]

[5] One of the women present acquired a 14,000 litre tank under trial by IDE; that is her water insurance; her plan is to fill it up with rain water and seal it; it is to be used to save her vegetable crop during the summer days of acute water scarcity.

Water scarcity is a major constraint in the Palpa district, which is mostly dry. Some of the users in our meeting collected surplus overflow from the drinking water system during the night and used it for drip irrigation. In Darham Danda, the remote village in Palpa's mountains, women have to make 14 turns to fetch water for domestic, livestock and drip irrigation requirements. If 3–4 people help in fetching water, they can do the household's water-fetching in 4–5 turns; but even that takes half a day since each turn takes 1 hour for a slow walker and 30–40 minutes for a fast walker.

The output market is rapidly emerging as another constraint. Members of micro-irrigation communities tend to grow the same vegetables, and their products end up in the same limited local market at around the same time. This results in a glut, and prices go crashing down. In Aaboo Khaiseni Yekle Phat, some women vegetable farmers sold their cauliflower and cabbages at rock-bottom prices; and even then, had to dump some in the drain. Trucking vegetables to distant towns individually is an uncertain business, as some have found out after costly experiments; so now, most depend on buyers to lift vegetables ex-farm.

Even at its early stage of development, drip users in Ramadi village are concerned about the limited market. IDEN helped them to meet local vendors from Bhesisahar and Bhotowodar in a workshop to create better understanding between the two. The growers urged vendors to stop buying vegetables from the *terai* (lowlands). The vendors forcefully argued their position, that women producers do their best to sell directly, door-to-door, and come to the traders only to sell their left-overs. Moreover, if they want vendors to sell their produce, growers must ensure a wide variety of vegetable crops, as consumers cannot be expected to buy only what they grow.

It is clear that limited and shallow local vegetable markets may nullify some of the benefits and small-farmer value that the micro-irrigation technology is producing, except for smart growers who anticipate the glut and prepare for it. Along with agricultural support, perhaps IDEN may also need to think of some training in vegetable marketing.[6] For, as the vegetable market becomes a buyers' market, drip users will need to innovate in order to keep their incomes stable or even to increase them.

Alternatively, IDEN may want to reconsider its present approach of creating concentrated micro-irrigation communities which glut the shallow local vegetable markets, and, instead, spread the kits more thinly over a wider area by letting the dealers loose.

5. Market dynamic

An extraordinary aspect of the micro-irrigation intervention in the four sites was the emergence and nature of the market dynamic. In Gujarat and Nepal, we found little evidence of competition to IDE in the micro-irrigation market. In Gujarat, the intervention itself is very young; the benefits of the technology are yet to be discovered by the adopters; and a potential for profitable business is yet to emerge. In Nepal, there are signs of such potential emerging; but it is not clear to us if IDEN is doing much to assist this process. Our impression is that IDEN's approach of providing intensive support to micro-irrigation communities, and of discouraging dealers from selling micro-irrigation kits to isolated buyers, may in fact hamper the market development process.

In Karnataka and Madhya Pradesh, however, we witnessed highly charged market dynamic in micro-irrigation material. We saw earlier that in Maikaal, farmers have begun to experiment with the technology, and the grey market has emerged to help them do it at much lower cost than by using branded drip products. Products like "Pepsy" are likely to be welcome by first-time adopters – especially, the poor farmers – who want to avoid undue risk of technology failure. However, BioRe's approach is somewhat doubtful about grey market activity, since it continues to sell only ISI-marked branded material that more than doubles the cost of micro-irrigation systems. Karnataka has a similar market dynamic; and IDE's posture here is similar to BioRe's in Maikaal.

[6] We met a micro-irrigation adopter at lunch in Tanahun who has been using a drip kit for 3 years to earn regularly Rs 7,500–10,000 from a single crop of cucumber. He probably gets 10 kg of cucumber per plant (100 tonnes/ha) on his tiny plot; marketing two-thirds of it in the retail market and the rest as snack-food to travellers. He spends 2 months marketing his crop.

Within the national drip and sprinkler irrigation equipment market of Rs 2,000–2,500 million per year, the Karnataka drip irrigation business is estimated at Rs 400–500 million per year. Fifteen years ago, when drip irrigation came to be commercially marketed for the first time, some of the leading players, especially Jain Irrigation, invested heavily in market development and were beginning to reap the benefits. But in the 1990s, the Government of India introduced subsidy in drip systems. For sericulture, subsidy was fixed at 50 percent for general farmers, 70 percent for women and 90 percent for farmers of scheduled tribes or scheduled castes;[7] for horticulture, it was 30 percent for general category farmers and 50 percent for the ST/SC farmers. Subsidies were available only on systems larger than 1 acre (0.4 ha).

The major industry players, like Jain Irrigation, are frustrated by the distortions caused by the subsidy. It has increased competition for them. The subsidy has attracted a large number (40–50 companies are registered) of shady players in the drip business who sell low-quality products, and often claim subsidy without selling systems. Getting the ISI registration is said to involve a one-time bribe of Rs 600,000–800,000; but then the manufacturer becomes entitled to market his products under the subsidy scheme. This has made big players uncompetitive; it has also created quality problems and impeded market growth due to diminishing farmer faith in the technology.

Even today, the drip irrigation industry does not see much promise in the small-farmer segment of the market. According to the Jain Irrigation dealer, a successful adopter is typically a large commercial farmer with some education. But since such farmers are few in number, the potential in a district gets exhausted fairly soon. Moreover, with such farmers, who maintain their systems well, there is little replacement demand; so the market gets easily saturated. These farmers integrate drip technology into their farming enterprise very well; so they buy it for its long-term productivity and economic benefits, not for the expedient goal of tiding over a drought season.

Governments are now cutting subsidies on drip irrigation; and this is creating a new generation of problems for the industry mainstream, which has become addicted to subsidies over several years. Until last year, when the subsidy was as high as 90 percent, the marketing dynamic of the drip system was fired by the subsidy culture. The manufacturers and dealers, including the leading brands, were seeking "unearned profit" in the form of subsidies, rather than manufacturing and marketing margins from serving satisfied customers. Since ISI-marked products enjoyed a degree of monopoly in the form of subsidy access, their manufacturers raised their prices to levels where they and the bureaucrats empowered to approve subsidies claimed the bulk of the subsidy. However, since claiming the subsidy involved between 1 and 3 years and 15–20 percent bribe money, there was always a market for non-subsidy drip systems and products.

Now that the subsidy has been reduced to 30 percent, the profits in ISI-marked drip systems have plunged. All suppliers with major names in the ISI-sector are facing declining fortunes; they have been progressively cutting their prices to stimulate non-subsidy sales; but they face stiff competition from non-ISI suppliers, who sell unbranded products at rock bottom prices.

We met two dealers in Bangalore (Karnataka) who deal in the cash-and-carry market for ISI as well as non-ISI products. Jai Kisan Irrigation and SN Pipe Products were two such. SN Pipe's Saiyad was of the view that "ISI mark + subsidy = fraud." He stocked best as well as second-quality material from ISI as well as non-ISI sectors; he himself was a manufacturer and sold ready-made products, as well as executing orders for material of required quality with a 24-hour lead time. Saiyad asserted, as did the other dealer we met, that there is no real difference between the average quality of ISI and non-ISI products. Under ISI-marked branded products, farmers are often cheated with poor quality. At the same time, many non-ISI products are of excellent quality.

In general, then, the ISI-mark is at best a poor indicator and guarantee of quality. The company brand name is a much better indicator; for example, the brand name Jain Irrigation conveys assured quality; but companies with such respected brands exact a commensurately high price. But for

[7] In India, the scheduled tribes and scheduled castes are groups of low social status, and generally rather poor. Various types of legal and financial assistance are used by government, for the general objective of reducing the differentials between these groups and the rest of society.

discerning consumers, there are non-ISI marked products which are nearly as good as the best available in the market, but sell at 60–70 percent lower price. The comparative prices he gave are shown in Table 2.

Table 2. Comparison of prices (Rupees/metre) of different grades of products.

	12 mm lateral	16 mm lateral	Micro-tubes	Total system
Non-ISI II quality	1.40	2.30		
Non-ISI top quality	1.90	2.80	0.50	2,500
ISI Branded	2.80 – 3.50	4.60	0.60	10,000
Jain Irrigation	4.35	5.50	1.10	12,500

For a majority of potential adopters, high perceived risk in drip irrigation investment is a major barrier to adoption. This perception is not unfounded. Even reputed suppliers agree that the failure rate in the drip system is as high as 50–60 percent. Many farmers invest in the technology, but then abandon it because of poor experience with it. As a result of uncertainty about how well it will work, many first-time buyers of drip products view their purchase decision more as an expenditure decision (like buying a bag of fertiliser) than as a long-term capital investment decision. In turn, this means that most first-time buyers are highly price-sensitive, and search for lowest-priced products; this tendency is also strengthened by the lack of faith in the quality assurance of ISI-marked products. As a result of all these, very little non-subsidy demand goes to ISI-marked branded products.

The industry representatives we met did not seem to take IDE and its micro-irrigation venture very seriously. Most thought that there is a better fit between commercial farming and drip irrigation technology than between low-input subsistence farming system and micro-irrigation technology. One of them explained to us their viewpoint: “When a farmer in Nasik makes Rs 200,000/acre/year from grape orchards, he does not mind investing Rs 2,000/acre on installing a drip irrigation system. Similarly, coconut or areca nut farmers internalise the drip technology easily; but vegetable growers, especially small-scale, find it more difficult to do so. Vegetable prices fluctuate heavily, and growers need to deal with output as well as price risks; so they are lukewarm to capital intensive farming.”

The industry had thought similarly about mulberry growers too; but IDE’s breakthrough has begun to change their thinking somewhat. Problems with the availability of spare parts, insufficient and erratic power supply are other factors that impede wide acceptance of drip irrigation among smallholders. While the industry respected IDE’s marketing ethos, it betrayed its doubt about IDE’s propensity to down-scale and simplify the micro-irrigation technology. The Jain dealer quipped: “…drip irrigation technology involves more than just joining tubes with laterals… micro-tubes are an obsolete technology... besides the kits overlook the importance of custom design…”

Arguably, IDE in Karnataka could have carved out a more strategic role for itself in Karnataka’s fluid market environment. Now that the subsidy is cut down, business in the non-ISI brands is booming. According to Saiyad (the dealer in Bangalore), for every 100 metres of ISI-marked branded laterals, the sale of non-ISI laterals is 1,000 meters. When we tried to cross-check this figure, Sundar, one of IDE’s friendly ISI-marked manufacturers, suggested this ratio of 1:10 is hugely exaggerated; according to him, the actual ratio is probably 1:5 or 1:6 but not as high as 1:10.

By tying up with top brands in the ISI-approved sector, IDE has ensured that it promotes drip systems in the highest price range without commensurate quality assurance, and by doing that, it has virtually excluded from its ambit the low-end customers who are its target segment. Even if they have an intent to purchase, the poorer farmers are likely to be far more readily drawn to the non-ISI market than to Jain Irrigation and Primere or IDE’s KB, which is, and is perceived to be, in the same league.

Since the company brand name has a stronger association with consumer’s perception of quality than the ISI mark, IDE could use the KB brand name to develop and market a range of low-cost, high-quality drip products in the non-ISI sector, that can not only achieve quick penetration among small farmers, but also make KB a leading non-ISI brand. Indeed, IDE can develop the bucket and drum kit market by introducing trial kits at rock-bottom prices: bucket kit at Rs 100 and drum kit at

Rs 250. These can be made using recycled but good quality material under a minimalist IDE quality control mechanism.

In general, then, Paul Polak's original insight that drip kits made from recycled plastic should sell at rock-bottom prices still remains valid and unfulfilled. IDE, India, is once again falling into the same trap that has kept its treadle pump market from expanding to its full potential: of offering a high-quality product at a high price to a target market that is extremely price sensitive. If micro-irrigation is to take off in a big way, it seems to us that this will need to change, and marketing elitism will need to make way for some street-smart market manoeuvring.

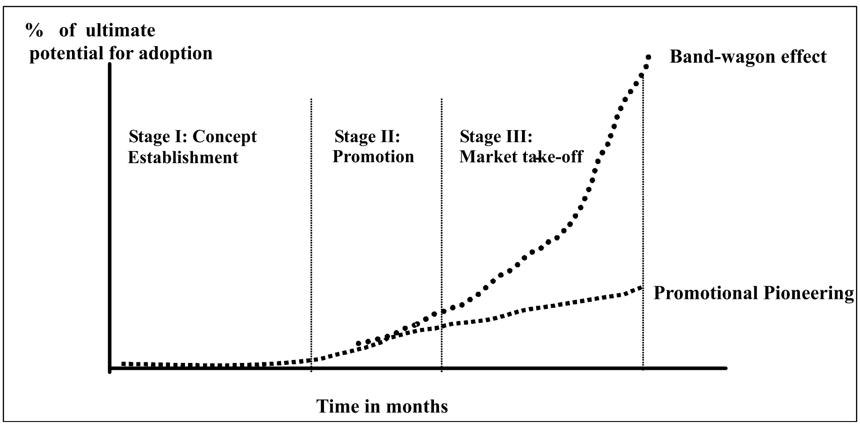
6. Assessment and future challenges

A critical strategic issue for IDE is: what exactly is it marketing, or indeed, what business is it in, in the field of micro irrigation? As a product, bucket and drum kits hardly offer a USP since all parts are available in the grey market and assembling a kit is not difficult. So if the technology had some special benefits to offer to smallholders, the more dynamic would have surely taken to it since, besides upper-end brands like Jain, they also have access to a whole range of tubes. The only part they can not easily access is the micro-tube. The drip systems have been marketed in the country for over 15 years now; and the micro-tube is considered by the industry an obsolete technology when compared to dripper.

One concept that the IDE is trying to market is a whole new farming system. In Gujarat, they found a growing lucrative market in drumstick in Padra *taluka*; and drumstick is especially amenable to drip irrigation. So in Saurashtra, they are marketing drumstick micro-irrigation as a concept. In Karnataka, micro-irrigation of mulberry has been a big hit, and can be counted as a significant IDE breakthrough.

The exciting aspect of IDE's micro-irrigation programme, and its organisational philosophy, is the implicit vision about how market development takes place for new products and technologies with potential for livelihoods creation. This vision is set out simply in Figure 1, which sets out the roadmap outlining IDE's entry into a new domain with a new technology concept. Typically, it spends a good deal of time and energy initially in establishing a new technology concept, adapting it to the local conditions and demonstrating its potential benefits to its target customers.

Figure 1. Stages in the adoption of a new techonlogy.



The best example of "concept establishment" work is to be found in IDE Nepal's micro-irrigation programme. IDE Nepal has by far the clearest strategic position. It is in the business of marketing low-cost micro-irrigation technologies to "selected" smallholder communities, along with an intensive pre- and after-sales support system. IDEN actively discourages direct sale of drip kits by its dealers without its recommendation, because it believes that without adequate technical support, adoption may be neither beneficial nor sustainable. Since IDE Nepal believes that such support can be best provided to groups of adopters organised by IDE, potential adopters outside the IDE groups may find it very difficult to get the IDE micro-irrigation kits.[8]

IDEN follows an elaborate process, and has invested significant organisational resources in achieving its strategic goal. This intensive support and backstopping make IDEN's drip programme virtually failure-proof. We could see this in course of our visits; in 5 days, we met over 200 adopters, mostly women, a few men; and we did not find anyone who was disappointed with the system. Everyone was happy, some more, some less so; clogging bothered everyone; but in no case can one say that the adoption failed.

The process of introducing the micro-irrigation technology in a new community involves several steps, as follows:

- Step 1: The Marketing Supervisor makes an exploratory visit to the village to undertake a rough feasibility analysis. He explores a range of questions: does the village have a tradition of vegetable cultivation? Is there some water available? Is there access to a market nearby? Are farmers open to new ideas?
- Step 2: If the village passes this test, a meeting is planned and organised, if possible with the entire community. In this the technology is demonstrated, a sales speech delivered with the idea of generating interest in it. Invariably, 10–15 farmers show readiness to try it out.
- Step 3: A training workshop is conducted for the "pioneers" (those who showed interest in the trial) in two aspects: [a] agronomic: seed preparation, common nursery, spacing, etc.; and [b] drip kit purchase, installation, operation and maintenance. After this, a common nursery is raised in 4–6 weeks; as it gets ready, pioneers are asked to approach the dealers and obtain their kits.
- Step 4: Marketing Supervisor, Agricultural Technician and Installer visit the community again to train in proper installation of the system, its uses, its operations and repairs. Some agronomic training is given too on planting and spacing.
- Step 5: After this, the Marketing Supervisor and Agriculture Technician keep visiting the community alternately at an interval of one week; this interval grows longer as the community becomes at ease with the system; but IDE support is available virtually on demand.

An issue which may become important as drip sales grow is IDEN's capacity to sustain such a support system. We probably saw some of IDEN's best-performing drip-irrigation communities. One wonders if it is easy to provide such a cover to all 3,200 adopters so far, or even to the 1,200-odd who will buy the kits this year. IDEN's challenge then is to find innovative ways to extend its technical support cover in a cost-effective manner – through collaboration with NGOs, or through enlisting successful and enterprising adopters in the task of supporting new ones.

In the market-development process that is illustrated in Figure 1, the first stage entails the laborious, patient and often frustrating work of pioneering a new concept: support for early adopters, developing manufacturers, setting up supply chains. Adoption is slow, and restricted to a small number of risk-loving customers. Many potential customers, the bystanders, closely watch the trials with by early adopters, gathering their evidence and drawing their own inferences. It takes time for this

[8] We met the Pokhra assembler and a dealer; both of them suggested that there is a direct demand for drip kits without IDEN recommendation. It is not clear how dealers respond. The assembler said they service the demand; the dealer said he does not.

evidence-gathering and analytical process to mature, since each bystander sets up and works with his own mental model.

If the technology delivers, the market development process enters the second phase when IDE's promotional efforts begin to deliver results in rapid growth of technology adoption and sales volumes. In this phase, promotion and marketing acquire a critical role; sales begin to build up; awareness about the technology spreads.

If the product or technology is capable of sustaining itself, without subsidy and other external support, then we begin to see interest in it from other players in the market who basically want to build a profitable line of business on the groundwork of pioneering and promotion done by IDE. It is here that IDE differs from other NGOs. Whereas most NGOs would view this growing interest of private players in their product with a sense of concern and insecurity, IDE views it as the sign of its success, the fruit of its arduous labour throughout stages I and II.

The role IDE might ideally play becomes complex at this stage. As the pioneer and the oldest player, it could set standards for others, become a rallying point, and actively assist its competitors to take on its own brand; for its ultimate aim in stage III is not the gains from its promotional pioneering but to capitalise on the "bandwagon effect" produced by the entry of other players, which is the market development role it claims to be playing.

Against this model, we found that Gujarat and Nepal are still mostly in stage 1 of the market development process for micro-irrigation; however, Kolar and Maikaal are somewhere in stage II or even III. In that sense, the market dynamic we found here is different from Gujarat and Nepal, and offers interesting insights. After five years of stage 1 labour by IDE as well as BioRe, some 1,500 acres (600 ha) of Maikaal Cotton's bio-cotton area is now under drip.

There are indications all around that drip technology is being rapidly internalised by farmers and is on the verge of taking off in this region. In Maikaal, the micro-irrigation market is already in stage III of Figure 1; and there are strong indications that private business is doing far more to cut the costs and reach the technology to poor farmers than IDE and BioRe are, probably because the former understand the mindset and the behaviour of the poor.

7. Conclusions

Following this preliminary assessment, we conclude that:

(a) In South Asia, IDE's micro-irrigation programme has responded to two critical but distinct needs: of the poor women to create a new means of income and livelihood; and of farmers in water-scarce areas to cope with extremes of water scarcity.

(b) The best example of the first is to be found in the Nepal hills, where Micro-Irrigation Communities, mostly of poor women vegetable growers, created by IDE, Nepal, have experienced major improvements in cash income and household food and nutrition security.

(c) The best examples of the second are to be found among organic cotton farmers in Maikaal region of Madhya Pradesh, near the site of the Maheshwar dam, among mulberry farmers of Kolar district in Karnataka and among lemon growers in Saurashtra in Gujarat.

(d) The strategic issues in marketing micro-irrigation bucket and drum kits to the poor women vegetable growers are totally different from promoting micro-irrigation to farmers coping with extreme water scarcity.

(e) In terms of sheer scale of outreach, promoting micro-irrigation as a means of coping with water scarcity offers much greater potential than promoting it to poor women vegetable growers.

(f) In doing both, it seems that the IDE operating philosophy of paring the cost of the technology down to the minimum and of using normal market processes to mainstream it holds great promise.

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Commercialisation of smallholder irrigation: The case of horticultural crops in semi-arid areas of eastern Kenya

Commercialisation de la petite irrigation: Le cas de l'horticulture dans des zones semi-arides de l'est du Kenya

H. Ade Freeman and Said S. Silim

Abstract

The paper reports a study of the economics of irrigated production of horticultural crops in the Makueni and Meru Central districts of eastern Kenya. These are semi-arid areas where water scarcity is an existing and growing problem. The producers who were studied are smallholders, operating both as individuals and in groups, and in many cases using pumps to lift river water for irrigation. The study indicates that the potential returns to Horticultural crops are good, but notes that these returns are to some extent offset by significant transaction costs, especially in relation to marketing. Problems were identified in several areas, including market information, access to credit, risk and uncertainty, difficulties of contract enforcement, insufficient numbers of traders acting as middlemen, and high costs for them in collection of small, dispersed product quantities.

Résumé

Cette communication présente les résultats d'une étude économique de l'horticulture irriguée dans des districts de Makueni et Meru Central dans l'Est du Kenya. Il s'agit des zones semi-arides où la pénurie d'eau pose un énorme problème. Les petits agriculteurs qui ont participé à cette étude fonctionnent aussi bien individuellement qu'en groupements, et ils utilisent souvent des motopompes pour amener l'eau d'irrigation depuis les fleuves et d'autres cours d'eau. L'étude montre que l'horticulture est potentiellement rentable mais que les gains sont plus ou moins neutralisés par les coûts de transactions, surtout lies à l'écoulement des produits. Des problèmes ont aussi été identifiés dans d'autres domaines : information sur les marchés, accès au crédit, risques et incertitudes, difficultés de faire respecter les obligations contractuelles, nombre insuffisant d'intermédiaires, et coûts élevés liés à la collecte de petites quantités de produits depuis des zones dispersées.

1. Introduction

The horticultural sector in Kenya has experienced tremendous growth over the last two decades. In 1996, total production of fruits and vegetables was estimated at 3.1 million tonnes. Of the estimated annual total produce marketed, over 3 million tonnes are consumed in local markets, about 250,000 tonnes are used as input in the processing industry, and about 90,000 tonnes are exported as fresh produce (Mulandi 1998). Thus, the horticultural sub-sector provides food, contributes to rural livelihoods through generation of employment in agriculture and related service sectors, and generates export revenue.

In semi-arid areas of Kenya the growth of production and commercialisation of horticultural crops are linked to the increase in smallholder irrigation and adoption of new technologies. This provides new opportunities for improving food security and livelihoods for large numbers of poor people who might not benefit from investments in high rainfall and more favourable agro-ecological environments. Irrigation can reduce crop production risk, providing greater incentives to increase input use, increase crop yields, intensify crop production, and encourage diversification into higher-valued crops. The resulting increase in marketable surplus and commercial activities has the potential to generate increased income for farmers. Yet, as smallholder commercial irrigation expands, issues relating to access to water among competing user groups, enterprise profitability, and access to markets take on added importance because they directly influence the size and distribution of benefits accruing to various stakeholders.

This study provides an overview of production and marketing of horticultural crops in Makueni and Meru Central districts of eastern Kenya where smallholder irrigation is an important activity.

2. Bio-physical and socio-economic profile of the study area

Table 1 shows that Makueni and Meru Central districts have a total area of 10,452 km^2, an estimated population of 1.3 million, and are characterised as arid and semi-arid agro-ecological zones. The rainfall pattern in these districts is bi-modal with the first season known as the long rains falling between March to May, and the second season known as the short rains falling from October to December. Average annual rainfall in both seasons varies from 500 mm to 2600 mm in Meru Central and slightly over 1,000 mm in Makueni.

Data for the study was collected from secondary sources and key informants in the study area. Rapid market surveys, using a checklist, were conducted to fill in data gaps. The results are used to draw implications for likely economic and social impact from the growth of smallholder commercial irrigation.

Production of horticultural crops is an important economic activity in Makuenui and Meru Central districts. In 1998, total production of horticultural crops was estimated at 5,572 metric tonnes in Makueni and 21,592 metric tonnes in Meru Central. Although accurate estimates were not available at the time of our survey, anecdotal evidence suggested that smallholder farmers produced most of these crops.

Table 1. Area and population in the study area.

District	Total area (km^2)	Cultivable area (ha)	Proportion of cultivable land in total area (%)	Total population (000)	Population density (person/km^2)
Makueni	7,440	554,000	74	767	103
Meru Central	3,012	216,500	72	500	166

Sources: Ministry of Agriculture and Central Bureau of Statistics.

3. Production systems

In Kibwezi division of Makueni district, irrigation activities are concentrated along Kibwezi, Athi, and Thange rivers. In Meru Central, irrigation activities are concentrated along the main rivers originating from Mount Kenya, Kathita, Kithino, Thigithu, and Mutunga rivers, and their tributaries.

Access to water for irrigation is a key determinant of commercial production of horticultural crops in the study area. Smallholder farmers irrigate a wide range of vegetables and fruits, year-round for sale in domestic and export markets. These include Asian vegetables (brinjals, ravaya, chillies, okra, and karella, guar, dudhi, turia, curry leaves, patra, and saragua); vegetables for the domestic and export market (tomatoes, kale, onions, spinach, and baby corn) and fruits (mangoes, paw-paw, custard apple, and citrus).

Levels of production of some principal vegetable crops in recent years are shown in Tables 2 and 3.

Table 2. Trend in production of horticultural crops in Meru Central (1991 –1998).
Units : tonnes/year

Year	1991	1992	1993	1994	1995	1996	1997	1998
Cabbages	3,365	2,445	1,626	5,190	4,000	3,600	6,300	6,600
Tomatoes	1,164	1,300	1,680	1,988	2,400	3,420	4,000	5,160
Kale	854	754	224	278	264	300	210	340
Onions	334	245	636	1,270	1,600	3,600	3,900	4,200
Karella	-	-	198	287	609	400	558	700
Brinjals	-	-	214	366	296	264	360	468
Snowpeas	-	-	30	56	360	980	-	-
Fr. Beans	1,720	1,420	2,999	3,160	800	1,050	1,170	1,640
Okra	-	-	240	516	365	450	396	500
Dudhi	-	-	45	54	162	150	319	384
Valore	-	-	714	76	48	100	-	-
Carrots	444	440	368	344	545	720	1,300	1,600

Source: Ministry of Agriculture, Meru Central Annual Report, 1999.

Table 3. Trend in production (tonnes/year) of horticultural crops in Makueni (1996-1998).

	1996	1997	1998
Brinjals	3,200	4,050	1,800
Chillies	-	225	120
Okra	1,485	900	560
Karella	315	1,000	396
Tomatoes	1,800	2,000	1,400
Kale	144	720	800
Onions	90	240	192
Mangoes	120	-	42
Pawpaw	1,200	300	210
Custard apple	60	12	12
Citrus	850	120	40

Source: Ministry of Agriculture, Makueni District Annual Report 1999.

4. Organisation of irrigation

There were variations in the organisation of irrigated agriculture in the two sites. In Makueni district, many farmers used their own motorised pumps on their plots. These farmers made their own decisions on when to irrigate and were not affected by water rationing and management problems faced by those in the group-based schemes. They were, however, constrained by lack of investment capital, high maintenance costs, and low bargaining power in marketing. Though required by the Water Act (CAP 372 of laws of Kenya), few individual irrigators purchased water permits as a result of weak statutory enforcement by authorities and bureaucracy involved in getting permits.

Group-based irrigators pooled their resources by collective ownership of motorised pump sets and communal production. The groups were allocated water at different schedules. They seemed to benefit from pooling their resources, but were faced with frequent management problems. There was limited availability of water for group members at the lower end of the canal. Some farmers in irrigation schemes, mostly along the Kibwezi River, grew crops independently on their own plots but were also members of groups that controlled the supply of water. A water management committee allocated water according to a water allocation timetable. Most farmers in group-based schemes purchased water permits because many donors stipulated it as a requirement.

In Meru Central district group-based irrigation was dominant, but few individuals owned irrigation equipment. These group-based schemes were mostly donor-driven as some donors required the formation of groups as a prerequisite for funding. Many of these schemes operated on a cost-sharing basis with donor funds providing the initial investment for establishment of water intake pipes and storage tanks. The farmers generally managed these groups appointing a committee to manage the project while the farmers themselves enforced by-laws. Few individual farmers, mostly large-scale producers, used their own motorised pumps on their plots.

Farmers used different irrigation technologies in the two districts. In Makueni district motorised pump-fed furrow irrigation was dominant, but a few farmers used gravity-fed furrow irrigation. The Super Money Maker manual treadle pump was introduced recently but has not been widely adopted. A few large-scale farmers and institutional operators such as the University of Nairobi and Tana and Athi River Development Authority used drip and sprinkler irrigation systems.

In Meru Central district sprinklers were dominant due mostly to the nature of the topography. Furrow irrigation, where water flows by gravity, was another common irrigation technique. A few farmers used the bucket kit while some large-scale farmers used motorised pumps.

5. Organisation of marketing

Although marketing arrangements were similar across both sites, the marketing channels were different for domestic and export markets. The main crops sold in domestic markets were cabbages, onions, kale, tomatoes and “export crops,” such as french beans, that were rejected by exporters because they did not meet export standards. Most farmers sold their crops at the farm-gate to rural traders within the village or to traders coming from out of the district both to save time and to avoid farm-to-market transport costs. Rural assemblers sold to larger traders in local markets, who then sold to other traders in regional markets or large urban markets such as Nairobi and Mombasa. Some traders entered into informal contracts with farmers before the crop was harvested. Rural traders collected and assembled small quantities of produce from many farmers scattered all over the rural areas. However, a few farmers, especially those who were located close to market centres, sold crops directly in local markets because they could get better prices. Crops were mostly packed in bags, except for tomatoes that were packed in cartons. All transactions in local markets were in cash.

The major crops sold in export markets were french beans, baby corn, and Asian vegetables. There were several companies involved in marketing of export crops. In Meru Central it was estimated that the number of companies involved in marketing rose from 13 in 1997 to 20 in 1999, an increase of 54 percent in 2 years. Some of the exporting companies were seasonal, involved in crop marketing only during the peak season, while others were engaged in marketing year-round.

There were several marketing arrangements for export crops:

- Exporting companies organised marketing directly with individual farmers or farmers' co-operatives, with written contracts specifying volumes, dates of collection, and prices. This was a common practice with large-scale producers, but few smallholder farmers had formal contracts with exporting companies or their agents.
- Company agents or brokers entered into verbal and informal contracts with groups of farmers. Although they agreed to enforce penalties in case of a breach of contract without a written document it was difficult to effect them. Farmers were not restricted to sell to one agent, but they invariably sold to agents who provided farm inputs such as seeds and chemicals.
- Company agents or brokers entered into verbal and informal contracts with individual farmers.
- Individual farmers sold to company agents or brokers without a formal or informal contract. Transactions with informal contracts were usually on credit and it could take up to one month between collection of produce and payment.

Interlinked transactions were very common, with company agents providing farmers with seeds, chemicals, advice on planting, application of chemicals, grading, sorting, and packing. In some cases technicians hired by the exporting company supervised farm activities from production to marketing and scheduled planting through control over quantities of seed provided to avoid gluts in the market.

About 90 percent of total horticultural export from Kenya is destined for European markets. In these markets the EU sets the grades and standards for exports, including maximum pesticide residue levels, size, shape, and weight of packaging materials.

6. Marketing constraints at smallholder level

Farmers cited several marketing constraints. These included:

- Lack of physical infrastructure reflected in inaccessible roads, lack of market facilities, power, and electricity;
- Unavailability of quality seeds and other inputs, including production and trading capital;
- High levels of post-harvest losses;
- Lack of economies of scale leading to high cost of assembly;
- High level of crops rejected at both farm level and at company warehouses because products did not meet market standards. In some cases farmers were not compensated for rejected products;
- High levels of price risk and market uncertainty;
- Unreliable information on market trends or scheduling of production decisions to meet market needs. Farmers and other market intermediaries were not aware about important

information on price, marketing conditions, and grades and standards further up the marketing chain.

7. Profitability of horticultural crop production

Gross margin analysis was used to illustrate the profitability of investment in selected horticultural crops (Table 4).

The enterprise budget data in Table 4 suggests that smallholder production of horticultural crops is a highly profitable enterprise when compared to alternative crop investment options that farmers can undertake. For example, gross margin for the most profitable enterprise is about 400 percent higher than those for the competing maize crop. This raises the question why every farmer in the area is not jumping on to this. Several reasons explain why the industry has not seen a massive entry into horticultural crop production, as the profitability estimates would suggest. One important factor is that the enterprise budget figures do not include transaction costs that are not explicitly measured. These costs arise mainly from the specific institutional arrangements that determine the production, market access, and trade in horticultural crops. Because such costs are not included as monetary costs in the enterprise budget, it is likely that these budgets erroneously overestimate the actual profitability of horticultural crop enterprises by underestimating the cost of inputs and overestimating the price of farm output. Consequently, the enterprise budget makes horticultural crop enterprise more profitable that it actually is, especially in the study areas where poor rural infrastructure, risk, and other market imperfections lead to high transaction costs.

Table 4. Gross margins of (KSh per hectare per year)[1] selected crop enterprises in Meru Central and Makueni districts.

	Meru Central			Makueni	
Activity	French beans	Tomato	Potatoes	Karella	Ravaya long
Land preparation	3,705	3,705	3,705	7,200	7,200
Seeds	29,640	741	29,640	0	0
Planting	2,470	7,410	2,964	2,012	1,817
Weeding	5,928	5,928	4,940	5,415	10,381
Manure	0	17,290	17,290	0	0
Fertiliser	8,892	11,115	13,338	3,735	3,960
Irrigation	0	0	0	32,230	25,300
Chemical	16,796	55,328	21,489	29,208	21,872
Nursery management	0	4,940	0	0	0
Pruning	0	1,976	0	0	0
Ridging	0	0	3,705	0	0
Fertiliser application	1,482	0	988	0	0
Spraying	2,470	2,470	7,410	0	0
Harvesting	39,520	6,175	14,820	5,425	12,472
Others	0	0	0	13,469	0
Miscellaneous costs	0	0	0	9,869	14,048
TOTAL VARIABLE COST	110,903	117,078	120,289	108,563	97,050
Mean output (kg/ha)	9,880	24,700	19,760	12,500	20,000
Average price/kg	30	10	10	25	15
TOTAL REVENUE	296,400	247,000	197,600	312,500	300,000
GROSS MARGIN	185,497	129,922	77,311	203,937	202,950
US$ equivalents:					
Total revenue	4,896	4,080	3,264	5,162	4,955
Gross margin	3,064	2,146	1,277	3,369	3,352

Source: Ministry of Agriculture and Meru Central Annual Report, 1999.

[1]The average bank exchange rates of the Kenya shilling in 1998 and 1999 were US$1 = KSh 60.54 and KSh 70.42, respectively.

8. Conclusions and implications

Several implications can be drawn from the overview of horticultural production and marketing presented in this paper. An important issue that needs serious attention is the question of water scarcity. As smallholder irrigation expands in a regime of lack of enforcement of water regulation, lack of water pricing, and uncontrolled water use, issues relating to water scarcity are likely to be an overarching concern that could lead to social conflicts. There is urgent need for policy reforms that will take into account the likely equity and efficiency considerations of growing water scarcity problems as well as the types of institutional innovations for allocating water that are likely to have the greatest impact on smallholder farmers.

Access to water and control over resources and income from sale of horticultural products are likely to influence gender relations with increasing commercialisation of smallholder agriculture. Interventions need to address the issue of how women farmers get access to resources and information as well as how access and control over resources influence their participation and investment decisions in profitable commercial activities.

Issues of produce marketing need to be resolved if the horticultural sector is to play an important role in poverty reduction. The conventional wisdom is that unscrupulous middlemen exploit farmers. While it is true that middlemen do act opportunistically the case study suggested that problems of market imperfection and high transaction cost feature prominently in smallholder farmers marketing decisions. For example,

- Market intermediaries rarely knew or provided important information such as price trends, seasonal requirements, market product specifications or quality standards. The cost of acquiring such information was high, precluding many smallholder farmers from using such information to make production and investment decisions.
- Rural assemblers faced high opportunity costs in collecting small volumes of product from large numbers of producers scattered all over the rural areas.
- Many producers continued to sell to particular market intermediaries even when they were dissatisfied with the service, because they could not find an alternative market outlet or the cost of finding and/or negotiating with an alternative buyer was too high.
- Market intermediaries could misinform farmers about overall market conditions, wrongly claiming that produce quality deteriorated in transit, or by delaying payments because of imperfections in information collection and dissemination systems.
- Most farmers and market intermediaries relied on their own funds to finance production and trading activities. There was a lack of credit available for lending despite the need for production and trading credit. Formal credit was not available for traders because lenders either found it difficult or encountered high costs in assessing the creditworthiness of potential borrowers. This high cost of acquiring information on potential borrowers is reflected in widespread failures of credit markets.
- Farmers lost cash income because of the high cost of enforcing contracts.
- Both production and trading were characterised by high levels of uncertainty about the availability of markets, the quality of the product, and the conditions of trading.

Given the complex production and trading environment in which smallholder farmers operate, is it likely that they will survive in the highly competitive and exacting world of horticultural exports, where high transaction costs in the smallholder sector typically favour large producers? Our research suggests that many smallholder farmers can benefit from the opportunities created by commercialisation of irrigation. Nonetheless, for this to happen marketing interventions in the horticultural sector need to focus on improving the competitive advantage and increasing the returns to investments by smallholder farmers. This may be achieved through improvements in marketing arrangements that reduce risk and uncertainty, lower transaction costs, improve co-ordination and information flows between market intermediaries and farmers, and promote transparent and trust-building relationships.

Several private companies and development organisations are increasingly promoting contract farming as a mechanism for linking smallholder farmers into high value horticultural markets. However, contract farming can be a relatively high-cost option when dealing with large numbers of widely dispersed smallholder farmers. They are not very effective when the legal system is weak and, as a result, cannot enforce the terms of the contracts. Collective or group marketing arrangements are also extensively promoted by development organisations as mechanisms for reducing transaction costs and improving sellers' negotiating power. Yet, the experience in rural Africa shows that in reality many collective and group marketing initiatives are not sustainable after support by the development agency is withdrawn. Organisational problems, competing interests, and high incidence of free riding frequently weaken collective or group marketing arrangements.

One option that has not been extensively investigated is improving the efficiency of rural collection points. Collection points are ubiquitous in rural Africa but they serve mostly as bulking facilities. However, the traditional bulking facilities could be improved upon and used as mechanisms to improve access to market services, dissemination of information on production conditions, prices, market conditions, and application of known grades and standards. The successful implementation of improved collection points by some private horticultural export companies in Kenya, such as Homegrown Ltd., suggest that these arrangements need not involve formal contracts (Evans 1999). On the contrary, their success is based on transparent marketing activities and trust building relationships between smallholder farmers and buyers.

The challenge of commercialisation of smallholder irrigation and its potential for income generation for the poor, therefore, needs to give a central role to innovative marketing interventions that focus on the realities of cost of production, marketing, and trade in rural areas.

Acknowledgements

The authors are grateful to Alice Murage and Geoffrey Muricho for providing valuable research assistance and to the International Water Management Institute, IWMI, for funding this study. The views expressed in this paper are those of the authors and are not representative of IWMI or ICRISAT.

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Capitalisation sur les conditions favorables au maraîchage irrigué en Afrique de l'Ouest à travers la commercialisation de technologies en irrigation appropriées

Marketing of appropriate irrigation technologies to capitalise on favourable conditions for irrigated horticulture in West Africa

P. Beaujault et B. Dotson

Résumé

Cet article décrit la méthodologie d'intervention de l'ONG américaine EnterpriseWorks dans le secteur de l'irrigation à petite échelle et l'impact particulier qu'elle a eu dans la promotion de la pompe à pédales pour le maraîchage irrigué en Afrique de l'Ouest. C'est une approche commerciale conduit en partenariat avec des agences de développement et des entrepreneurs locaux. Le soutien EnterpriseWorks comprend des études de marché, identification des solutions technologiques appropriées, appui à la production et la vente, et contrôle de la qualité. Les résultats de vente et des revenus supplémentaires obtenus dans six pays africains démontrent la réussite et la durabilité de l'approche ainsi que les avantages de la pompe à pédales, technologie peu coûteuse et efficace, vis-à-vis des pompes motorisées et des méthodes traditionnelles de la corde et du seau.

Abstract

This article describes the mode of intervention of EnterpriseWorks, an American NGO, in the small-scale irrigation sector with special emphasis on the impacts it has had on the promotion of the treadle pump for horticulture production in West Africa. It is a commercially based approach conducted in collaboration with local-level development agencies and entrepreneurs. EnterpriseWorks interventions include market surveys, identification of appropriate technology solutions, manufacturing and sales support, and quality control. Sales and income figures from six African countries are used to demonstrate the success and sustainability of the approach as well as the advantages of the treadle pump as an inexpensive but effective technology alternative to motorized pumps and traditional bucket and rope methods.

1. Introduction

EnterpriseWorks est une organisation non gouvernementale (ONG) américaine à but non lucratif, dont la mission est d'aider les petits producteurs à accroître leurs revenus à travers la création d'entreprises rentables. Précédemment, elle a été connue sous le nom de ATI (Appropriate Technology International).

EnterpriseWorks intervient dans plusieurs pays en Afrique, soit par l'intermédiaire de programmes nationaux au Sénégal, en Guinée Bissau, au Mali, au Bénin, en Tanzanie, en Ouganda et bientôt au Ghana, soit par l'intermédiaire d'une assistance technique contractuelle auprès d'organisations nationales au Niger (avec l'Agence nigérienne de promotion de l'irrigation privée, ANPIP), en Côte d'Ivoire (avec l'Agence nationale de développement rural, ANADER) et au Burkina Faso (avec l'Association des professionnels de l'irrigation privée et des activités connexes, APIPAC).

2. Contexte d'intervention de EnterpriseWorks dans le secteur de l'irrigation

Les études de marché dans le secteur du maraîchage en Afrique de l'Ouest montrent que l'accès à l'eau et le coût de l'équipement de l'accès à l'eau sont d'importantes barrières à une production accrue de légumes irrigués.

Les producteurs de petite échelle, ceux qui cultivent moins de 0,5 ha, représentent une part sensible du secteur et comptent pour la majorité de la production commerciale et des producteurs du pays. De tels producteurs ne pouvant pas acheter les motopompes, le moyen courant pour irriguer reste la corde et le seau. Mais la faible capacité de cette méthode (1000 litres/heure) est une importante contrainte à l'accroissement de la production.

Néanmoins, des conditions économiques majeures pour une production accrue sont souvent présentes. Ces conditions sont:

- un marché et une demande du marché pour les légumes
- l'accès à des sources d'eau suffisantes
- la disponibilité d'un champ irrigable
- la disponibilité d'une main-d'œuvre
- la disponibilité d'autres intrants (semences, fertilisants, etc.)
- l'accès à un capital suffisant pour l'expansion

3. Méthodologie EnterpriseWorks et son application au secteur pompe à pédales

L'approche EnterpriseWorks est une approche commerciale du développement. Cette approche sous-tend la méthodologie de travail qui se décline comme suit:

- Etudier les secteurs économiques clés pour identifier leurs contraintes
- Identifier les solutions de technologies appropriées susceptibles à faire face à ces contraintes
- Evaluer le potentiel du marché pour ces technologies
- Etablir et soutenir des entreprises commerciales dans la production et la vente des technologies
- Développer des marchés pour ces entreprises par un support marketing
- Suivre la qualité de fabrication et d'utilisation
- Quitter l'activité quand le système est autonome

Examinons maintenant l'application de cette méthodologie à la pompe à pédales.

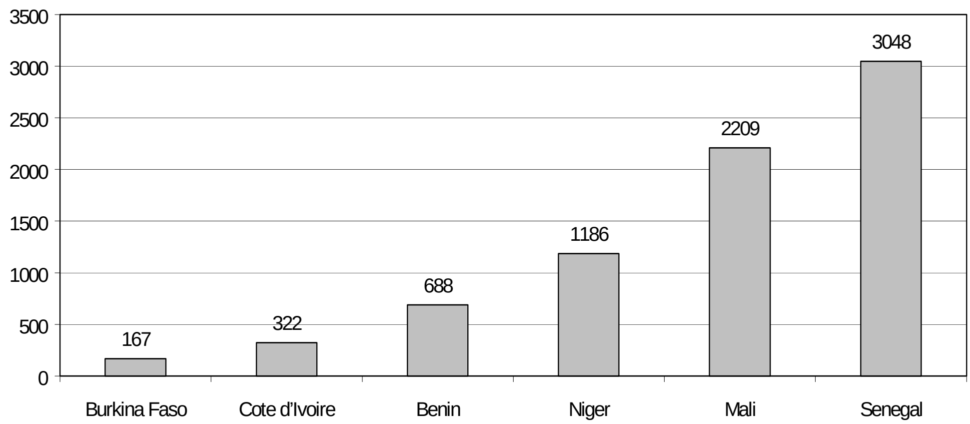
- *Etude du secteur irrigué:* Le manque d'équipement pour puiser l'eau est la barrière principale à l'accroissement de la production. L'accès à un équipement amélioré réduit le temps d'arrosage, accroît la superficie cultivable, ce qui conduit à une plus grande production.
- *Identification de solutions de technologies appropriées:* La pompe à pédales est une pompe légère, puissante, à motricité humaine qui aspire 4 à 7 m^3 / h d'eau de surface et de puits jusqu'à 7 m de profondeur, et qui possède les qualités suivantes : (a) peu coûteuse et financièrement accessible aux maraîchers, (b) donne un ratio bénéfice / coût très positif, (c) peut être fabriquée à partir des matériaux disponibles localement, (d) rentable pour les fabricants.
- *Evaluation de la potentialité du marché:* Cette étape porte sur: (a) la demande potentielle du consommateur, (b) l'existence d'une capacité de fabrication locale, (c) le pouvoir d'achat de la part des maraîchers. En effet, les bénéfices potentiels de l'achat de technologies sont les clés qui déterminent la demande potentielle du consommateur. Ces bénéfices doivent être: en argent liquide, importants, comparés aux coûts d'investissement, et rapides (habituellement quelques semaines).
- *Soutien à la production et la vente:* EnterpriseWorks collabore avec les entrepreneurs locaux pour établir la production et la vente commerciale des technologies testées et éprouvées. Les partenaires de EnterpriseWorks: (a) sont des entreprises métalliques établies, (b) investissent avec leurs propres fonds, (c) vendent directement aux clients, (d) sont proches de la clientèle potentielle (production décentralisée), et (e) ne sont pas subventionnés dans leur production et vente. Cette approche commerciale se fonde sur le profit comme motivation, ce qui garantit la durabilité de nos interventions.

- *Support marketing:* L'appui EnterpriseWorks est fourni en collaboration avec les partenaires entrepreneurs et comporte des techniques élémentaires de marketing pour introduire et développer les nouveaux produits. Il s'étale sur le moyen terme et s'appuie sur des liens directs entre consommateurs et fabricants. L'effort s'arrête dès que la demande du produit est fermement établie.
- *Suivi de qualité:* Un suivi de la qualité de fabrication et de l'utilisation est assuré au démarrage du produit.
- *Fin d'intervention:* EnterpriseWorks quitte l'activité dès que le système est autonome.

4. Ventes et impacts au niveau des producteurs

Avec cette approche, EnterpriseWorks et ses partenaires ont établi la production et la vente commerciale de technologies d'irrigation peu coûteuses dans 6 pays en Afrique de l'Ouest. La figure 1 montre que près de 8000 pompes à pédales ont été vendues de 1991 à 2001. La durabilité de cette approche a été démontrée au Sénégal où plus de 400 pompes ont été vendues depuis que l'appui du projet aux fabricants a pris fin en 1998.

Figure 1. Cumul des ventes des pompes à pédales, 1991-2001.



Au Mali, les cultivateurs ont réduit leur temps d'irrigation de 72 pourcent par rapport à la méthode de la corde et du seau. De plus, la superficie moyenne s'est accrue d'environ 82 pourcent après l'achat de la pompe, augmentant énormément la production.

Ainsi, cette production supplémentaire se traduit par un revenu annuel net additionnel de 194.000 FCFA (US$273) par an et par pompe. De plus, un cultivateur gagne plus de 100 pourcent de recettes sur son investissement dès la première année. Cela se traduit par 1.164.000 FCFA (US$1639) de revenus supplémentaires sur les six années de durée de vie estimée de la pompe.

Une estimation des impacts globaux est présentée dans le tableau 1.

Tableau 1. Estimation d'impact global sur le revenu.

Pays	Année du démarrage du projet	Cumul des ventes	Revenu net additionnel par an et par pompe (US$)	Durée de vie estimée de la pompe	Revenus supplémentaires globaux (US$)
Bénin	1998	688	577,15	6	2 382 475
Burkina Faso	2000	167	Pre-impact	6	Pre-impact
Cote d'Ivoire	2000	322	Pre-impact	6	Pre-impact
Mali	1995	2209	273,24	6	3 621 523
Niger	1997	1186	291,03	6	2 070 970
Sénégal	1991	3048	586,23	6	10 720 974
Total		7620			18 795 942

Le tableau 2 compare les résultats d'une étude comparative menée au Ghana des coûts de pompage entre des pompes motorisées et pompes à pédales.

Tableau 2. Comparaison des coûts (en cedis[1]) de pompage de 1m^3 d'eau au Ghana.

	Pompe à pédales				Pompe motorisée			
	(0,33 ha)	(0,50 ha)	(0,66 ha)	(1 ha)	(0,33 ha)	(0,50 ha)	(0,66 ha)	(1 ha)
Main d'œuvre	208	208	208	208	0.25	0.25	0.25	0.25
Dépréciation								
3 ans								64
4 ans				5		96	96	
5 ans			7		115			
6 ans	12	8						
Pièces de rechange	8	8	8	8	83	83	83	83
Lubrifiant	3	3	3	3	20	20	20	20
Fuel	0	0	0	0	200	200	200	200
Total	231	227	226	224	418	399	399	367

[1] 1 US$ = 7000 cedis.

Source : Perry, Ed. 2001. Ghana Irrigation Subsector Study, Project paper, EnterpriseWorks Worldwide, 25p.

5. Autres interventions de EnterpriseWorks

En plus du secteur pompe à pédales, EnterpriseWorks intervient dans des secteurs suivants liés à l'irrigation à petite échelle en Afrique de l'Ouest:

- L'appui à la commercialisation de puits en PVC et de puits forages, avec l'ANPIP au Niger
- Le test d'équipements d'irrigation motorisés, peu coûteux, comme le Groupe Moto Pompe GMP à hélice, avec l'APIPAC au Burkina Faso
- L'appui à la commercialisation des bulbilles d'oignons au Mali.

Enabling environments, financing mechanisms and equitable access to irrigation

Environnements favorables, mécanismes de financement et accès équitable à l'irrigation

Charles L. Abernethy

Abstract

Irrigation development in Africa, in the past 30 or 40 years, has been done primarily by governments, with or without the financial and technical contributions of foreign donors. In many cases new installations have been oriented towards welfare objectives. In recent times several countries have been introducing policies of management transfer, under which farmers must usually make increased financial contributions towards the running costs of the irrigation schemes which serve them. The paper considers what constraints may prevent further increases of private finance beyond this modest beginning (including the possible input of private capital) and what changes in the institutional environment may help to reduce these constraints. Enabling conditions are reviewed under five categories: profitability, rights to land and water, sources of finance, intra-community relationships, and residual supports by government. The ultimate objective should be self-supporting irrigation systems with a sound economic base, but the existing situation is in some respects far from that. Particular attention needs to be given to the long-term security of such investments, through measures such as systems of documented land and water rights, laws governing the nature and procedures of organisations of irrigators, and facilitation of market development for higher-value crops.

Résumé

Le développement de l'irrigation en Afrique dans les 30 ou 40 dernières années a été surtout l'œuvre des gouvernements, avec ou sans l'assistance financière et technique de bailleurs de fonds étrangers. Dans beaucoup de cas, la mise en place des infrastructures neuves a été motivée par des objectifs sociaux. Plus récemment, beaucoup de pays ont commencé à introduire des politiques de transfert de gestion où les agriculteurs sont appelés à assumer plus de responsabilités financières dans le fonctionnement de leur aménagement. Cet article met en évidence des contraintes qui risquent d'empêcher une participation financière plus importante de la part du secteur privé (y compris l'injection des capitaux privés) et propose des changements au cadre institutionnel qui aideraient à surmonter ces contraintes. Ces facteurs sont de cinq ordres : la profitabilité, des droits d'accès à l'eau et à la terre, des sources de financement, des relations intra-communautaires, et le soutien résiduel de l'Etat. Bien que l'objectif global reste la mise en place d'aménagements hydro-agricoles autogérés à base économique solide, la situation existante est loin de là. Une attention particulière doit être prêtée à la sécurisation des investissements à travers des mesures tels l'enregistrement et la documentation relatifs aux droits d'accès à la terre et à l'eau, des lois précisant la nature et les procédures des organisations d'agriculteurs, et le développement de marchés pour des cultures à haute valeur.

1. Introduction

The goal of increasing the participation of the private sector in African irrigated agriculture seems to be good. Government-sponsored irrigation systems have often had mediocre results, and many governments lack the resources of money and skills required for efficient state management of these systems. But the introduction of a greater level of private-sector involvement depends very much on the behaviour of the government irrigation agencies.

More than a decade ago, Moris (1987: 100) commented on the "privileged" status of irrigation as a subject for government investment in Africa. By "privileged," he said he meant

> *preferred investments, chosen because they are thought to answer some pressing policy problem. When accorded privileged status, technologies are more likely to be adopted by reference to the seriousness of the problem than on the basis of their own likely*

> *performance under realistic field conditions… In Africa irrigation is often seen as the universal answer to drought, and thereby escapes detailed justification and local adaptation.*

According to this view, there was the risk of over-investment in creating too many irrigation systems; their designs were often brought in, with little or no change, from donor countries with different needs; and there was little attention to cost.

In the 1970s and 1980s, perceptions of the urgency of food needs and drought relief were accentuated by recent memories of the suffering caused by droughts in the Sahel, Ethiopia and elsewhere. Events of that kind may have led to a perception of irrigation as something intrinsically good and desirable: "privileged," in Moris's view. But much more recently, Schiffler (2001) has expressed quite similar concerns about the impacts of irrigation development, at a global scale:

> *… using actual food prices instead of the food price projections made in the past, many of the past investments in irrigation would not have been economically viable. Indeed, over-investment in irrigation may have contributed to accelerate the decline in real food prices, thus making it harder for small-scale farmers in developing countries to break out of poverty. Publicly-funded large-scale irrigation projects have beyond any doubt improved the living conditions of millions of farmers in developing countries. However, by reducing food prices they may well have had a negative impact on many more farmers in rainfed agriculture and in privately-funded small-scale irrigation schemes*.

Neither of these is telling us that irrigation is an inappropriate technology. What they say is that there have been injudicious investments, and the installation of systems whose basic economics are in some cases dubious or non-viable, and that government-assisted schemes may actually reduce or prevent private activity, by lowering prices. It may be that governments and donors have installed, with irrigation development, a production capacity that is in excess of effective demand for its outputs.

Similar accusations, of increasing the poverty of those who are not fortunate enough to obtain a place in the government irrigation systems, were made in India during its great irrigation expansions 25 – 30 years ago. One implication is that governments, after giving some farmers the advantage of occupying new irrigation systems, should not then give those people further gifts in the form of continued free services of management, operation and maintenance by government.

On a more optimistic note, Moris (1987: 113) observed that:

> *The main exceptions come from the areas of Africa where large-scale commercial producers have evolved their own irrigation systems, usually to protect export crops like coffee, tea or tobacco. In Zimbabwe, Swaziland and Kenya, there are producers who inherited or purchased highly efficient and cost-effective irrigation systems, a demand-led outgrowth of large-scale commercial farming in a hazardous environment. The contrast between demand-led and bureaucratically imposed irrigation performance is striking*.

In the 14 years since he wrote this, the tendency towards "bureaucratically imposed" irrigation has reduced in Africa. A theme in the present paper is that we should encourage further movement in the "demand-led" direction. We live, however, with some legacies of the past, including the residual consequences of past decisions, and the persistence of some attitudes of bureaucratic dominance.

It should be emphasised that the "demand" we are speaking of here is demand for the products of irrigated agriculture, not demand for irrigation facilities themselves. There is evidence that the desire to have irrigation, or the desire to have a plot of land within an irrigation system, is high. Among the most striking cases are the irrigation co-operatives along the Niger River in Niger. The annual fee payment required from users is typically equivalent to nearly 200 US$/ha/year (PMI-Niger 1998: 117) at official exchange rate, and much more than that (around 800 US$/ha/y) at purchasing power parity rate. These rates are extremely high by global developing-country standards; yet all plots are taken up, and there are waiting lists for access to plots at many of these systems. But perhaps this simply reflects the fact that, if the government is sponsoring irrigation development, those who remain outside of such systems will be at a great disadvantage. This type of demand for irrigation ***service*** does not guarantee in any way that there are consumers ready to pay the true economic cost of irrigation ***products***.

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In investigating how to stimulate greater private-sector involvement in irrigation, we shall look at three levels of involvement, which are progressively more difficult to achieve:

a how to encourage private people (usually, existing users of irrigation systems) to take over responsibility for operation, maintenance, and management of existing government-built irrigation systems;

b how to encourage private investments of capital in the creation of new irrigation systems, and in the expansion of existing irrigation systems, or the up-grading of their facilities and technologies;

c how to encourage new entrants into the business of irrigated agriculture; in other words, to reach a situation where irrigated agriculture not only can survive on its own financing, but can become sufficiently successful to attract new people who are willing to contribute fresh money and effort to it; this could be in the construction or utilisation of facilities, or in provision of support services.

We shall try to identify institutional and financial arrangements that will make these results more likely; and we shall try to see whether additional institutional safeguards may be needed, to prevent the possible increases of inequity that can sometimes result from ill-planned increases of individual economic freedom.

2. Utilising existing government irrigation systems

The policy of irrigation management transfer, under which government agencies increase the roles of farmers' organisations in operation, maintenance, management decisions, and funding of recurrent costs, has been in existence in various countries since about 1975. It began in South America and the Philippines. African examples began more recently. Vermillion (1996, 1997) identified eight African countries then operating irrigation management transfer policies: Madagascar, Mauritania, Niger, Senegal, Somalia, Sudan, Tanzania, and Zimbabwe, to which Burkina Faso and perhaps some others should be added.

Irrigation management transfer, generally, does not bring in the external private sector to any significant extent. It is only a rather small step away from full government control of irrigation management. In the most common models, farmers on the irrigation systems are asked to form organisations, usually adopting some standardised constitution proposed by the government agency. These organisations then become responsible for the kind of local-level tasks listed in the previous paragraph.

Reviewing 29 studies of such transfers from around the world, Vermillion found that ownership of the irrigation facilities was vested in the farmers, after the transfer, in only three cases, of which one (in Senegal) was in Africa. The irrigated areas involved in that one African case were the smallest in all of these studies.

The outcomes of irrigation management transfer programmes have been very variable. It is difficult to claim that it has been, overall, a successful policy. A part of the difficulty of assessment lies in the obscurity, and diversity, of objectives. Possible objectives may be (Abernethy 1998: 18):

- To reduce public expenditures.
- To improve irrigation performance and generate surplus production.
- To enhance sustainability of irrigation facilities.
- To conserve water resources and reduce resource consumption.

Of these, only the second is clearly an objective of the system's users. They may be also interested in the third, but that probably depends on whether they can perceive themselves as the new owners of the system and its facilities. Since, in 90 percent of transfer programmes, the facilities still belong to the government agency, the users will assume that sustainability and renewal costs are the government's problem, not theirs.

The other objectives noted in the list above are essentially objectives of the government or of the society in general. It is not certain that the farmers will feel motivated towards those objectives.

The hope of improved agricultural production seems to be the main factor that could motivate farmers to want irrigation management transfer. Is it achieved? The evidence is mixed and uncertain. Most studies have been of the "before and after" type, so production would perhaps have been improving anyway. The extent of output improvements that have been noted in the literature does not seem (in general) significantly above the normal growth that happens through other influences such as crop improvements.

The organisations set up (under government promotion schemes) to be the recipients of irrigation management transfers are often of a kind that would be thought peculiar and unsatisfactory, if they existed, for example, in the world of business. Membership is often "inclusive": that means, the promoting agency, or the standard constitution, may simply announce that all people farming land within the boundaries of the irrigation scheme are members automatically. For example, the standard constitution of such organisations in Niger (PMI-Niger 1998) says, under the heading "Admission as a member of the co-operative":

> *Article 4: Each head of a household, to which a landholding in irrigation system XXX has been allocated, has the right to join as a member of the co-operative, and undertakes to respect the clauses of the present constitution.*

The member must then sign a personal contract with the organisation, which legitimises his or her continued use of the landholding, and regulates various aspects of agricultural behaviour, and inputs of work and fees.

The more usual concept of an organisation, in other kinds of activity, involves a collection of individuals who join together in order to achieve some shared objective that could not be achieved by individual efforts. It is clear that the sort of inclusive arrangement commonly used in irrigation management transfers is significantly different from this. The person in the Nigérien collective has made no personal commitment to any joint objectives. "Joining" the organisation is simply a requirement (imposed by government) for protecting a personal interest, the right to continue receiving water and cultivating the land-holding. In some such cases, the "members" scarcely know that the organisation exists. Field interviews may show that individual farmers feel a sense of alienation from the organisation.

There is usually not a special law enacted to define the operations of organisations that are set up to receive irrigation management transfers. In the case just mentioned, Niger, they were established under a law on rural co-operatives. Other countries have used other existing legal arrangements. The absence of a law specific to irrigation organisations may explain some of the problems we encounter.

Some of the problems and disappointments of irrigation management transfers may be attributed to inadequate attention to establishing suitable enabling environments, of which the legal deficiency just noted above, is an example. Vermillion (1994) set out a short list of prerequisites for success, which he identified from the more frequent recommendations of researchers. These were:

- a clearly recognised and sustainable water right;
- appropriate infrastructure relative to local management capacities;
- clear designation of responsibility and authority for essential management functions;
- effective accountability and incentive mechanisms;
- adequate resources (financial, human) for sustainable irrigation management.

This list includes aspects of national policy as well as of local arrangements. The list can be further expanded and refined (Abernethy 2001) thus:

Preconditions of national policy

Essential	A law defining the status, governance, scope, and financing of irrigators' organistions Political will and consistency in applying the transfer policy
Desirable	A clear and secure system of water rights Laws and procedures that will be applied in case of bankruptcy or other organisational failure

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Local preconditions

Essential Clear definition of ownership and responsibilities
Clear rules of membership
Consultation with all affected famers to define their objectives; and assistance to them in drawing up a constitution that reflects some combination of government's and members' goals
Skill training in aspects of management, especially communication and record-keeping
Adequate initial capital

Desirable A secure water right for the irrigation system
(In larger systems where the government will continue to operate main-system facilities) A clear contract or level-of-service declaration
Appropriate infrastructure that the famers can operate and maintain with minimal need for external skills

3. Capital investment

As we have seen, irrigation management transfer is a small step towards private-sector involvement. Only existing users of the facilities normally are concerned. Ownership of facilities and water rights is not normally part of the transfer, except in some rather small schemes. Government roles usually remain quite large. The transferred functions are usually lower-level operations and maintenance. The financial inputs expected from the organisations' members are small: they vary widely, but the range of US$10–50 per hectare, per year would probably cover the majority of cases. Membership is often automatic, rather than the result of personal desire to pursue joint objectives.

Financially, irrigation management transfer is (in most cases) essentially about bringing private funds, from existing irrigation users, to meet all or part of the operational and maintenance costs of irrigation systems. It does not usually address capital investment. In cases where the recipients of a transfer are required to make a contribution to capital, as in the Philippines or Niger, these are generally rather nominal contributions, quite far from meeting the true costs of installing such systems. Where irrigation users' organisations are required to contribute to capital costs, these contributions may be spread over periods such as 25 years, without interest or inflation effects; so these are conditions very much softer than the conditions that would face a genuine private investor.

When we contemplate the possibility of bringing private capital investment into irrigation, we soon see that this is a much more complex objective for public policy to achieve. We can consider three main modes in which it may happen:

- extension of existing government-built irrigation systems;
- private installation of new irrigation systems;
- small single-owner or small-group installations.

Extension of existing government systems could, in principle, be done either by the existing users, or by some external new group. Neither of these seems to happen much. This may seem quite strange, since there are many cases where an initial government scheme has not been extended to its full potential (in terms of the available water and land resources). Usually this is because of funding constraints on the government's side. Why are the users of such systems not motivated to invest labour and money in expanding their systems to fulfil their potential?

There can be several explanations, as conditions vary. A very likely explanation is that the organisations being set up under irrigation management transfer programmes are not appropriate for this kind of challenge. Extension of an existing irrigation system by its own users requires mobilisation of a substantial effort among them. Constraints that make that unlikely seem to include:

- Allocation of inputs and benefits.
  - How will the personal or household contributions of labour and money be determined?
  - Who will get the benefits of using the extended land?

The organisations set up under irrigation management transfer generally treat all members as more or less the same. New rules are required for a joint effort such as an expansion. Some members may see no benefit for themselves in an expansion. The ordinary rules about contributions to the organisations usually make these compulsory, and somehow uniform (most commonly, a uniform rate per hectare cultivated); but undertaking some new joint effort probably requires a different basis with voluntary and variable inputs. People will be quite willing to work for expansion of the system, if they believe that they themselves will be able to use the new land; but they will need some other incentive if they believe that others will use it.

- Ownership.
  - If the government owns the system and its water rights, why should the users improve it?
  - Who will own the new facilities and their water?
  - The water available for existing users will obviously be reduced if the system is extended: what will be their compensating benefit?

The literature of farmer-managed irrigation systems has many examples of autonomous expansions, resulting in more efficient use of the available land and water. In such cases, the members of an existing farmer-managed system have perceived that they could get a direct benefit to themselves by expanding the system to accommodate new users. The benefit may be a payment, such as an “entrance fee,” or a labour contribution, such as help with annual maintenance of a common intake or conveyance canal. If the organisation receives such inputs, the future contributions of money or labour by the existing users will be reduced, and the prospect of this reduction makes them willing to let some of their water be used by the new partners.

The existing users of a government-built system, on the other hand, may feel that it is in their personal interest to oppose, not promote, its extension. They consider the water in the supplying reservoir to be “theirs,” in the sense that they are angered if the government agency starts to build structures that would enable some other group of potential users to obtain a share. But it is not theirs in the sense of a right, in which they might voluntarily decide to sell a share.

Sri Lanka has begun experimenting with an organisational model, in government systems, that goes beyond the conventional irrigation management transfer models. There are two types of farmer organisation within the same irrigation system. One is of the inclusive, statutory type, which includes all farmers. This is responsible for the routine tasks of operation and maintenance. The other is a “Farmers’ company.” This is a voluntary organisation, with a shareholder structure. Joining the company is a matter of personal choice as is the number of shares taken.

The idea is that the inclusive organisation is responsible for tasks that must be performed to keep the system functioning, whereas the shareholding organisation can undertake other kinds of activities, such as seeking new markets, making production contracts, experimenting with new crops, arranging credit lines for members, and so on. It may be possible for a model of this kind to lead ultimately to resource accumulation, and so to investment by the existing users in expansion of their own system, but that remains to be seen.

Direct private investment in creation of new irrigation systems faces a different set of constraints. These constraints relate mainly to financial factors: markets, profits, and sources of capital. Historically, in the colonial period, African countries had substantial amounts of private irrigation. It was generally established for growing high-value crops, not basic foods, and these were mainly intended for export since home markets were too thin to support this kind of activity. Cotton, sugar, tobacco, and other crops were the main examples, and some of these continue to sustain private enterprises. All of these require substantial ancillary facilities for post-harvest processing, and are, therefore, suitable mainly for companies, which can afford to install these, with a reasonable assurance of market access and continuity. Many of these companies are foreign, or began with foreign origins.

Single-owner, or small-group, indigenous enterprises on the other hand have shown high levels of activity in many countries, especially in peri-urban environments around cities. Such enterprises benefit from two modern trends: the growth of the urban populations directly increases their potential markets, and the increased standards of living of middle-class city-dwellers lead to some changes and diversification of food preferences, including usually greater consumption of fruits and vegetables.

These small-scale peri-urban enterprises correspond best to the "demand-led" development that Moris (1987) praised.

Studies of small government-built irrigation systems, in both Burkina Faso and Niger (PMI-Burkina Faso 1997; PMI-Niger 1998) showed that both crop choices and overall performance were related to market access: nearness to the capital city, and linkage by good roads. More remote systems are likely to grow only basic cereals, primarily for local consumption; systems near the city are likely to grow more vegetables for sale. Small-scale investors, installing a well or a river-bank pump, are driven by the same market logic.

The role of exporting in these smaller enterprises is problematic. Home markets for fruits and vegetables are growing, but perhaps not very fast, and prices are not high, so exporting seems an attractive alternative. But it is hard for a small group in Africa to establish a satisfactory relationship with a distant contract customer in Europe (for example). There are many risks and possibilities of disputes over such matters as quality, delivery dates, packaging and so on. The evolution of satisfactory export marketing, therefore, seems to depend on the evolution of intermediary local firms, which can carry those risks. This evolution is taking place at varying rates in different countries.

4. New entrants

There are probably many new entrants, at the small local level, appearing in the peri-urban environments all the time, especially where ground-water access is relatively easy or where there is a perennial river that can be accessed. The policy question is, should that process be stimulated by governments, and if so, how? Going beyond that, there is the question of how urban investors (including potential investors of earnings from foreign employment) may be attracted to the irrigated agriculture sector.

These new entrants could have a variety of roles. They may come in simply to provide credit to the producers. They may become agriculture producers themselves. They may come as service-providers.

The tools that governments have for helping in these matters are few, and there are strong arguments for saying that it may be better to do as little as possible, leaving the process to be as far as possible demand-led. The record of the impacts of subsidies, such as pump subsidies and fertiliser subsidies, is not good. We noted earlier Schiffler's comment on the prolonged decline of cereal prices, which may have been caused at least in part by over-investment in irrigation facilities. It will not be useful to those small investors who are already in vegetable-growing enterprises, if governments start to subsidise further entrants sufficiently to cause long-term price falls in those products too.

One of the main things that governments can do is to improve security of tenure for small irrigators, in regard to both land and water rights. The lack of land title documents is often cited as a major constraint inhibiting commercial banks from lending to small farmers and in several countries, it is an obstacle to engaging new private investors too. In some countries, especially in West Africa, traditional and hereditary rights over the allocation and use of land are exercised by local chiefs, who may use this position of power in order to control, or at least to extract profit from, potential new investors. Negotiations in these circumstances can be long and frustrating for the investor.

Water rights for small farmers are not likely to be documented, in many countries, for a rather long time; but it is a valuable policy objective to aim for, even in the long term. A company that decides to invest in irrigated agriculture without having any documented right to its water source will always be to some extent insecure, and will, therefore, seek higher rates of profit.

Many private irrigation farmers in Africa operate on a very small-scale. Formation into organisations can make their operations more efficient in aspects such as marketing, transport and purchase of inputs. Malaysia has experimented with arrangements such as "group farming" (where farmers co-ordinate their field activities but remain separate as land-owners) and "mini-estates" (where

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farmers form a share-based company which becomes the land-owner). Government agencies can develop programmes to assist the formation of such larger and stronger units, by training and advice and perhaps assistance with market contacts for export crops.

Private-sector organisations which provide specific contract services to irrigation farmers, but do not engage in agriculture themselves, have been appearing in various countries. These include (in Bangladesh) landless pump-operating groups who take a loan to install a well and a pump, and contract to supply water to neighbouring farmers, and (in China) maintenance companies. Arrangements of this kind allow some economies: for example, a maintenance contractor can invest in equipment which it may then apply to numerous different irrigation systems. Arrangements of this kind are likely to be profitable mainly in countries where the areas to be served are substantial and lie not too far apart. In countries where those conditions do not exist, we may find (for example) teams of young men who offer, for payment, to contract with irrigators' organisations to perform low-level manual maintenance of canals and drains.

5. Components of the enabling environment

After the above rapid overview of some possible private-sector development paths, and some constraints, we shall now try to identify the elements of an enabling environment that may increase the private-sector role. Five groups of enabling conditions will be considered:

- profitability;
- rights;
- sources of finance;
- intra-community relationships;
- technical and organisational support.

5.1 Profitability

The first and most essential requirement for developing any unsubsidised private-sector activity is that it should be profitable. Unfortunately, the mass of literature and research on irrigation management over the past decade or two has given very little attention to profitability. The new IWMI 5-year strategy scarcely refers to it. Irrigation is still perceived quite commonly as a welfare activity rather than as an economically self-sustaining activity. The conditions under which irrigated agriculture is profitable, and how its profitability compares with other possible uses of capital in rural environments of developing countries, are matters that have been inadequately explored.

We have to consider the competitiveness of private irrigated agriculture at two distinct levels:

- Can private-sector producers bring crops to market at prices that are the same as, or lower than, those required by producers on government irrigation systems?
- Are the potential profits from irrigated agriculture sufficient, in comparison with other investment opportunities, to attract private capital?

It seems clear that, as in other sectors, it must be difficult for private irrigated agriculture to be directly competitive with state-financed systems. The users of state-financed systems rarely if ever pay the full costs of their systems, inclusive of capital. The high amounts of new irrigation capacity that have come into existence in the past 30 years have been linked with a long-term decline of prices. So it seems reasonable to say that private-sector irrigated agriculture is not likely to be competitive if it uses the same kind of crop patterns that are usual in the state-supported systems.

Kaboré, Tahirou and Lowenberg-DeBoer (1994) investigated the opportunity cost of private capital in the Sahel, looking at the returns that were obtained from small-scale rural enterprises like fishing, retail trade, and so on. They found varied results, but the general indication was that capital was so scarce that returns of the order of 50 percent per year were obtainable. This kind of information indicates the likely competitive difficulty of attracting capital into irrigated agriculture.

We have noted already the problem of long-term decline of prices for basic cereal crops. The implication is that, for commercial success of private investments in irrigation, it seems that it will be necessary to focus on higher-value crops in the peri-urban areas, and on export crops, in order to generate sufficiently attractive returns to capital.

There are areas where the state can facilitate these kinds of developments. Efficient and accessible market facilities in the city peripheries are essential, and if markets are connected to the rural areas by good roads they will help to expand the peri-urban ring. Official systems of quality control and labelling can help exporters, who also may need help in establishing delivery chains and cold storage facilities.

What are the prospects of bringing in private-sector organisations in contractor modes, as suppliers of support services rather than for crop production? The likely profitability of this seems to depend on the local density of irrigation systems. It is obviously easier to promote this kind of development in countries like China or Bangladesh, where population densities and numbers of irrigation systems are high, than in places where they are few and relatively far apart. Such development, therefore, would be more likely to happen in the North African countries or Madagascar than in most of sub-Saharan Africa.

5.2 Secure rights

Investment depends largely on security; on feeling secure about the future. Clear, transparent and secure systems of land tenure and water rights are a primary need. Without these, investment is much less likely, and the rate of return demanded by an investor will be much higher.

Construction of new facilities particularly needs secure rights to land and water. Investments of that kind may well take a decade or more to recover their initial outlay, so the investor probably will want documented rights for a time period of that order at least.

One of the principal benefits of a system of secure, documented water rights would be that it would encourage investment in water-saving technologies. A limited quantity of water can be used (for example) to irrigate a larger area of tree crops, by installing micro-jet sprinklers. That kind of fixed capital investment is less likely if the water supply is uncertain, or if it is undefined.

The existence of a sophisticated system of documented water rights in Chile has resulted in that country having substantial investments in micro-irrigation, of export crops such as grapes, with consequent enhancement of water productivity and extension of irrigable area.

Security is also needed in regard to the management of irrigation systems. Management decision-making must be done in ways that give the system's users confidence that its performance will be reliable, delivering timely and adequate water, equitably distributed among participants. This is probably a reason against private expansion of existing government irrigation systems: in many countries, the management of government systems has been weak and inflexible, so a private investor would prefer to be sure of having control of operational management.

In several Asian countries, such as India or Thailand, we see clear evidence of the problems of erratic water-delivery performance in government surface-irrigation systems. Farmers have invested heavily in equipping themselves with wells and pumps (even if they are in areas nominally provided with canal water), because they know by experience that the delivery of canal water is unreliable. That may perhaps be tolerable while they are growing rice, but when they move to higher-value crops, especially certain vegetables, whose water schedules may need to be frequent and more carefully observed, they invest in pumps so that they can control irrigation timing.

To some extent that behaviour can be addressed by requiring government management organisations to issue level-of-service declarations, accompanied by some statements of compensation that will be payable to system users if the terms of the declaration are not fulfilled. This type of accountability alters the relationship between service-providers and service-users, and increases the users' confidence as well as the service-providers' performance.

5.3 Sources of finance

The users of irrigation systems are usually not affluent people. Therefore the development of unsubsidised farming activities, and in particular the promotion of private investment to create new irrigation facilities, depend on access to external financial resources. Banks and other types of investors have roles to play in this. In some countries family members working abroad, or in urban areas, may be significant sources of small-scale capital.

The risks to such potential lenders may be quite large at present, which will obviously affect both their willingness to provide capital to irrigation development, and the rates of return they will seek.

The risks can be reduced by various adjustments in the institutional environment. There tends to be a focus on the roles of commercial banks, such as improving their accessibility in the rural areas. These aspects are certainly important, but in the present time, when urbanisation and foreign employment are both increasing fast, it may be equally important to look for ways of encouraging investment of these urban and overseas savings. This means that returns should be as secure and as competitive as the available alternatives. To achieve this is difficult at present, but the improvements in security of rights and in marketing facilities mentioned above would be steps in this direction.

In the past, official control of unrealistic rates of currency exchange was a major obstacle to repatriation and investment of foreign earnings. That problem has reduced in recent times, but has not entirely disappeared.

Innovative lending practices, such as those pioneered by the Grameen Bank in Bangladesh and now spreading in other Asian countries, including use of community groups to guarantee personal repayments, rather than demanding collateral, also may be useful, but these refer more to the level of seasonal crop investments rather than creation of new facilities.

5.4 Intra-community relationships

Profitable farming may involve a shift away from staple cereal crops towards, for example, vegetables or fruits, or other niche crops such as flowers and ornamental plants. This in turn may mean changes in production relationships, in which a farmer or farming group become entrepreneurs and employers of local labour for post-harvest tasks such as grading, processing, packaging, and so on.

Farmers in cereal-growing irrigation systems are essentially rather equal. There is hiring of labour, and use of exchange labour, at harvest and planting times especially. But the extent of temporarily employed labour may increase considerably when the crop changes to fruits and vegetables.

There are risks that these changes may reinforce existing inequities, or introduce fresh sources of inequity, for example by being undertaken by people who are already in some way privileged.

The enabling environment, therefore, should include strengthening of measures that address inequity, such as increased transparency of management, dispute resolution procedures, and ways of giving voice to landless participants.

5.5 Technical and organisational support systems

Even if private activity flourishes, there are likely to be residual roles that have to be filled or at least monitored by government organisations. These may include technological advice or extension, ensuring the availability and certifying the quality of input supplies, general overseeing of irrigation system administration, and intervention in certain circumstances such as corrupt behaviour.

The kind of private irrigation enterprises that we can expect to see will in general not be large, and will probably suffer from scarcity of financial resources in the foreseeable future. Governments which want to promote evolution along this path will probably have to provide these private enterprises with advice and assistance in finding and connecting to markets, especially for those that aim at export products. Quality certification systems may be a part of this.

Most of the other technical supports that would be required are already in existence, but some may need to be strengthened. These include research farms that can conduct trials of new varieties, seed certification systems, and extension services. In some countries, especially those where the total irrigated areas are small, extension services are not well skilled in irrigation issues, and there may be training needs for staff in those.

The experience of privatisation in other fields of public services has shown that it may bring benefits, but it also entails risks. There are especially risks of inequity, corruption, and reinforcement of privileges, and risks of weakening field activities due to inadequate commercial performance. The institutional environment may, therefore, need to be strengthened (if the goal is a widespread increase of private activity) by introducing some new type of regulating organisation. Such a regulating body would have the duty of monitoring the organisational behaviour of irrigation systems through procedures of reports or inspections, and would also have powers for responding to failures or abuses.

In future, if the scope of conventional government irrigation agencies reduces, we may see the evolution of a new type of government agency. This would be regulatory rather than executive, and headed by an official called perhaps Inspector or Registrar of Irrigation Organisations, whose function will be to ensure compliance with some set of rules of organisational and financial behaviour. An arrangement of this kind is normal in regard to commercial companies, and will need to be considered if the scale of private-sector activity increases significantly.

6. Inequity of access

At present, a sharp increase of private-sector irrigation investment may not seem very likely, but if it should happen there will be concerns about inequity which should be addressed. We have grown accustomed to seeing procedures of choosing new settlers in government-sponsored irrigation systems; sometimes these procedures of settler selection are obscure, and there are possibilities of favouritism and other sources of inequity. However these issues have not been of a scale that has hitherto caused too much complaint. The potential for inequity in a private-sector system could be much greater. The granting of water rights, for example, is a central requirement for strengthening the private sector; but it also carries dangers, as there will doubtless be people who end up without such rights.

It is not possible to generalise this kind of question. Countries have to find policies that are consistent with their own political and social systems. But it seems that, especially in the drier countries, there will be a need to ensure that water rights are not captured by restricted groups, leaving others disadvantaged, with conceivably no right of access to water.

The best institutional way to guard against this possibility seems to be through forming river-basin organisations, which would act as the source of documented water rights, and would include some form of stakeholder forum or stakeholder council, probably in an advisory rather than executive role.

7. Summary and conclusions

Irrigation construction in Africa over the past 30 years has been dominated by investments made by governments and foreign donors. To some extent, the provision of irrigation was seen as inherently good. A consequence of this attitude has been that schemes were in many cases built without being subjected to strong economic scrutiny.

Globally, there has been over-investment in irrigation, resulting in a production capacity that exceeds effective demand, at least for the basic cereal crops. This has contributed to prolonged weakness of prices for those crops, which further reduces the economic viability of irrigation schemes.

Private funding may be brought into irrigated agriculture in several ways, especially:

- funding of recurrent costs of operation, maintenance and management, especially by existing users of irrigation systems;
- providing capital to extend existing irrigation systems;

- constructing new irrigation facilities;
- investing in higher technologies, especially water-saving technologies, in existing irrigation systems;
- supplying support services, such as marketing or contracted maintenance.

There are severe constraints facing each of these options, and reasons why they have been slow to happen.

Increase of private-sector roles, in an economic sector that has been dominated by government, can lead to serious problems of corruption, and inequitable access to resources. Governments which aim to privatise irrigation activities, in whole or in part, should first ensure that there are institutional mechanisms in place to prevent these outcomes.

The actions that governments could take, to encourage private-sector financial inputs, while guarding against inequity, include:

- Establish a clear and secure system of documented water rights.
- Establish river-basin organisations with stakeholder councils, which will have among their duties the supervision of water-rights allocations.
- Enact a law defining the status, governance, scope, and financing of irrigators' organisations. If the number of such organisations is significant, there should be a small regulating agency to oversee their compliance with certain standards of organisational and financial behaviour.
- Establish laws and procedures that will be applied in case of bankruptcy or other organisational failure.
- In government-built irrigation systems, establish clear definition of ownership and responsibilities, especially in regard to the physical facilities and water rights.
- In larger existing systems where the government will continue to operate main-system facilities, establish a clear contract or level-of-service declaration, with rules about compensation to users in case of failure to deliver the specified level of irrigation service.
- Promote the establishment of good physical facilities for marketing, especially in the periphery of large cities; such facilities include good transport links and cold storages, and may be provided where possible through private investment.
- Ensure that small organisations of irrigators have an accessible source of advice in relation to export markets.
- Provide skill training for users' organisations in government irrigation systems, in aspects of management, especially communication and record-keeping.

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Individual pump ownership and associated service providers in *fadama* irrigation in Northern Nigeria

La propriété individuelle de pompes et des fournisseurs de services dans l'irrigation fadama au Nigeria

Salihu S. Abubakar

Abstract

A study was conducted in September 2001 to determine the impact of individual pump ownership and associated services in Northern Nigeria. The results showed that fadama farming was profitable and that individual ownership of water pumps impacted on the profit margin of the farmers. The gross margin for pump owners in the study area was by 13.7 percent higher than those of non-pump owners. The results showed that the major factors of success were pump ownership which had a correlation coefficient with gross margin (r = 0.710) and access to credit (r = 0.785). The other factors of success are the farmers' control over decisions on design and planning of irrigation infrastructure, and on crops grown. Access to inputs/spare parts and access to markets, although positively related to gross margin, had weak correlation coefficients of 0.388 and 0.335, respectively. The study concludes that individual ownership of pumps for fadama farming is profitable and sustainable and that the mode of pump acquisition could be replicated elsewhere. Ways of improving the effectiveness of the operations are suggested.

Résumé

Cet article communique les résultats d'une étude réalisée en septembre 2001 pour déterminer les impacts de la propriété individuelle de pompes dans le nord du Nigeria. On constate que l'agriculture de type fadama est profitable et que la possession de pompes influe sur la marge de profit des exploitants. La marge brute réalisée par les propriétaires de pompes dans la zone d'étude est 13,7 pourcent plus élevé que celle des exploitants qui ne possèdent pas de pompes. Les facteurs déterminants sont la propriété d'une pompe et l'accès au crédit qui sont corrélés à la marge brute, des coefficients de corrélation étant de r = 0,710 et de r = 0,785 respectivement. Le fait que les exploitants soient en plein contrôle des décisions relatives à la conception et la planification de l'infrastructure d'irrigation et aux pratiques culturales sont aussi des facteurs de réussite. L'accès aux pièces détachées et intrants, et l'accès aux marchés, bien que reliés positivement à la marge brute, n'affichent que les coefficients de corrélation faibles, de 0,388 et 0,335 respectivement. L'étude conclut que la possession de pompes conduit a une agriculture fadama profitable et durable, et que le mode d'acquisition des pompes est applicable ailleurs. Diverses suggestions en vue d'améliorer l'efficacité du fonctionnement sont enfin proposées.

1. Introduction

The development of irrigation dominated agricultural rural investment strategies in Nigeria in the 1970s and 1980s. The Government of Nigeria invested about US$3 billion in irrigation development over a period of two decades, through the River Basin Development Authorities (RBDAs). This amount does not include the money expended on irrigation development through Agricultural Development Projects (ADPs) (Pradhan and Nwa 1993). Large, medium and small dams were constructed all over the country and these have impounded water capable of irrigating over 500,000 ha of farmland (Soribe 1993). The total irrigation potential is estimated as two million hectares. The expected returns from this investment were, however, not achieved.

The problems that were faced by the large-scale irrigation projects operated by the River Basin Development Authorities stemmed largely from the inadequate attention paid to user farmers in project formulation and implementation. This was also part of the reason why the large-scale approach to irrigation development had difficulties in making the expected impact. This led to the attention that is presently being paid to *fadama* development.

Fadama small-scale irrigation development started with the enclave ADP (Agricultural Development Project) of Bida in Niger State of Nigeria. Informal irrigation systems, based on controlled flooding with farmers' participation were constructed. Water-control structures enabled irrigated cultivation of mainly rice and dry season vegetables. The technology also facilitated supplementary irrigation in the rainy season. Major characteristics of this method of irrigation infrastructure development, which make it popular among and acceptable by farmers, are (1) low cost, (2) farmers' involvement in development, and (3) ease of management, all of which require group activity.

Kano, Sokoto and Bauchi State ADPs started *fadama* irrigation with bunding and impounding of run-off and using residual moisture to produce a second crop. Farmers were also provided with 3-inch diesel pumps and hand pumps procured through farmer supply companies. These did not achieve the expected results. Subsequently, small portable petrol-driven pumps were introduced which could be owned and operated by individual farmers. These effectively replaced the existing *shadouf* and became popular with the farmers due to portability, convenience, ease of operation and maintenance. However, beyond 100 meters from the source of water, farmers began to encounter difficulties in conveying water. The need to explore more water sources or develop economical conveyance techniques arose.

The experts in these irrigation projects in the ADPs carried out an investigation in 1982 to ascertain the existence or otherwise of suitable shallow groundwater (aquifers) beneath these flood plains and establish appropriate technologies for exploiting them. Low cost technologies of drilling of tubewells using the same type and size of pump as owned by private *fadama* irrigation farmers were introduced. Shallow aquifer studies in the above states were then conducted to:

1. identify potentials in *fadama* for use of surface and shallow groundwater development;
2. delineate all *fadama* areas associated with surface and shallow groundwater resources in the state;
3. recommend suitable, simple and cost-effective drilling technologies for tubewell installations, along with abstraction of water.

The three ADPs have now developed substantial *fadama* lands through small-scale farmer-managed, cost-effective irrigation schemes with farmers' participation (Qamar and Tyem 1994).

1.1 Farmer-owned and farmer-operated irrigation farms using shallow wells

The irrigated area of this category of farmers is so small, often less than 0.25 ha, and is used for the cultivation of vegetable crops as against cereal crops, because of the lower value of the latter. The system is such that irrigated plots are usually very small, about 2m x 3m, and there is usually no shortage of water in the plots where crops are grown. The system is generally characterised by high conveyance losses and other wastages to which very little or no attention is paid by most farmers. More than 80,000 motorised pump-sets have been sold to farmers by ADPs alone, and it is believed that as many as that have again been sold by the private sector (FAO 1991).

The importance of the success of this type of farmer-owned and farmer-operated irrigation is that it demonstrates that farmers are prepared to make substantial capital investments (mostly without the assistance of official credit sources) to improve their farming operations when returns are high and the assets purchased are relatively easy to acquire. There appears to be no reason why farmers should not acquire larger pumping units, where situations require this, either as individuals or groups. The concept of farmers owning more permanent structures such as small headworks and canals and distribution systems would be a further step forward that justifies careful investigation and appropriate follow-up in the interest of accelerating irrigation development (FAO 1991).

Kolawole and Scoones (1994) identify land tenure system, population pressure, and environmental impact, as the factors threatening sustainability of use of *fadama* lands. Development intervention is also one such factor.

Falolu and Sangari (1994) reported that between 1983 and 1988 a total of 1,639 tubewells and 2,988 washbores were drilled and installed with fittings.

1.2 Fadama land and irrigated agriculture development in Jigawa State

In the area of *fadama* development about 8,000 tubewells have been constructed, out of which 6,000 have been provided with 2-inch (50 mm) petrol-driven pumps. This has facilitated the cultivation of over 5,000 hectares annually under irrigation. JARDA (Jigawa Agricultural and Rural Development Authority) had also constructed over 70 km of *fadama* access roads for ease of transportation of inputs and farm produce. The ADP had also gone into collaboration with Habib Nigeria Bank Ltd., to develop 120 hectares of *fadama* land using small-scale farmer-managed technologies. At present the state has the registration of 360 *Fadama* Users Association (FUAs), each association having at least 25 members.

2. The case study

This study was conducted to determine the impact of individual pump ownership and access to associated services on the *fadama* area.

2.1 Methodology

The study was conducted by taking a random sample of farmers in the study area. Each farmer gave his own individual response by answering some questions in a questionnaire. Thereafter, a checklist of questions were asked, for a collective response of members of FUAs, staff of the ADP and local mechanics.

2.2 The study area

Jigawa State was created in 1992 from part of the former Kano State. It lies between latitude 11^0–13^o north and longitude 8^o–$10^o35'$ east. It covers a land area of about 24,410 km^2, with a human population of about 3,721,357 persons. Although most parts of the state lie within the Sudan savannah vegetation zone there are traces of guinea savannah on some parts of the southern borders of the state. The mean daily minimum and maximum temperatures are 19^oC and 35^oC, respectively. The rainy season lasts between June and September with an average of 644 mm rainfall per annum.

A total 70 percent of the land mass of Jigawa State is cultivated during the rainy season; bush fallows constitute about 10 percent, uncultivable land 5 percent, grazing reserves 10 percent and forest estates about 5 percent of the total. Prominent rainfed crops are millet, sorghum, cowpea, groundnuts, sesame, rice, bambara nuts, pepper, bitter melon and cotton. The State is blessed with floodplains popularly known as *fadama* lands. These floodplains are characterised by availability and accessibility to both open surface and underground water. The estimated land area under this category is about 15,000 hectares, 80 percent of which is cultivable under irrigation during the dry season between November and March.

Jigawa State has seven major irrigation schemes, one of which is the Hadejia Valley project, covering about 3,000 hectares. The major crops grown during the dry season are tomatoes, pepper, onions, wheat, lettuce, carrot, garden eggplant, maize, amarantus and sugar cane.

2.3 Analytical tools

Both descriptive statistics and correlation analysis were employed in data analysis. Correlation analysis was used to study the relationship between success in use of the pumps and some variables. Success was measured by the profitability of the crops produced.

3. Results and discussion

3.1 Socio-economic characteristics of respondents

The socio-economic characteristics of respondents captured in this study include sex, age, level of education, membership of FUA, family size and farm size. These are presented in Table 1.

Table 1. Socio-economic characteristics of respondents.

Variable		Frequency	Percentage
Gender			
	Male	34	100
	Female	0	0
Age			
	20 – 30	2	5.9
	31 – 40	12	35.3
	41 – 50	8	23.5
	51 – 60	8	23.5
	61 – 70	4	11.8
Level of education			
	Adult education	13	38.2
	Koranic	18	52.9
	Primary	1	2.9
	Secondary	1	2.9
	Tertiary	1	2.9
Family size			
	1 – 10	13	39.4
	11 – 20	15	45.5
	21 – 30	4	12.1
	> 30	1	3.0
Farm size			
	< 1 ha	13	38.2
	1 – 1.5 ha	8	23.5
	1,6 – 2 ha	9	26.5
	> 2 ha	4	11.8
Membership in FUA		34	100

From Table 1 it can be deduced that *fadama* farming is predominantly a male affair; among the sample of farmers none are female. When the age of farmers is considered, those within the age limit of 31–40 years predominate, being 35 percent of the total. This age group was then followed in equal proportion by those in the ranges of 41–50 and 51–60 years having 23.5 percent each. The younger farmers were the least involved, with just 5.9 percent, followed by those in the range of 61–70 who are 11.8 percent of the total.

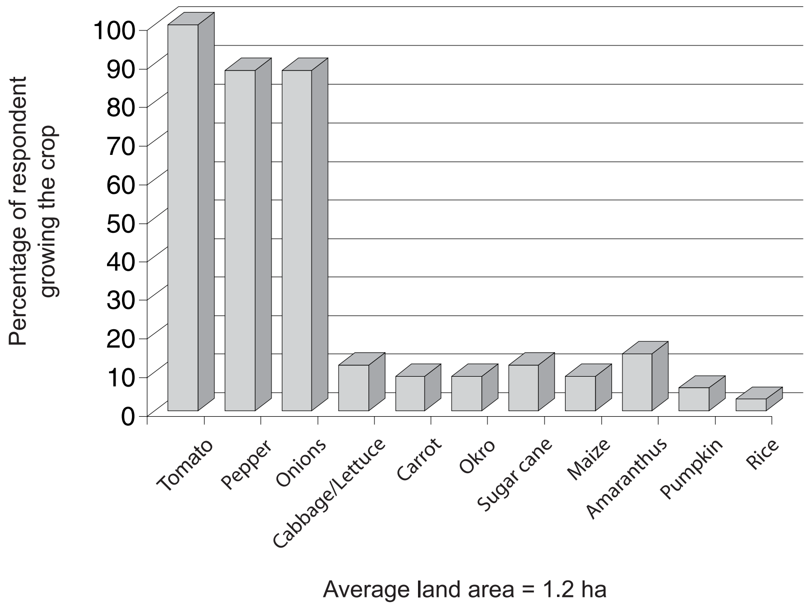
The educational levels of farmers studied was found to vary in the following order, koranic 52.9 percent, adult education 38.2 percent and primary school, secondary school and tertiary education having the least percentages of 2.9 percent each. All the farmers that responded were members of FUA, that is, 100 percent. When the family size is looked at, it was found that farmers having families with 11–20 members are the major group with about 45.5 percent, followed by those having 1–10 members, with 39.4 percent. Families that have members up to 21–30 and over 31 members were just 12.1 percent and 3.0 percent, respectively.

The farm sizes of the farmers also vary, farmers having less than one hectare predominate with 38.2 percent. This is followed by those having up to 2 hectares, 26.5 percent and those having 1–1.5 hectares, 23.5 percent. Only 11.8 percent of the farmers studied had over two hectares of *fadama* land under cultivation.

3.2 Crop production by farmers in the fadama area.

Figure 1 shows the crops that were cultivated by the farmers in the study area. All the farmers (100%) grew tomato. Other crops that are popular with the farmers are pepper and onions, grown by 88.25 percent. The fourth crop in terms of importance is amaranthus, grown by only 14.7 percent of the farmers. This was followed by sugar cane, cabbage/lettuce with 8.8 percent and 11.8 percent of farmers involved respectively. Carrot, okro and irrigated maize were cultivated by only 8.82 per-cent, while pumpkin and irrigated rice had the least frequency of cultivation, 5.9 percent and 2.9 percent, respectively.

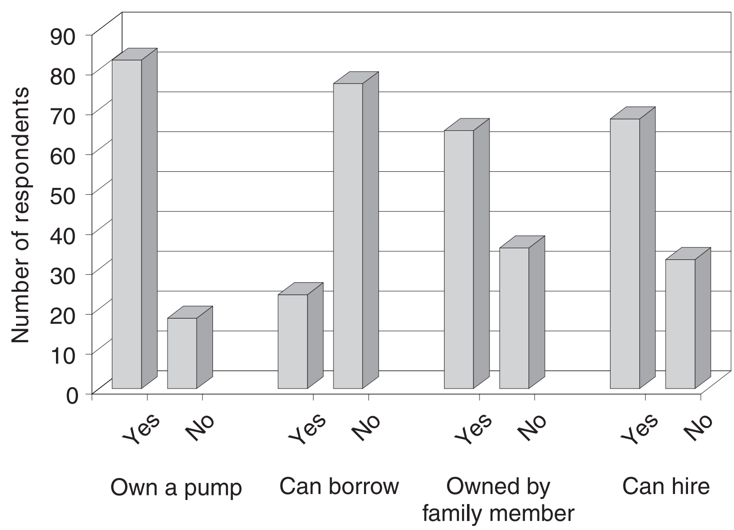
Figure 1. Crops grown under fadama *cultivation in Chiyoko.*



3.3 Access and ownership of individual pumps

Figure 2 describes ownership of individual pumps and access to pumps, that is, whether a farmer can easily borrow or hire a pump.

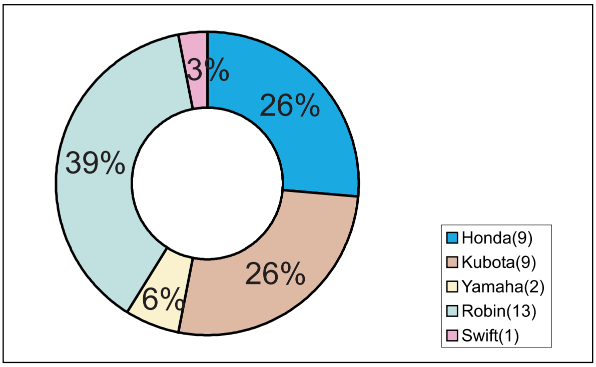
Figure 2. Access and ownership of individual pumps.



About 82.3 percent of the farmers sampled owned motorised pumps, while 17.7 percent did not. Among the farmers that owned pumps only 23.5 percent are willing to lend their pumps, while the majority, 76.5 percent do not want to lend their pumps to any body. It was also found that 67.6 percent of pump owners did not want to hire out their pumps; and only 32.4 percent was willing to hire out.

Sampled farmers in the study area use a variety of pumps for irrigating their farms (Figure 3). They are Robin, Honda, Kubota, Yamaha and Swift. Mechanics trained by ADP officials usually attend to pump problems that may arise.

Figure 3. Brands of pumps used by farmers.



3.4 *Costs and returns of crop production in fadama lands*

The cost and returns of *fadama* crops were computed. Two categories were studied: pump owners and non-owners. This is shown in Table 2.

Analysis of the cost and returns of the sampled farmers, for the 2000 /2001 cropping season, using the Gross margin analysis shows that the mean gross margin for pump owners was 110,586.00 Naira[1] (US$968) while that of non-owners was N97,253.33 (US$852). (Non-owners are farmers who do not own pumps personally, and who must therefore hire or borrow.) The level of profit of pump owners is higher than those of non-owners, thereby putting the former at a financial advantage over the latter. The income of non-owners is less, partly because the cost of hiring has to be considered; and partly because the hired or borrowed pump may not always be available when it is needed, which affects the productivity of the crops.

Most farmers indicated that *fadama* farming has enabled them to buy work bulls, pumps, or houses, while others have taken additional wives. Some have bought motorcycles and buses. A sizeable number had even gone on pilgrimage with the proceeds from the *fadama*. Further analysis shows a strong relationship between ownership of pump and gross margin (r = 0.710).

[1] In September 2001, US$1 = 114.2 Naira at the bank exchange rate.

Table 2. Cost and returns (Naira/season) in Chiyoko fadama.

Cost / income item	Owners of pumps	Non-owners of pumps
Seed, fertilisers, pesticides	25,450	11,438
Farm operations	9,658	12,042
Total variable costs	35,160	22,063
Gross revenue	142,477	119,317
Gross margin	110,586	97,253

3.5 Profitability, sustainability and replicability

The data obtained and the assessment by farmers themselves indicated that the *fadama* farming is profitable. In addition, the ability of farmers to plan what to grow and the number of acres to cultivate, along with the guarantee of perennial streams in their locality and inputs availability for their production, appear to ensure sustainability of *fadama* cultivation in the area. It can also be asserted that this practice can be replicated in areas with similar *fadama* features.

3.6 Factors affecting success

3.6.1 Secure water supply

The presence of a perennial stream along the stretch of the entire *fadama* in Chiyako (the study area) gave the assurance for a season-long secure water supply to the irrigated area. In addition, most farmers have either tubewells or washbores or even both in their farms. Table 3 gives the proportions of each.

Table 3. Proportion of tubewells and washbores among farmers studied.

	Frequency	%
Washbores	25	73.5
Tubewells	5	14.5
Open wells	4	11.8

3.6.2 Simplicity of technology

The technology of running individual pump-sets by farmers in the study area was quite simple and affordable. The operation and maintenance of the entire system is handled entirely by the farmers with ease. The farmers only sought the assistance of the local mechanic in a situation where some vital spare parts are to be replaced. Refuelling and change of engine oil at regular intervals are done by the farmers themselves.

3.6.3 Technology and crops offering high returns

Technology of crop production is being supplied mostly by extension agents of Jigawa State ADP (JARDA). The following crops were identified to offer high returns in order of priority: Tomato, pepper, onions, leafy vegetables, sugar cane, carrots and maize.

3.6.4 Control on planning, design and construction of irrigation infrastructure

The respondents participate in planning what their irrigation needs will be. The *Fadama* User Association (FUA) is the main group of farmers that liaise with the ADP for the planning and subsequently the construction of the irrigation wells on an individual farmer's field. Decisions on operation and maintenance of pumps are principally taken by the farmers themselves. They irrigate their farms using pump-sets. If problems arise with the use of pump-sets, they consult nearby local mechanics who attend to the maintenance or repair of these devices.

3.6.5 Control on decisions affecting crop rotation, area cropped and planting date

The farmers in the study area take decisions by themselves on the planting date, area cropped and crop rotation in line with the advice of extension staff of the ADP. Usually such decisions are guided by quality and quantity of land available to individual farmers, availability of enough capital for farming and the priorities of the farmers.

3.6.6 Ability to size up the risks and benefits

All the respondents in the study area indicated that they were prepared to make large capital investment to improve their farming operation. This shows that they have the ability to size up risk and benefits and can, therefore, count on themselves in order to improve on their financial position. Moreover, a large proportion of the farmers considered *fadama* farming worthwhile. Correlation analysis between ability to take risk and gross margin shows a positive but weak relationship (r = 0.367).

3.6.7 Flexibility for continuously adapting their irrigation to changing situations and demand

Most of the farmers now purchase their new pumps from the open market along with spare parts. Hitherto, farmers were supplied the pumps and spare parts by the ADP. Inputs were also purchased at the ADP. But now farmers source their inputs from the open market. This indicates the level of flexibility of farmers to changing situations and demand. Thus having realised the benefits from *fadama* farming they are willing to adapt themselves to new circumstances that prevail in order to continue cultivating their crops

3.6.8 Availability of and timely access to credit

Most respondents utilised the proceeds from their previous harvest as well as personal savings to finance their production. Some augment what they have with loans from friends. However, from the study carried out so far only one farmer got a loan from the Nigerian Agricultural and Co-operative Bank (NACB). Correlation analysis between access to credit and gross margin shows a positive and strong relationship (r = 0.785).

3.6.9 Timely access to inputs and spare parts for maintenance

The main problems identified with the pumps in the study area are piston and rings spoilage, valve spoilage, and frequent connecting-rod and plugs spoilage. A few of the farmers indicated problems of high fuel consumption of their pumps. All these problems are solved by mechanics located within the study area. The mechanics are trained by the ADP. The farmers indicated that the mechanics are efficient in the repair of their pumps and spare parts are usually bought in Kano by the mechanics on behalf of the farmers. Correlation analysis between availability of spare parts and gross margin shows a positive but weak relationship (r =0.388).

3.6.10 Ease of access to market

Marketing of *fadama* crops by the farmers in the area constitutes little problem. With the exception of tomatoes all the crops are being bought on the farm or taken to nearby retail and wholesale markets. Correlation analysis between access to market and gross margin shows a positive but weak relationship (r = 0.335).

3.6.11 Macro-economic and institutional environment

The respondents indicated that the institutional arrangement for management of the *fadama* which gave them a say in decisions was more favourable to them than the previous arrangements. They were, however, unhappy that the government macro-economic policies have been counter-productive. They indicated, for instance, that they were unhappy with the removal of subsidy on inputs like fertilisers, which led to the high cost of fertilisers. The continued depreciation of the Naira and inflation have also not encouraged production.

4. Summary, conclusions and recommendations

The study indicated that 82 percent of the farmers that were interviewed are pump owners, and the acquisition of the pump had led to profitable *fadama* irrigation farming among them. Most of the people interviewed were content with what they had in terms of possession of houses, means of transportation, food reserve, etc. Some of the farmers mentioned that during peak periods of production, buyers come to the village from neighbouring states and some from faraway southern parts of the country to buy their produce. Pump ownership in the study area was initiated first by the ADP when a package was given to farmers in the form of loans, which included the construction of tubewells and washbore wells for the pump owners. Now individual farmers can buy their own pumps and maintain them. This has shown that pump ownership can be easily replicated in any *fadama* area.

Marketing of tomatoes constituted a problem to the farmers in the area. All the farmers had to contend with post-harvest loss due to poor market for their tomatoes at certain points in time during the season.

Results of correlation analysis showed strong relationships between gross margin and ownership of pump (r = 0.710), and between gross margin and access to credit (r = 0.785). Positive but weak correlation was found between gross margin and access to market (r = 0.335), availability of spare parts (r = 0.388), and ability to take risk (r = 0.367). This implies that pump ownership and access to credit are the most important factors that affect the profit margin, hence the success.

On sustainability of pump ownership, the study indicated that farmers can own and maintain their pumps without any difficulty. It is only in a situation where a major part is to be replaced that a local mechanic comes in. On the whole pump ownership has provided the farmer with a lot of freedom to take decisions on the design and planning of his irrigated farming activities. Such farmers find it easy to maintain their infrastructure and equipment on their own and, therefore, sustain their farming activities. In view of the fact that most pump owners find the farming business profitable, the experiences of the farmers in this study area may be replicated in other similar settings. It was also found that availability of spare parts was not a problem.

It can, therefore, be recommended that:

1. Credit facilities be made available to more *fadama* farmers so as to acquire pumps and finance their production activities with ease. The study did indicate that the majority of the farmers have little access to credit. The farmers may need the credit only at the initial stage.

2. The private sector be encouraged to establish cottage industries for fruits and vegetable processing. This will address the marketing problem of tomatoes in the area.

3. Government and the private sector endeavour to establish cold storage structures in areas of high production so as to reduce the huge post-harvest losses by farmers.

4. Government should evolve policies that will facilitate, for *fadama* farmers, the smooth flow of information, availability of production inputs including pumps, and easy access to markets where farmers can get favourable prices for their crops. This will enhance the replication of the success story in some of the *fadama* areas to other areas with similar settings and conditions.

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Roving course on pump selection in Burkina Faso, Mali and Niger: Lessons learned

Leçons tirées des cours itinérants sur le choix des pompes au Burkina Faso, au Mali et au Niger

S. van 't Hof

Abstract

The utility of 4-days training courses for promoting the transfer of irrigation technology in Africa is discussed, using the case of three roving courses on pump selection that took place in Burkina Faso, Mali and Niger in January and June, 2001. Typically, a roving course aims to help unlock the potential for technology transfer and innovation adoption of a single technology, such as irrigation pumps, drip or sprinkler irrigation, and low-cost drilling, by offering a short-term training to 10-20 key persons in each country. This takes for granted that other constraints to technology transfer, if any, are of minor importance only. The extent to which this hypothesis holds true in the case of roving courses in Burkina Faso, Mali and Niger is examined. Ideally, roving courses should be embedded in a wider technology transfer process. Where this ideal situation cannot be created or found, stand-alone roving courses should attempt to take into account the conditions that prevail in individual countries in order to maximise their direct use in the transfer process. The need for a regional initiative to stimulate the technology transfer process from Asia to Africa is emphasised.

Résumé

L'utilité de formations de quatre jours pour promouvoir le transfert de technologie vers l'Afrique est présenté ici à partir du cas de trois cours itinérants sur le choix des pompes qui ont été donnés au Burkina Faso, au Mali et au Niger en janvier et juin 2001. Habituellement, un cours itinérant cherche à libérer le potentiel pour les transferts de technologies et l'adoption de technologies simples telles que les pompes pour l'irrigation, l'irrigation localisée ou par aspersion et les forages à faible coût, en organisant des courtes formations à 10-20 personnes dans chaque pays. Ceci présuppose que les autres contraintes aux transferts de technologies sont mineures, si même il y en a. A quel point cette assertion est vraie est examiné à travers le cas des cours itinérants au Burkina Faso, Mali et Niger. Idéalement, les formations itinérantes devraient être inclus dans un programme plus étendu de transfert de technologies. Quand cette situation idéale ne peut être trouvée ou créée, des cours seuls doivent essayer de prendre en compte les conditions qui prévalent dans chaque pays pour maximiser leur utilisation directe dans le processus de transfert. Enfin, on insiste sur le besoin d'une initiative régionale pour stimuler le processus de transfert de technologies de l'Asie vers l'Afrique.

1. Introduction

Three roving courses on pump selection took place in Burkina Faso and Niger, in January 2001, and in Mali in June 2001 (Van 't Hof 2001a, c and d). These courses were financed through a World Bank grant. Their aim was to train project staff, technicians, local consultants and equipment firms involved in small-scale irrigation design, to help farmers choose pumping equipment that is best adapted to local hydrologic and climatic conditions. The main subject of the course was how to use a pump selection tool in the form of a spreadsheet application called "PumpSelect" (Van 't Hof 2000b), which contains a database with the characteristics of about 100 pumps and 50 engines, many of Asian origin. The emphasis of PumpSelect is on mobile pump sets with relatively small diesel engines and mixed-flow pumps for discharges of 25 to 150 litres/second with static heads of 2 to 6 meters. A training manual (Van 't Hof 2000a) was used to explain how hydrological, economic and technical analyses can be combined to enable participants to advise farmers on selecting the most appropriate pumps and on improving system performance. Finally, practical results of the approach were illustrated, using a case from Timbuktu, Mali (Arby and Van 't Hof 2000).

The need for improving the availability of efficient and affordable low-lift pumps from countries, such as China, India and Turkey, has been emphasised by Zolty and Gadelle (2001). It featured prominently during the 1997 workshop on "Irrigation technology transfer in support of food security," Harare (FAO 1997), with contributions from Chinese and Indian pump industry representatives.

Nobody doubts that small-scale irrigation development in Asia, with millions of farmers buying diesel-powered pumping equipment, could ever have taken place if equipment prices had been 10 times higher.

In Asian countries with high intensities of pump-based irrigation (for example, India, Bangladesh, China, Vietnam and Cambodia), prices charged by agents and merchants to farmer customers, for pumps of Indian or Chinese manufacture, are typically around 10 percent of the prices charged by agents and merchants in West Africa, for pumps of similar capacity made in Europe. Low-lift pumping costs in Asia (inclusive of capital depreciation) are, therefore, in the order of 70 US$/ha/season; whereas in West Africa, using the same basis of calculation, they are currently about 300 – 400 US$/ha/season (Perlack 1988; Van 't Hof 1998). If efficient, affordable and reasonably reliable pumping equipment can be imported to West Africa from major manufacturing countries such as India and China, these costs can be brought down to an estimated 100 – 150 US$/ha/season (Arby and Van 't Hof, 2000). This would greatly improve the competitiveness of irrigated agriculture in West Africa and would eliminate one of the main barriers to spontaneous irrigation development along Sahelian rivers, such as the Niger, the Senegal and the Logone.

In the background documents to the World Food Summit of 1995 (FAO 1996) specific mention is made of low-lift pump schemes as one of the successful approaches to water development even in Africa. However, most farmer-managed low-lift pump schemes in West Africa continue to rely on foreign imports when it comes to acquiring and replacing pumping equipment (Arby 1998 and 2001). Measures are urgently needed to improve the availability of affordable technologies for more spontaneous, sustainable small-scale irrigation development. Therefore, roving courses seem a practical way for increasing local awareness that less costly pumping equipment is a prerequisite for developing irrigation in Africa.

The question is how to organise roving courses for effectively enhancing the adoption of affordable irrigation technologies. In this note a preliminary assessment of the roving courses on pump selection is carried out, constraints to the practical application of the information supplied during the course are identified, and suggestions are made on improving roving courses for promoting the transfer of irrigation technology in Africa in general. Special attention is paid to the role of the private sector.

2. Course facts

- **Sponsors:** the World Bank (Trust Fund No TF039961) paid the trainer, local World Bank financed projects (APIPAC, ANPIP and APROFA[1]) provided training spaces with computers (at least one computer for every two participants).
- **Cost:** fixed cost (course preparation) US$3,216, variable cost (21 days mission, 3 wrap-up reports, reimbursement for travel, hotel, food, visa and report edition) US$10,182, or a variable cost of US$300 per selected participant (see below). Total cost US$13,398.
- **Time and dates:** course 1: Amsterdam-Burkina Faso-Niamey 14-22 January 2001; course 2: Niamey-Amsterdam 22-29 January 2001; course 3: Amsterdam-Bamako-Amsterdam 10-18 June 2001.
- **Teaching aids**. By trainer: spreadsheet application "PumpSelect" with database, manual (60 p.), fully worked case study, 50 overhead sheets; by local project: overhead projector, computers (at least one for every two participants).
- **Course teacher:** present author.[2]

[1] Agence Nigérienne pour la Promotion de l'Irrigation Privée (ANPIP), Association des Professionnels de l'Irrigation Privée et des Activités Connexes (APIPAC), Agence pour la Promotion de Filières Agricoles (APROFA).

[2] The author has designed more than 10 rice schemes of 10 - 35 ha in the region of Timbuktu, Mali, and co-founded the HIPPO foundation (HIPPO = High-efficiency Irrigation Pumps, Procurement and Organisation, http://www.hipponet.nl).

- **Course organisation**: On average, 11 participants were selected by each local project. The attendants at the courses belonged to: projects 16, NGOs 5, government 3, consultancy firms 5, supplier 1, Chambers of Agriculture 3, volunteer organisation 1. Some of these were selected but never showed up; others were only available part of the time. The vast majority were available all the time and very interested in the course.
- **Course programme**: Monday was used for presentations and for preparing the course, including loading various files on each computer. Tuesday through Thursday were full training days with case studies; Friday was used for dealing with final questions and evaluation.

3. Constraints to the practical application of course information

Possible constraints to the practical application of course information in a particular country include the lack of:

1. information on characteristics and parameters of locally available equipment;
2. equipment alternatives;
3. certainty about the performance of new equipment;
4. after-sales service of new equipment;
5. repair and maintenance know-how;
6. awareness of the availability among potential buyers;
7. willingness to consider buying in spite of better performance;
8. local training capability to train others.

Constraint 1 occurred in Burkina Faso, where there was no or limited information on the parameters and characteristics of locally available pump sets (Honda, Robin, Yanmar, and Kirloskar).

Constraint 2 is typical of the situation in Niger for Asian diesel-powered pump sets. The availability of Chinese equipment leaves much to be desired in Burkina Faso and Niger. The situation is Mali is much better, but no efforts to optimise equipment for low-lift conditions along the Niger River were observed.

Uncertainty about the performance of new equipment (constraint 3) is a general problem. Very few efforts, if any, are made to collect information on equipment performance (head, discharge, fuel consumption, repair cost, and life-span) of any equipment, exotic or common. In the case of the small, petrol pumps of Honda, Yamaha and Robin, the manufacturers do not seem to have this type of information.

Lack of after-sale service of new equipment (constraint 4) is common. An example is the 300 or 500 Kirloskar TV-1 pump sets that came to Burkina Faso in 1996. Not a single seller of spare parts could be identified in January 2001, with the exception of one, who had no spares in stock, but claimed to know where they were. He was ready to provide some prices. When asked if he had a list of spare parts from the manufacturer, the answer was negative.

Lack of repair and maintenance know-how (no. 5) is a common constraint, too. Even simple diesel engines from India and China require some know-how. There is little reason to believe that this know-how is widespread, especially since there are no maintenance manuals.

Constraint 6 – lack of awareness of the availability among potential buyers – is likely to prevail in most countries. There seem to be no generally accessible lists of equipment, their suppliers and contact details. Early October 2001, an unknown buyer in Mali apparently did not know any Malian importers of Chinese equipment (i.e., an S195 diesel engine), and contacted a Belgian company, who in turn contacted the HIPPO Foundation in the Netherlands. The latter provided the Belgian company with the names and addresses of three Malian importers of Chinese S195 diesel engines, although the company stated that buying locally was not an option!

The unwillingness to consider buying new equipment in spite of better (economic) performance (constraint 7) can be seen at work in several countries. The interaction between the three private-sector groups that deal with pumps (users, suppliers, and advisers) can yield arbitrary outcomes. For example, a consultant, when asked to advise a development organisation for choosing an equipment, may be hesitant to advise cheaper exotic equipment because there is insufficient experience with it in that particular country. The same consultant may well be less hesitant in a country where this equipment is much more common. The organisation considers that its small-scale development project is already sufficiently complex and will be inclined to reduce the risk of breakdown and maintenance problems. The farmers, because they don't have to pay for the equipment, will incite the development organisation to buy the most expensive (and reliable) equipment available on the market.

As a result of this type of short-term thinking, the introduction of affordable, exotic equipment is blocked. Lack of competition will increase prices and erode after-sales services. There will be little incentive to importers to improve the equipment selection process. Exotic equipment will lose its competitive edge and farmers will not be able to carry out spontaneous, small-scale irrigation development. This is the aid trap of the equipment market in large parts of sub-Saharan Africa.

Finally, it was not assessed whether the roving course enhanced the local capability to train other groups (constraint 8). The roving course on pump selection was not intended as a Training of Trainers course. On the other hand, it cannot be ruled out that a number of trainees are now capable of carrying out similar training activities. The main teaching aids were a manual, a spreadsheet application, and a report. Electronic versions were provided to all trainees having a diskette, i.e., almost all of them. Transparencies can be produced on a US$ 60 printer by enlarging the 50-odd images in the manual.

4. Course assessment and potential for improved course design and organisation

The aim of the roving course was to train project staff, technicians, local consultants and equipment firms involved in small-scale irrigation design to help farmers choose equipment that is best adapted to local hydrologic and climatic conditions.

The participants successfully carried out most of the exercises, showing that they were capable of using PumpSelect for the technical analysis of pumping systems and for simple economic calculations. Some participants grasped the course content in just a few hours. Nevertheless, the level of the participants was highly variable, some missed basic notions in physics, while others had difficulty in interpolating pump characteristic curves or lacked experience in using spreadsheets. The advanced economic calculations based on the method of Perlack (1988) could be explained to only very few people.

A number of additional suggestions were made by one or more participants during the course, including:

(1) the database of PumpSelect should be enlarged to include locally available pumps;

(2) more information is needed on equipment use and maintenance;

(3) a field demonstration should be included;

(4) addresses of manufacturers and their local representatives should be provided.

The overall sentiment was that the course was very interesting, but perhaps lacked direct applicability, except for those directly involved in pump selection on a regular basis.

The first suggestion was first made in Burkina Faso, with respect to the small petrol pumps (Honda, Robin, and Yamaha). A week later it became clear that all the necessary information had already been collected by the ANPIP (2000) project in Niger, where 12 small pumps had been measured on a test bench. This enabled the inclusion of these small pump sets in the PumpSelect database, although there were difficulties in distinguishing between pump and engine efficiency (not measured separately on the test bench). In Mali, one of the exercises consisted in entering data of 12 Indian pump sets in the data base of PumpSelect. Another exercise consisted in comparing the pumping costs of three different local pumping systems.

A one-day field demonstration would be very useful to show the reliability of simulations with PumpSelect in practice. This should involve practical exercises where participants would measure various speeds, heads, discharges and fuel consumption. A good place for this would be an agricultural mechanisation training facility, especially if it could become part of the curriculum. An inexpensive 5 hp, low-lift diesel pump from China or India would seem quite suitable.

If it were admitted that pump selection is an effective method to ensure that farmers buy the most economic equipment available, an effort should be made in each country to complete the national database. Entering a set of data in PumpSelect takes about 10 minutes per pump, so the main problem is to obtain characteristics and other parameters and to make sure they are correct. Of course, this will also require the establishment of a list with addresses of manufacturers and their local representatives. Regional networking to obtain characteristics and parameters is advisable.

5. Conclusions and recommendations

Training courses can only be effective in the context of a wider technology transfer process. Such a process involves aspects, such as the identification of marketable (e.g., affordable) technologies, promotion and capacity building of supply chains. Often, the private sector efficiently takes care of all these aspects, but this does not seem to be the case of irrigation technology transfer in sub-Saharan Africa, to the detriment of private irrigation development.

At present, importers of Asian (Chinese, Indian, and Turkish) equipment in West Africa are not capable of selecting the most appropriate equipment with a fair degree of certainty. For the same reason, they are incapable to convince development organisations, the main buyers of irrigation equipment, of the appropriateness of what they offer, perhaps also because of weak after-sales services. On the other hand, development organisations do not display rational behaviour in terms of demand. They are not aware of potentially useful technologies; they seem to be generally tangled up in organisation-specific procurement processes, and follow short-term logic where a long-term vision is required.

To end this deadlock, an intervention at a regional scale could be considered along the following lines:

(1) identification[3] and test of a range of Asian pumping equipment based on present engine availability[4] on the West African market;

(2) strengthening importers' after-sales services (repair and maintenance manuals, spare part lists);

(3) promoting the equipment with demonstrations, advertising and especially by showing that the equipment has the lowest possible pumping costs.

The pump selection course can be used to improve the decision-making capacity of sales persons, local consultants, development organisations, and farmers. It is much more likely that the private sector will respond to providing affordable irrigation equipment, once importers know what they have to import and farmers and development agencies know what to ask for.

[3] Van't Hof (2000c) proposed more than 10 low-lift pumping systems from Asia.

[4] All common Indian and Chinese engines have reached the West African market, sometimes in large numbers.

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Reflections on irrigation finance in Africa

Réflexions sur le financement de l'irrigation en Afrique

Chet Aeschliman

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Abstract

The paper first describes five sets of difficulties that often affect the financing of small-scale projects in African irrigation development: these are problems arising from project design, from the beneficiaries, the lending institution, the government, and the donors. The author then draws various lessons, about project design, supply and demand for credit, appropriate institutional development, and relevant policies. The final section proposes ten rules for sound development of projects. The aim of self-sufficiency is emphasised: dependency on credit should be minimised, equipment should be as cheap as possible and rapidly repayable. Governments and project designers should not focus too rigidly on production-enhancement objectives as these may be negated by other aspects of the local context, such as post-harvest losses or weak market mechanisms; the investigation of such factors, and steps to alleviate them, should be an integral part of pre-project planning. Where credit is a necessary project component, it should as far as possible be managed through local decentralised micro-finance institutions which are near to the borrowers and able to know their circumstances.

Résumé

On décrit cinq catégories de difficultés qui souvent affectent le financement de petits projets d'irrigation en Afrique : ce sont des problèmes liés à la conception de projets, aux bénéficiaires, aux organismes de crédit, au gouvernement, et aux bailleurs de fonds. L'auteur tire des leçons concernant la conception de projets, la demande et l'octroi de crédits, le développement institutionnel, et les politiques associées. Enfin, dix règles sont proposées pour favoriser le développement de projets crédibles. La notion d'autosuffisance est soulignée : la dépendance sur le crédit est à minimiser, le matériel acquis ne doit pas être trop coûteux et doit être facilement remboursable. Des gouvernements et des concepteurs de projets ne doivent pas mettre trop l'accent sur les objectifs d'amélioration de la production car ils courent le risque d'être neutralisés par les éléments en rapport avec le contexte local tels des pertes post-récoltes ou des mécanismes faibles de marché. L'analyse de ces facteurs et l'identification de mesures pour les lever doivent être partie intégrale de la planification pré-projet. En ce qui concerne le crédit, il doit être géré, autant que possible, par des institutions de micro-crédit locales décentralisées qui sont proche des emprunteurs et qui comprennent leurs réalités quotidiennes.

1. Problems in irrigation finance

Experience to date with the FAO's Special Programme for Food Security provides information on problems encountered and lessons learned from past efforts in the financing irrigation development projects. Those who are familiar with agricultural credit will undoubtedly note that many of these problems are not intrinsic to irrigation, but apply generally to all types of agricultural lending. The difficulties encountered generally fall into five categories:

- Difficulties linked to faulty initial design of projects;
- Difficulties linked to the beneficiaries themselves;
- Difficulties caused by the lending institution;
- Difficulties caused by governments;
- Difficulties caused by donors.

In the following sections these five problem categories are reviewed, and thereafter various principles of project design are described with the general objective of avoiding or reducing these difficulties.

2. Difficulties linked to faulty initial design of projects

Probably a majority of irrigation finance problems are the direct result of defective project design. Some of the most common project design errors include the following:

2.1 Giving lip service only to the participative process

Despite considerable effort and lip service by various parties, the *participatory process* continues to be mostly artificial. Most often, it consists only of "sensitisation" meetings, explaining technical decisions already taken elsewhere by "experts." Many of these schemes are hatched by foreigners with little knowledge of local customs and conditions. The schemes are often too complex for potential participants to understand, or to enter as effective partners. Beneficiaries, often represented by only a few leaders, are typically presented with a *fait accompli* (the programme will provide you with such-and-such equipment, which will cost you so much, and which will provide you so much income and profit…). A sensitivity analysis, to help potential borrowers assess the risk of success or failure, is almost never presented.

With the exception of certain World Bank efforts (notably the PSAN project in Burkina Faso and the PDPI project in Senegal), which seem truly well appreciated by beneficiaries (LeBrun 1998: 7), irrigation projects have generally deliberately by-passed this preliminary phase of briefing beneficiaries on future developments, which is absolutely necessary for success. These two World Bank projects succeeded because they fully involved participants, not only in the conception of the programme, but also in the specifics of project implementation, and even in project monitoring and evaluation.

Nearly everyone gives lip service to beneficiary participation in project design, but very few project designs, in reality, adequately involve those who will be most affected by their execution. This is frequently due to the need to write project proposals quickly, and as the old adage goes, "haste makes waste."

2.2 Inappropriate / excessively costly and complex technical solutions

When faced with the choice between a simple, inexpensive solution and a costly, complex one, many professional project design officers, desiring to display their command of the subject matter, have a tendency to choose the latter. Thus they violate one of the most fundamental rules of development work, the KISS ("Keep it simple, stupid!") principle. As one micro-irrigation expert puts it, "Western entrepreneurs and trained engineers have difficulty unlearning enough of what they've been taught, to innovate, design, and market micro-irrigation systems that are affordable enough for poor farmers to take advantage of them."[1]

Typically, the family income is only two or three hundred dollars a year, far too little to afford the modern irrigation devices available off the shelf that are often promoted by development "experts." However, without improved irrigation, they cannot fully benefit from green revolution inputs. Furthermore, many development experts expect that in an open marketplace, small inefficient farms will be taken over by larger and more efficient farms. In the face of rapid population growth, however, actual farm size in developing countries is instead steadily decreasing. The failure of the development community to take these simple facts into account is a major factor constraining the emergence of practical solutions, both to improved irrigation performance and to hunger and poverty.

Bilateral donor-funded agricultural development projects frequently also have an inherent, built-in problem, i.e., statutes in the donor country require that equipment used in development projects be manufactured in the donor country. It doesn't matter that the donated equipment may be five times as expensive as alternative irrigation equipment made locally in Africa or imported from India or China. It also may not matter that a much less complex and vastly less expensive solution may be more appropriate.

[1] Paul Polak of IDE, quoted in Keller, Adhikari, Petersen and Suryawanshi (2001).

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Experience with complicated equipment or technologies, such as power pump-based irrigation and animal traction, in areas with little tradition of using them, has often been disastrous. Project designers have greatly underestimated the difficulties of introducing such new technologies in contexts where the population has no experience with machines or care of animals.

For example, instead of using expensive European motor pumps, it may be possible to pump water much more cheaply and with less dependence on foreign technology, spare parts, etc., by using alternative equipment like locally-made treadle pumps and rope pumps. Accordingly, those in the business of designing irrigation development projects or project components need to make a much more eloquent and convincing effort to convince bilateral donors that, if they really want to sponsor sustainable development, they should agree to less costly and less complex designs. Most of the time, "small truly is beautiful." Donors have to realise that insistence on using equipment manufactured in their country of origin will at least seriously undermine the project's probability of success, and at worst render profitability and sustainability completely impossible.

Some project design officers' continuing preference for expensive and complicated irrigation solutions is difficult to understand, particularly since the benefits and advantages of focusing more on micro-irrigation equipment have been so well documented. They include:

- By replacing surface systems and practices that have traditionally been used to irrigate small plots with low-cost micro-irrigation systems, the area of land that can be fully irrigated from a given volume of applied water can be significantly increased. However, of perhaps even greater importance from the perspective of basin-wide water resources, the production per unit of water depleted by evaporation and transpiration is often increased by 30 to 50 percent. The improved use of increasingly scarce water resources is well suited to peri-urban irrigators, with water consumption reductions of up to 60 percent in comparison to traditional (furrow) irrigation. Furthermore, the availability of affordable micro-irrigation systems in small kits unlocks these potential benefits for literally millions of resource-poor farmers who have access to as little as 20 to 500 m^2 of land. In addition, it opens the potential benefits of irrigation even to smallholders in places where water supplies were considered insufficient or too costly to acquire for traditional irrigation methods to be practical. These technologies are significantly lower in cost, available in small packages, operate at very low pressures, and are easy to understand and operate.[2]
- Labour savings
  - through reduction of time spent in water control in the field;
  - through reducing the gross water requirement for a given area and, therefore, the time spent in water acquisition.
- Opportunity to exploit a limited water supply
  - from a manual or small motorised pump;
  - where water must be carried over a distance;
  - from a small or erratic stream or canal flow.
- Improved conveyance and application efficiency, leading to saving of water and reduced risk of raised water tables.
- Improved control over the timing and depth of irrigation, permitting more accurate application of fertiliser, and hence leading to possible improvements in yield and quality of output.
- Potential benefits of tapping shallow aquifers and not mining deep water.

[2] Keller et al.(2001), p. 1.

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- Effective irrigation of coarse or shallow soils and sloping lands (avoiding need for land forming / terracing).
- Reduction in the area of land taken up by the distribution system.
- Better use of poor quality water, provided that appropriate management practices are adopted.
- Reduced risk to health, by elimination of standing water.
- Unaffected by wind (as regards drip systems).
- Avoids leaf scorch and reduces risk of foliar fungal disease (as regards drip systems).
- Localised soil-wetting reduces evaporative losses and weed growth between rows.
- Operates at relatively low pressure, thereby saving energy, and in many cases eliminating the need for expensive pumps.
- Simple to install and easy to operate by men, women and children and ideal for vegetable cultivation, but also used extensively to irrigate small plots of HYV paddy. In Asia, at least, water-saving micro-irrigation of wheat, tobacco and jute enabled irrigators to harvest remarkably higher yields compared to rain-fed farming.
- The benefit: cost ratio on treadle pump investment is in the neighbourhood of 5:1; the internal rate of return (IRR) is variously estimated to be around 100 percent; the payback period is usually less than a year. For a marginal farmer with US$50–100 to spare, there are few “capital investment propositions” more attractive than a treadle pump (Shah et al. 2000: 29).
- Scalable, divisible and portable technologies with low capital investment requirements (US$100 or less, sometimes under US$10) with potential for poverty alleviation via wealth creation.
- Improved household nutrition levels.
- Low operation and maintenance costs.

Specific areas with the greatest potential for successful micro-irrigation include:

- Areas with chronic water shortages;
- Hillside farming systems in proximity to good urban markets;
- *Fadamas*, *dambos*, and *goulbis*;
- Peri-urban zones of major cities.

As previously stated, a key factor in the disappointing performance of many poverty alleviation initiatives is their failure to address the fact that most of the farms in developing countries are less than two hectares in size. The key to tripling the global harvest through modern seeds and inputs has been irrigation, but until recently commercial irrigation devices have been too large and too expensive for small farmers. This has left them on the outside, looking in on many of the accomplishments of modern agriculture. Yet because small farmers are themselves poor, and are disproportionately concentrated in food-deficit rural areas, increased productivity and income are central to practical approaches to poverty alleviation. For most small farmers in developing countries, affordable small-plot irrigation may be the first step to wealth creation (World Bank; Winrock; and IDE 2000: iii).

Similarly, in some cases, the basic problem to be solved by the project is misdiagnosed during the project identification and design process. For example, the “problem” to be resolved by a proposed new project is often stated in terms of “low production” or “low yields.” However, with post-harvest losses typically 30 percent or more of the entire harvest, a more viable project concept might well be warehousing grain until prices rise shortly before the next harvest. If farmers could sell that lost 30 percent or more rather than losing it to spoilage, or sell the ***entire*** crop at a much higher price later in the year, their profitability would increase dramatically without having to get involved in complex, expensive, and unproven imported technologies. If post-harvest losses are not directly addressed by a proposed project, it should be remembered that even the doubled or tripled production that a costly and complex project may produce is also subject to post-harvest losses.

2.3 Lack of a market development approach

The strategy of subsidising the cost of conventional irrigation systems to farmers with small plots has generally been proven to be unsustainable. It has not been a very efficient mechanism for addressing the needs of farmers of small plots, nor has it resulted in the expected improvements in irrigated agricultural performance. A growing number of irrigation experts believe that, for economically sustainable success, the uptake of micro-irrigation systems for use on small plots should be ***demand-driven*** and without direct subsidies. Thus the systems must be financially feasible (or affordable), and farmers should be willing to pay the ongoing costs (including reasonable profit margins) associated with producing and marketing their crops once the market demand is well established.

Funding the development of low-cost systems and establishing demand-driven markets for them is proving to be a very appropriate and cost-effective role for donors, replacing the direct subsidies provided to farmers in previous irrigation projects. Product development, supply chain and market development, and product promotion are technologies that Western countries providing technical assistance are quite effective at.[3]

The shift in emphasis from the technology development phase (although this phase is still important) to the phase of developing a private-sector-led supply chain and rural mass-marketing of the equipment characterises the present approach to smallholder irrigation development (as opposed to earlier approaches of appropriate technology). The overriding principle of all successful approaches is that they ***treat farmers as entrepreneurs*** motivated by profit, who make investment decisions based on information available to them. Successful technology transfer depends on finding farmers who fit this profile and using them as demonstrators who will influence their less entrepreneurial or more risk-averse neighbours.

2.3.1 Components of the Market Creation Model

The market-creation model of development involves these steps:

1. ***Feasibility Study*** building on previous local irrigation experience and emphasising the participatory approach, as well as identifying opportunities for marketing the increased production (especially high-value crops where local smallholders may have a comparative advantage) resulting from irrigation.

2. ***Development of the Technology Package***. This involves decisions about importing versus local manufacture, types and sizes of micro-irrigation equipment and kits, principal crops to be promoted, aiming at a limited product line that is affordable to poor farmers and ***that can pay for itself in a season or, at maximum, a year***.

3. ***Supply Chain Development***. Once the product(s) are identified, they must be procured or manufactured, preferably the latter, as the Kenya experience shows (see following page). Although drip tape is not produced in many developing countries, PVC pipe and other plastic products are widely produced. Micro-irrigation kits can easily be produced using micro-tubes, which can be manufactured with a minimal upgrade at a PVC pipe factory. The method of manufacture is linked to the selection of technology and these decisions must be made in tandem. Also, it is critical to determine how and by whom the products will be distributed. It is desirable to have as wide a distribution network as possible, not just to one target area within the country. Local agricultural outlets, hardware stores, etc., are logical candidates to be retailers. The structure and relationship of

[3] Heierli, U. and P. Polak, (2001) pp 1–31. Readers wishing a more in-depth explanation of the "market creation" approach around which donor thinking on irrigation finance is coalescing should consult this document. Figures 1 and 2 have been adapted from those developed by Mr. Heierli.

manufacturer, wholesaler and retailer need to be determined for each programme. Questions of quality control, guarantees and other issues need to be resolved. Various types of supply chains have been developed, and to ensure sustainability it is essential that all parties in the chain make a profit.

In the development of supply chains, provisions are made for private sector enterprises to supply the associated inputs (seeds, fertilisers, soil amendments, plant protection agents, etc.) that the smallholder farming community will need in order to take maximum advantage of the water-related technologies. In addition, provisions are made for the private sector and/or government agencies and NGOs to provide necessary farmer training.

The availability of credit is a major factor in the successful mass dissemination of productivity-enhancing technologies for the smallholder; special consideration is given to building into the supply chain mechanisms for credit for the smallholder.

4. ***Rural mass marketing***. In order to convince farmers to buy new technology, major efforts must be put into marketing. This may take different forms depending on the country.

5. ***Agricultural production: Adding value to product, and output marketing***. With micro-irrigation, farmers may be producing high-value crops with which they are unfamiliar. They may need training on variety selection and management practices. Farmers may also need training in the use of post-harvest practices and on-farm processing in order to add value to their products, and to gain access to profitable and stable markets. Promotion of high-value crops may involve policy dialogue with the host government to facilitate relevant infrastructure development and the creation of new markets. Marketing may also involve improved storage and preserving (drying, pickling, cooling, freezing, canning, etc.) of high-value crops carried out on an industrial scale.

6. ***Impact measurement and feedback***. For the programme to work effectively, managers must be able to monitor impacts in order to adapt the programme continuously to meet its objectives. Programmes may need to adapt new technologies, tap new markets, or find new sources of donor funding. In order to respond to changing conditions, programme staff members need to monitor sales, redefine the target smallholders and measure the impact that the technology is having on incomes, employment, and other factors. This data needs to be fed back to the programme to enhance profitability, build sustainability, and ensure greater incomes for the target smallholders.

The process involves a number of actors with a variety of skills to be obtained through the establishment of a network that would include a variety of organisations, including donors, NGOs and other implementers, host governments and the private sector. There is a strong need for co-ordination of the programme to assure that parties work together towards a common goal. A network secretariat would have a major objective of promoting co-ordination among all the actors involved in promoting smallholder irrigation.

Two case studies in Africa (Kenya and Zambia) illustrate the importance of some of these components (World Bank et al. 2000: 11–12):

In Kenya, the Kenya Agricultural Research Institute (KARI) distributed bucket kits. This experience provides two important insights into problems associated with production and distribution. The bucket kit is manufactured in the U.S. and shipped to Kenya in container-lot quantities. Although the shipping costs per kit are relatively low, delays hinder the availability of kits. An entire container is expensive, so the programme must depend on a large influx of funding to import the kits. This means that the programme is not run as a sustainable business.

In the second, the kits have been distributed only at the national headquarters of KARI and several other outlets. They are not available through the private sector at local outlets. Although good demonstration programmes have been conducted, both at the national headquarters and at local agricultural field days, there is no consistent advertising campaign. Only sporadic advertisements and newspaper articles have announced the availability of the kits. This has resulted in uncertainty, and reliance on distribution through NGOs which buy a number of kits for their target farmers. Finally, spare parts are not readily available as there is no national supply chain of kit retailers.

Market Linkages. The Zambia Dambo development project provides a number of interesting lessons learned. First, the programme emphasised local production of treadle pumps, which lowered costs from US$200 to between US$60 and US$70 per pump. The contractor, IDE (International Development Enterprises), has operated the project in 4 areas of Zambia with 128 retailers, with emphasis on demonstrations to reach farmers. Farmers have been linked to micro-credit. The dispersed nature of the population, and poor quality of transportation and other infrastructure, have hindered adoption. The most significant lesson is that farmers who are linked to established horticulture markets realise the highest incomes. Generally, limited access to markets has prevented many farmers from full adoption of the technology. Zambian farmers tend to be dispersed, and, although access to land and water in *dambo* areas is good, farmers are generally located far from markets, and are constrained by poor road infrastructure.

The various components required in a "market creation" approach are illustrated in the diagrams on the following two pages.

Given the complexity of the market-creation approach, it would seem desirable (if sufficient funds are available) to place the overall management of the development of such systems in the hands of experienced micro-irrigation consulting firms, such as IDE, EnterpriseWorks, HIPPO Foundation and SE3WE, that already have considerable experience in Africa. The first stop in the search should probably be the IPTRID (International Programme for Technology and Research in Irrigation and Drainage) secretariat located in FAO headquarters in Rome (iptrid@fao.org).

Figure 1. Supply chain for low-cost micro-irrigation equipment and services needed by farms to make use of it.

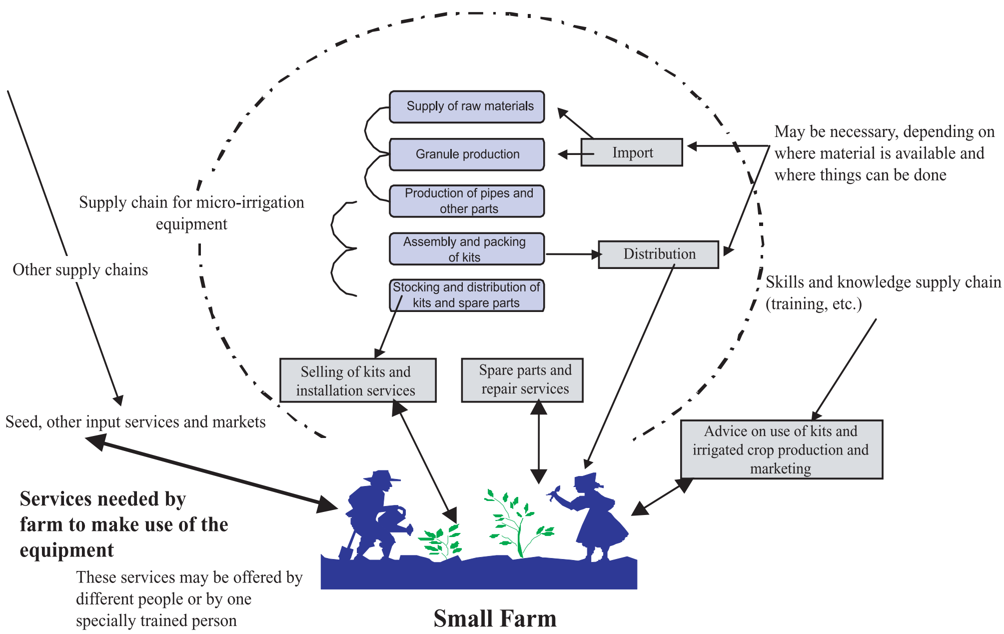
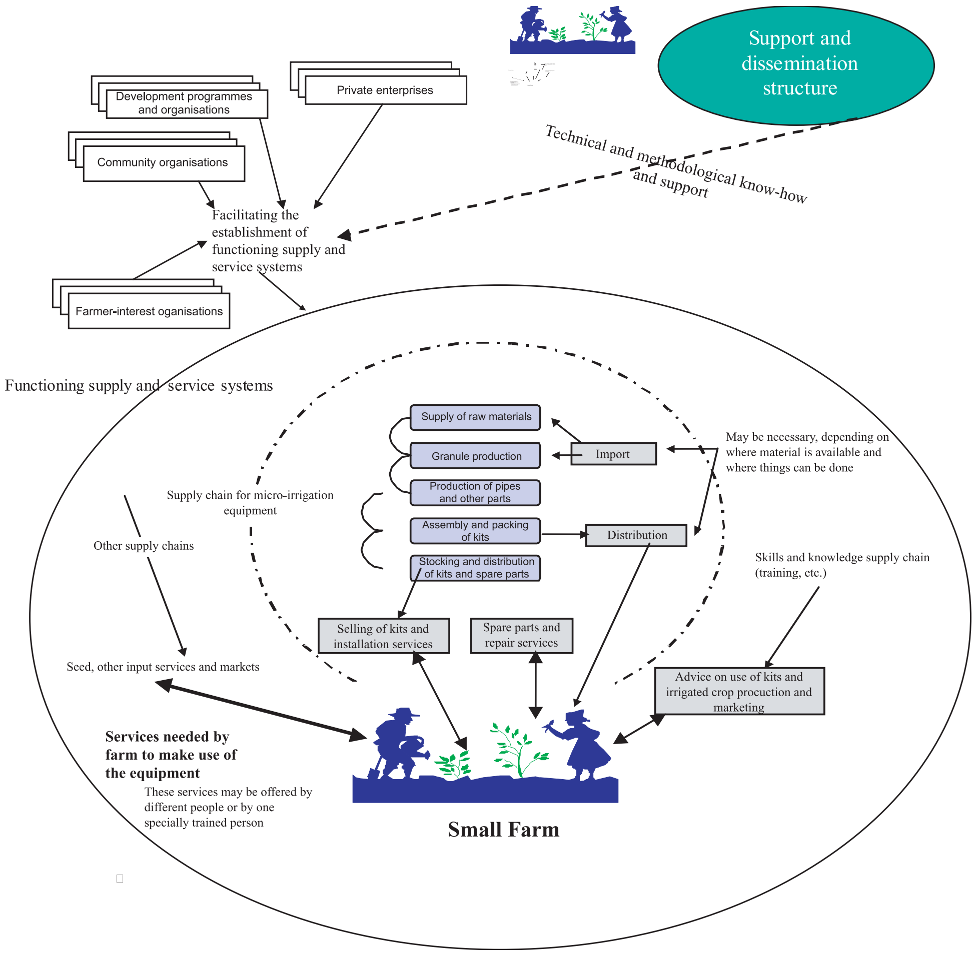


Figure 2. The challenge of supporting the establishment of viable supply and support systems for low-cost micro-irrigation.



2.4 "One size fits all" project designs

Unfortunately, most previous irrigation projects used a "one size fits all" type of technological solution. Typically, all participants received the same expensive European motor pump, regardless of the size or condition of their farm, and received the same chemical inputs, etc. Unfortunately, each farmer's situation is different, and the approach should be tailored to his or her circumstances. Even neighbours' farms can be vastly different, requiring different approaches and inputs. The ultimate result was that many farmers were coerced into borrowing money to pay for expensive, inappropriate solutions, and when they did not benefit after the technology failed, they felt little obligation to repay the loans.

Several factors combine to determine what technology is most appropriate for a given farmer, requiring a customised solution for each farmer, depending on various factors such as:

- The capital and operating costs of the equipment;
- The value and availability of water, land, labour and cash;

- Field topography, layout and soil type;
- Crop type;
- The nature of the water supply at the field edge;
    - Hand carried;
    - Gravity flow in a stream or other open channel;
    - Piped supply from a pump or other source;
- The technical skill of the farmer and his or her previous experience with irrigated farming;
- The farmer's access to equipment and spares;
- The availability of a market for irrigated produce;
- The quality of advice and technical support from government or private-sector extension services.

With so many factors determining what is appropriate irrigation equipment for a smallholder, it is impossible to identify one technology as the best one for everyone. Undoubtedly drip and sprinkler irrigation are the least expensive, entry-level technologies that have potential for adoption by resource-poor farmers, followed by treadle pumps. However, the exclusion of techniques such as buried porous pots or clay pipes, low-head and pressurised bubbler systems, or lay-flat pipe in place of open field channels, does not imply that these technologies are not appropriate in some farming systems, or that low-cost drip is a universal "solution" (Cornish 1998: 3).

2.5 Inadequate management information systems

Project designers frequently forget or overlook the importance of a high-performance management information system (M.I.S.) within any kind of credit programme. History shows that when the number of loans goes beyond a few hundred, control of disbursements and loan repayments tends to deteriorate rapidly, with the result that the programme goes out of control and usually fails, if there is not a good M.I.S. The lender absolutely must have daily, weekly and monthly listings of loans coming due and those overdue, so that loan officers and other staff can quickly follow up. When these reports are not available, lending programmes quickly get out of control, defaults rise dramatically, and lending and production targets are not attained.

Therefore, project designers should make sure to build in both sufficient numbers of computers and banking software licences for the foreseen volume of credit, branches, cashiers and back office personnel needing access to loan portfolio information.

Fortunately, we have within FAO access to state-of-the-art banking software. FAO developed the DOS version of its Microbanker software over a decade ago, and it is being successfully used in well over 1,500 financial institutions in every region of the world. This very capable software is already available in English, French and Spanish, as well as certain other European and Asian languages. Project designers should also not underestimate the effort it will take to train lending institution staff in how to use and exploit the software effectively. At a minimum, one should foresee an initial intensive training of key users for not less than 2 weeks, followed by a refresher course of a week to 10 days 6 months later. Those who have some experience with the DOS version of Microbanker know that it has a rather steep learning curve, and that it frankly is not the most user-friendly software in the world. Fortunately, a new, much more user-friendly Windows version is currently being tested in a variety of sites. MBWin is currently available only in English, but its new architecture facilitates its rapid translation into any language that Windows can use, and can, in addition, be simultaneously bilingual in two languages. French and Spanish versions will also soon be available, and conversions to other languages are not overly complicated. For budgetary purposes, project design officers desirous of using MBWin may wish to include its cost, as shown in Table 1.

Table 1. Price structure for Microbanker programme.

	Prices of Microbanker for Windows	
1	**SRTE Stand-Alone Version**	
	- Base Module (General ledger, customer maintenance, configurator, and take-on) and one application module	US$1,000
	- Additional application modules (Savings accounts, current accounts, time deposits, share accounts, and loan accounts)	US$250 each
2	**SRTE LAN Version (for Windows NT Server or Novell Netware)**	
	- Base Module (General ledger, customer maintenance, configurator, and take-on) and one application module	US$1,500
	- Additional application modules (Savings accounts, current accounts, time deposits, share accounts, and loan accounts)	US$400 each
3	**Site Licences**	
	- First 10 sites	US$800/site
	- Next 40 sites	US$600/site
	- After 50 sites	US$400/site
4	**The EXTE version** (user-customisable code), with unlimited number of site licenses, is also available, but most users will not need this.	US$75,000

Technical and pricing questions about MBWin should be directed to Mr. Ake Oloffson, AGSM, Rome (Ake.Oloffson@fao.org).

3. Difficulties linked to the beneficiaries themselves

The greatest constraint in this category is farmers' frequent ***pre-existing indebtedness*** to formal and informal lenders. Ideally, new irrigation loans should not be granted to those already over-indebted, but in the absence of credit bureaus in most African countries, it is frequently difficult to determine this before granting a loan, particularly if the lender is not located in the same community as the borrower. (This is a reason to try to use decentralised financial systems as much as possible – they know the local population much better). A related problem is the frequent inability of the proposed recipient of an irrigation loan to raise the necessary counterpart funds, typically from 10 percent to 25 percent of the total cost, as well as pay the increased farm operating costs after the installation of the new irrigation equipment.

In general, the almost systematic ***under-capitalisation*** of farmer-borrower farms renders them very vulnerable to the slightest unexpected event. In the case of the seemingly excellent farmer associations on the Senegal River, for example, using seven high-capacity motor pumps, borrowers had always been up to date in their payments to the lender. But when they started to exceed the capacity of the pumps, they all broke down. Since they had already spent all their available funds on operating costs, however, they could not repair the pumps, and the crops ultimately failed.

African farmers frequently seem unable (some would say they ***refuse***) to understand the mechanism of ***depreciation*** of fixed assets. Because the borrowers do not set aside funds for replacing the equipment at the end of their useful life, they end up at that point as dependent as ever on external capital. A phenomenon particularly widespread, but not limited to French-speaking West Africa, is that the cost of donated equipment is not factored into the price of whatever production results from that equipment, so that when it needs to be replaced, there are no funds to replace it. This phenomenon probably originates in the "hand-out mentality" that has developed, where farmers become convinced that, after all, they can get some donor to finance the next pump when the current one wears out.

Illiteracy, on the one hand, and lack of institutional ***organisation***, on the other, most often prevent farmer-borrower groups from maintaining adequate accounting records or even from properly filling out the loan application. As a result, these tasks are confided to third parties (teachers or children, typically) who do not have a personal stake in seeing that it is done right.

Lastly, the high rate of ***post-harvest losses*** (typically 20% or more for rice, 30% or more for tomatoes) before marketing the produce reduces the borrowers' income greatly, as well as their ability to repay their loans. The lesson here is for project development officers to give serious thought to creating viable warehousing facilities, in addition to irrigation equipment to increase production and yields.

4. Difficulties caused by the lending institution

Although the distance from the lending institution or branch office to the borrower's village is not a great obstacle to disbursing the loan, it is often a major obstacle when payments come due, particularly in terms of the cost of transport and lost time, and the inability of a far-away lender to appreciate the borrower's problems. The farmer association reflects the ***average*** member, and not the condition of its most vulnerable members, who risk being marginalised, even forced to rent out their land, as in the case of Fouta-Djalon in Guinea in 1995 (LeBrun 1998: 6).

Most decentralized financial systems are chronically short of long-term lending funds which would permit them to invest significant amounts in medium- and long-term investments such as irrigation equipment. Project design officers, who are frequently under pressure to complete their project papers, often forget to verify the availability of lenders' funds. When the time comes to disburse the irrigation loans which had been promised to farmers, one discovers that the lenders do not have sufficient lending capital. Worse, after disbursing the equipment loans, one discovers shortly thereafter that there are insufficient funds to pay for operating-cost loans. The chronic shortage of lending capital is just another reason to prefer micro-irrigation equipment to more expensive, imported power pumps.

Finally, there is an increasing cacophony of competing rural finance institutions promoting their products. Because some competitors may have subsidised lines of credit, those borrowing from unsubsidised sources may object when they learn how little the competing institution charges. At worst, the borrower defaults, and at best he takes all his future business to the less-costly competitor, thus missing the potential benefits to both borrower and lender of a long-term relationship.

5. Difficulties caused by governments

The principal problems frequently encountered in this category include the inability of local authorities to assure an adequate legal and regulatory framework. Problems also include well-meaning but counter-productive usury laws or directives that interest rates on agricultural loans should paradoxically be lower than for loans to other sectors, despite the higher risk of default. Successful rural decentralised finance systems generally cannot survive on such artificially low interest rates, and the end result is that, instead of protecting farmers from "damned usurers", farmers end up having no access to loans at all. Other problems include government directives to "encourage" certain segments of the population, which may or may not make economic sense to the lender. Another major problem in much of Africa is the inability to pursue a delinquent borrower effectively and legally.

A common problem is also that government officials try to force lenders to grant loans to individuals who do not qualify for loans according to the lender's established loan policy. Accordingly, it is necessary to try to negotiate a clause stating that government will not interfere in a lender's decisions to grant or refuse loans to borrowers. Also it needs to be certified that loans will be granted exclusively on the basis of the merits of the borrowers' projects; their repayment capacity and their likelihood of repayment. Attempts to assure that financial decisions are taken by experienced financial personnel, and ***not*** by politicians are also recommended. Once politics enters the lending decision process, failure will not be long in coming.

A whole other class of problems is derived from deficiencies in the government's development policy itself, particularly when it accords insufficient attention to improving marketing channels (quality improvement through setting of standards, terminating ineffective marketing boards, creating sufficient feeder roads to isolated areas, etc.). The end result of these kinds of policy deficiencies is either to (1) dissuade producers from even trying to fully exploit technologies like micro-irrigation or (2) create a situation where even if production rises substantially, farmers have no place to market the extra production. Project design officers, too, must identify reliable marketing channels before proposing irrigation projects that may considerably increase production. Increasing production alone is not enough to assure the profitability of irrigation loans, and hence their ultimate repayment.

Another problem that is clearly attributable to governments, is their propensity to incur massive budget deficits that provoke high inflation and interest rates. Because of the low rates of return typically applying to agriculture, these high rates greatly discourage farmers from borrowing and investing in their farms.

6. Difficulties caused by donors

Traditionally, the major development banks faced several obstacles in packaging small-scale irrigation activities into a loan package:

- The minimum loan size to justify the bank's investment in the entire project cycle is often too large for the needs of a national small-scale irrigation initiative. Because their projects had to be large in amount (typically US$25 million or more), the World Bank and other major international and bilateral donors focused principally on larger-scale systems, particularly the expensive mechanisation of large agricultural development perimeters, especially for rice production. Results with this approach have almost always been disappointing, for all the reasons already enumerated: lack of focus on market creation, use of overly complicated, expensive and uneconomical equipment imposed by bilateral donors, etc. Donors thus had a built-in bias against "thinking small."
- Small-scale irrigation is essentially a dispersed, local activity, whereas development bank funding tends to support centralised, large-scale investments or investments targeted at large institutions (e.g., national research and extension systems) capable of absorbing large tranches of funds.
- Traditionally, small-scale irrigation has depended on NGOs, CBOs or private companies to jump-start the process with training, demonstrations, loans, and mass communication campaigns. Development and commercial banks have traditionally focused on public-sector institutions.

Recent innovations in funding and country agreements have reduced significantly these barriers to funding small-scale irrigation initiatives. These new factors include:

- Technological advances, particularly in the area of developing affordable, small-scale water-lifting devices and drip irrigation systems;
- Governments, as the borrowing agencies, have been more amenable to passing on responsibilities and funding to NGOs or other local organisations to plan and implement development activities;
- There have been shifts in the policy environment, favouring private-sector initiatives and increased smallholder participation;
- Targeted micro-irrigation projects have been able to provide a package (training, funds, marketing assistance, etc.) to promote small-scale irrigation;
- Small-scale irrigation, where feasible, can be part of a larger loan package such as a larger water development or rural development project. Such projects often include investments to support other parts of the small-scale irrigation project business model, such as rural roads and marketing infrastructure;
- Heightened environmental concerns—in particular, concern for increasingly severe water shortages and for food security;
- Increased focus on poverty alleviation, achievable by increasing smallholder productivity through affordable small-plot irrigation;
- The emergence of viable market-creation approaches for smallholder development, and growing acceptance that the market creation approach is better than the failed subsidised approaches of the past, and growing commercial interest by manufacturers and irrigation consulting firms in micro-irrigation product development. Markets for smallholder irrigation technologies are, accordingly, evolving rapidly. For example, large irrigation equipment firms, such as Israel's Netafim, which previously were not interested in the idea, are now seriously developing equipment specifically aimed at smallholders in developing countries.

The Niger Private Irrigation Project, currently in the World Bank project cycle for 2001, represents many of these innovations in practice. The government has decentralised management of water resources to local communities and encouraged greater private-sector participation. The project combines tube wells with manual pumps, thus increasing project size, and includes funds for training, technical assistance and finance. An umbrella NGO will implement the project. Advice will include study tours, workshops, demonstrations, field trials, field days, and techniques to improve crop yield and quality. This work will be contracted to the Niger Association for Private Irrigation Promotion (ANPIP). The programme will also create savings associations; provide land-titling assistance for project beneficiaries; and assist local irrigation service providers. Total project cost is programmed at $33 million.[4] It will be interesting to see how successful this project is; doing "all the right things" will hopefully produce results.

7. Elements of reflection/lessons learned

7.1 Irrigation project design considerations

By this point, the reader would have noted that the author has made a number of pertinent observations on how irrigation projects or project components should be designed. First of all, it should be clear that projects should be designed and implemented with the full participation of the farmers most affected by them, and should not be hurried by project design officers in the faraway capital city or even foreign countries. The second major observation is that project design officers should not just see their jobs as increasing production or yields. The task at hand is much bigger than that. The "market development" approach presented above, and generally accepted by the donor community, now requires projects to take this approach.

So, yes, do take the time to figure out (with the farmers who will be using it) what is the most appropriate technological package, but in addition, you also now have to figure out who will manufacture the micro-irrigation equipment (importing is not a sustainable solution), how it will be distributed, how other inputs (seeds, seedlings, fertilisers, pesticides, etc.) are going to be delivered on time, from where financing will come and, finally, where the huge increase in production is going to be marketed. In short, you now have to take a systems approach to the design of irrigation projects and components.

Secondly, project design officers should make sure they have identified the real problem to be solved. Is it really low production or yields, or is it the large proportion of post-harvest losses and/or the farmers' inability to hold on to the harvest long enough for prices to rise? You may be able to increase local food production by 30 percent or more simply by creating storage capacity. Certainly farmers' incomes could be greatly enhanced if they can manage to delay the sale of their produce until later in the year when prices are higher. Accordingly, projects based on reducing post-harvest losses or warehousing of crops may be a more appropriate solution than an irrigation project or component. At a minimum, a post-harvest loss reduction component in your irrigation project would certainly complement and enhance whatever production and yield results are obtained.

Hopefully, the benefits of low-cost micro-irrigation technology (drip systems, low-pressure sprinklers, treadle pumps, rope pumps, etc.) are clear and obvious. They offer greater productivity and incomes for the masses, not just a few working on a single large irrigation system.

These low-tech micro-irrigation technologies do not work in all circumstances. If surface water is unavailable, or if pumping heads are more than 10 meters, none of the aforementioned technologies will work. In addition, intensification will necessarily require more costly solutions to the extent that power pumps must be imported. Project designers need to argue more eloquently the case to bilateral donors that expensive pumps do not represent responsible development, and that if they really want to help Africa to develop, then they should agree to finance the purchase of equivalent, but much less costly, power pumps from Asia. No matter where the power pumps come from, however, the project design needs to make sure that there are mechanisms built in to supply sufficient quantities of spare parts and backup pumps to replace temporarily pumps that break down. The project also has to somehow assure that there will be sufficient maintenance and repair capacity available to farmers. The absence of these latter features has doomed a majority of previous irrigation projects.

[4] The preceding discussion was inspired by World Bank, Winrock International and IDE, 2000, pp. 4-5 and 20.

Credit is not always the solution. In fact, if one accepts the premise that preference should be given to micro-irrigation technology over expensive power pump solutions, it follows that most African farmers probably don't need credit to purchase US$25 or US$50 micro-irrigation equipment. They can just buy them for cash. The problem is to create the manufacturing and distribution systems that make them available to the masses.

At this point in time, leasing is not a technology that can be definitely recommended as a sound approach. Ongoing experience with this approach in Mali and elsewhere, though, should be closely monitored, so that if successful approaches to leasing do appear, they can be replicated.

7.2 Credit supply and demand

The first recommendation in this area to project designers is that they should try to assure the objective of close proximity through the creation or support of one or more existing local DFSs (decentralised financial systems), such as a credit union, village bank or rural bank, through sensitisation of the population, capacity building and institutional development. The DFS thus created or strengthened has the considerable advantages of knowing the borrowers and is more able to monitor the loans closely than development project staff ever will. Of course, the project will have to abide by the DFS's overall credit policies and interest rate structure.

If the local DFS is a member of a federation, then it may be possible to negotiate considerable outreach to widespread sites where DFSs belonging to that network have been implanted. The federation may, as is increasingly the case, have a central liquidity, or rediscount, facility, that will be able to provide and manage the additional liquidity that the irrigation project may require. The federation may well help to negotiate, if necessary, with commercial or development banks, lines of credit that the rediscount facility can redistribute to its member DFSs.

It is becoming more and more common for DFSs to successfully mobilise large amounts of savings to lend their excess liquidity to other DFS networks (e.g., the case of FUCEC-TOGO). If there are no DFSs in the region where you want to implant irrigation technology, there are but two choices: (1) take a long-term perspective, and create the required DFSs, probably in collaboration with one or more existing networks interested in expanding into the zone or (2) choose a more propitious region already served by one or more networks of DFSs. Working with commercial banks, for reasons already cited, has in general produced experiences considerably less than satisfactory.

Detailed agreements will have to be negotiated with each federation, rediscount facility, bank or DFS. This is a time-consuming process that should not be minimised in the project document; if it is, the implementation of the project will fall behind schedule very early in the process. Fortunately, samples of previous agreements of this type can be used for inspiration.

A second recommendation is to make absolutely sure, in project design, that there is a definite and adequate source of funds for financing a considerable amount of medium-term irrigation loans. Most DFS networks will not have enough long-term funds, so they may have to be found from such sources as: capital grants through the project (although these are less and less attractive to donors); lines of credit from commercial or development banks, governments, central banks or even donors; or other sources (NGOs, etc.). Most African countries' banking systems have excess liquidity that can, in principle, be brought to bear, if properly negotiated, but that takes a considerable amount of time, something the busy project development officers are short of. But they have to find the time, because they need to negotiate all of the aforementioned during project design; if you wait until implementation, any significant snags will put the project way behind schedule, or cause it to fail outright.

Another increasingly relied-on source of long-term lending funds is, oddly enough to some, client savings. The war between those who claimed "it's obvious that the poor cannot save" and those, like credit union leaders, who claimed that "the poor can and do save", has been won by the latter. Most micro-finance specialists now acknowledge that the poor are able to and do, in fact, save considerable sums. Although there are many (especially proponents of the Grameen Bank approach) who still preach that it is "obvious" that poor people cannot save, and that it is necessary to "prime the pump," evidence now clearly shows quite the opposite, and most donors no longer are interested in hearing the tired old "poor people can't save" refrain.

The question is, therefore, no longer "do they save?" but rather how can we capture these savings and use them to finance development? The work of many micro-finance practitioners, especially the World Council of Credit Unions, shows that significant sums of savings can be mobilised from the poor. To attract a stable and rapidly growing pool of savings from such a population, you must pay positive real interest rates (i.e., greater than the rate of inflation, rates on such deposits being based preferably on "Consumer Price Index-Plus" formulae).

It is also frequently necessary to clean up the DFS's balance sheet, and write off defaulted loans and other accumulated "junk assets," as well as improve the services and image of the DFS through the introduction of modern methods and techniques, especially computerisation, modern loan-monitoring systems, and strict loan write-off procedures — sometimes a new coat of paint is really all that's needed. The combination of these measures frequently provokes a veritable explosion in savings growth, and the problem then becomes one of managing the DFS under the stresses of constant rapid growth (such as the need to double staff every year).

Another recommendation is to make sure that the term of irrigation loans is within the expected and useful life of the assets in the local environment (not in the environment prevailing in the country where it is manufactured). Past (and painful) experience has shown that many irrigation credit schemes' loan terms were too long, so that farmers continued owing money to the lender long after the equipment was already exhausted and retired. Experience shows that poor African farmers tend to over-use their expensive equipment in the hopes of maximising its output, but in doing so, greatly decrease its useful life. Accordingly, diesel and gasoline-powered pumps' repayment terms should in no case exceed 5 years. Electric pumps, where usable, tend to hold up better, and their terms can be stretched out to 7 or 8 years at the most.

Wherever possible it is necessary to build in a post-harvest loss-reduction component (probably involving warehousing). If an irrigation project succeeds greatly, and doubles or triples the production of rice or other crops, it does not necessarily improve the farms' profitability, if the increased crop results in a collapse of produce prices. A complementary warehousing scheme, in addition to letting the farmer store produce until prices improve, also permits him/her to reduce significantly the losses due to pests and humidity (typically around 30%) that occur in the absence of sound storage facilities.

To make this work, the lender has to be able to provide additional working capital loans during the period when the production is stored. Otherwise, farmers will be forced to sell at least part of their harvest just to survive, and thus will lose much of the benefit of increased production. The Nyesigiso DFS network in Mali has done this effectively by integrating the initial investment loan and extended working capital loans into a single package (LeBrun 1998: 8). Beyond just warehousing cereals or other produce, serious thought must be given to specify exactly how the increased production will be marketed at a profit. It does no good to increase production if it is unsold and rots at the farm.

Continue the tendency to rely less on formal guarantees. This does not mean complete elimination of hypothecation or reducing the lender's legal rights. Rather, because African legal and cultural systems frequently do not permit rapid resolution of conflict through the judicial system, lenders will probably be better protected from loss if they rely more on "joint and several" loan-repayment responsibility by borrower group members, through the creation of effective group solidarity and social pressure.

7.3 Institutional development

Good (or bad) organisation is usually a determining factor in the profitability of an irrigation project. If inputs are provided and applied on a timely basis, if borrower counterpart funds are collected on time, if the credit process is well thought-out, if there are replacement parts and back-up machines available, if there is a technically sound water management system in place, and if reliable marketing channels for increased production have been identified, most likely the project will succeed in increasing production and profits. When any of these elements are defective, the entire programme can suffer greatly. Accordingly, to succeed, project designers will be wise if they formally incorporate into their projects such institutional development activities as training, information services, assistance in improving the management of DFSs and their federations and refinancing bodies, and generally improving the degree of organisation.

Placing the overall responsibility for the management of irrigation rehabilitation projects directly in the hands of those concerned is a relatively new, but rapidly growing approach, and is perhaps best illustrated by the Asprodeb/PDPI project in Senegal. In that case, the farmer borrower associations themselves designed their projects and, with the assistance of their federation, their local lender obtained credit (and sometimes subsidies) accordingly through the CNCAS.[5] This type of approach, based on true, meaningful participation of beneficiaries in the design of their projects, is much more likely to succeed than "one size fits all" projects designed by hurried project designers and technicians "on farmers' behalf" in faraway capital cities. It permits the flexibility to custom-tailor a loan to a particular farmer's (or farmer group's) circumstances and needs. If it fails, the farmer can no longer blame the project or the lender, claiming that they made him or her do something he/she did not really believe in (LeBrun 1998: 8).

In the same vein, the concept of "twinning" between borrower groups that have already successfully borrowed monies for irrigation purposes and those who are just starting the process, is becoming an increasingly popular and effective measure that goes a long way towards assuring the proper application of project resources. This approach was successfully used in the ACODEP[6] project in Mali, particularly in the transition from monoculture to more intensive cultivation and polyculture.

Using this technique, those who have already benefited from the first interventions train those just starting, thus creating a spread effect ("tâche d'huile" in French). Twinning activities may be solidarity-based or may be paid by the receiving parties. They have the additional advantage of creating a peer-to-peer self-help group that can help each other when difficulties arise. Known types of problems can then be quickly resolved, instead of waiting for far-away project or technical officers to come resolve the problem.

While it is strongly urged that project designers make greater use of local DFSs, it is also important to warn that financial activities should be strictly separated from non-financial activities. For example, a village may have a strong village association that is well organised and is significantly improving life in the village. They are doing many worthwhile activities, but up to this point, they have not been involved in lending. The appendage of a financial "window" to such an association is usually a formula for disaster. Management and accounting organisation are almost never adequate to know which activities are profitable and which are not, funds get commingled and are often embezzled. Accordingly, it needs to be made sure that any village financial schemes' funds and accounts are completely separate from non-financial village operations. It is quite possible, and even very common, that the officers of a village association are also the officers of the local DFS; but they must be able to separate these functions in their mind, and keep the funds quite distinct from one another.

7.4 Policy considerations

In a market economy, the role of the State is focused on regulation, creation of infrastructure, and promoting and creating incentives. Four aspects of the State's contribution seem imperfectly mastered at this time in most African countries, as has become clear from a series of FAO (AGSM[7]) workshops in recent years:

- Firstly, governments are still too prone to offer subsidies to "encourage" a certain activity. The distortion caused by subsidies has frequently an effect quite the opposite of that intended. The fact that most African development banks, with their heavily subsidised interest rates, have now disappeared is eloquent testimony to the bankruptcy of that approach. So are the perverse effects of central banks' attempts to make financial institutions charge lower interest rates on farm loans than on those to much less risky sectors.

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[5] Caisse Nationale de Crédit Agricole du Sénégal.

[6] An irrigation project in Mali jointly executed by UNDP and ILO.

[7] The Marketing and Rural Finance Service of the FAO's Agricultural Support Division.

- Secondly, as previously indicated, governments may sometimes try to intervene too far, overstepping the bounds of their legitimate duties of safeguarding depositors' interests and assuring an adequate food supply to the country's population throughout the year. To forestall harmful interventions of this type, project design officers would do well to negotiate clauses with governments requiring that they do not interfere in lenders' loan-granting decisions, do not declare loan-repayment moratoriums, nor take any other actions inimical to the success of the lending programme. The ability of lenders to operate without political interference is of fundamental importance to project success. If loans are granted because of political pressure, both the project and the lending institution will be in jeopardy.

- Thirdly, while many countries, especially those that are members of the UEMOA,[8] have made important strides in improving regulations, most still have a long way to go to assure effective prudential control. All countries need to intensify efforts in this area, particularly by clarifying current grey areas. The aim should not be to gain control of DFSs, but rather to assure the public that funds deposited there are reasonably safe.

- Fourthly, largely as a result of the micro-finance "movement" these past few years, many innovative financial institutions and financial service products have appeared. However, many other lenders still rely heavily on traditional practices and products, which are more appropriate for the commercial banking sector than for development finance. All governments need to gently push those involved in development finance to adopt more appropriate institutional forms and financial service products. The IDA of the World Bank Group has developed useful training sessions for local leaders on mastering this type of negotiations.

Finally, the author would like to recommend that the State use its powers of persuasion to sensitise borrower groups and their lenders of the need to create a progressively increased self-financing capacity over time, so that the subsidisation of irrigation equipment can be phased out. This is particularly important for the irrigation sector, given the frequently high cost of the initial investment and most governments' declining ability to support this type of subsidy. As we all know, subsidisation also attracts influential opportunists who frequently benefit from such programmes more than those originally targeted. If we let the market rule, such influential people will not be so attracted.

8. Summary of conclusions and recommendations

In most African countries, there is sufficient liquidity within the banking and DFS sectors to finance all foreseeable irrigation needs. The problem is not one of lack of financial resources, but rather of identifying a sound way of accessing and using them, which will inspire the confidence of those responsible for their management. This paper has attempted to provide some guidance on how to create that confidence through the conception of sounder irrigation projects.

The following "Ten Commandments" of irrigation finance summarise the guidelines for developing such sounder projects:

1. At the project identification stage, make sure to identify correctly the farmers' real principal problems, before attempting to design the most appropriate solution. While this sounds obvious, in reality many problem statements are incorrect or inappropriate in great part because the participatory process has been short-circuited. Make a concerted effort to determine whether the main problem is one of "low production and/or yields," or whether it is huge post-harvest losses (PHL). If PHL is large, consider an initial project or phase that specifically addresses PHL. This will improve farm profitability so dramatically that there is a good chance that farmers will be able to self-finance most, if not all, of the second phase (micro-irrigation) of the project, or of follow-on projects.

[8] Union Economique et Monétaire Ouest-Africaine : West African Economic and Monetray Union.

This would be particularly true if the project design is based on leasing (straight or lease-purchase) irrigation equipment, rather than outright purchase. For more information on proven solutions for PHL, see the FAO publications "Warehousing and Inventory Credit" and the "Manual on the Establishment, Operation and Management of Cereal Banks." These books are downloadable for free from the FAO and are available in booklet form for a nominal fee.

Corollary No. 1 is that project design officers should not short-circuit the participative process; those most affected by the design must be intimately involved in it from the outset. Corollary No. 2 is to abide by the principle of K.I.S.S. (Keep It Simple, Stupid!) during project design, and adopt the technical solution that is least complex (and probably least expensive), consistent with accomplishing project objectives.

2. Recognise that credit is not always, not even in a majority of cases, the most appropriate solution. If numerous inexpensive, locally-manufactured treadle pumps will do the same job as an expensive European motor pump, selling them outright for cash is definitely better and will save many problems resulting later on from credit programmes, particularly from the high defaults typically experienced when using expensive irrigation equipment.

   Similarly, during project design, give serious consideration and allocate time to identifying possible local manufacturers and/or retailers of required irrigation equipment. Maybe the "poorest of the poor" will not benefit directly from the project, but production and profitability will almost certainly improve considerably, and the very poor will still probably at least benefit from the need for additional labour to run the more mechanised and/or larger farms.

3. If, after the above precautions, you still opt for a credit programme or component, make sure that a sufficient quantity of long-term funds is available to finance the projected volume of irrigation lending. Do not leave the details of this component as something whose details "will be worked out by project staff during implementation." This is an essential component, and you must be reasonably sure that the funds will be available; because their eventual non-availability would jeopardise the entire project.

   Corollary 1 is that experience so far with loan guarantees has tended to encourage poor performance by lenders, since the latter will recover their capital whether they perform well or not, and hence you should avoid loan guarantee schemes, if at all possible. Corollary 2 is that there is currently insufficient information to support leasing of irrigation equipment as a valid approach, although efforts in this direction in Mali and elsewhere need to be closely monitored to identify sound new approaches.

4. If, despite points 1 through 3 above, you still decide to propose the use of complex, expensive irrigation equipment installations, then use a rational approach to procurement. First, make absolutely sure that there will be sufficient spare (backup) machines, spare parts, and competent, readily available repairmen when pumps break down, as they certainly will. Secondly, make sure to use the most appropriate and cost-effective equipment available to carry out project activities, and not necessarily those preferred by donors, especially in bilateral programmes.

   Often it will be better to introduce an inexpensive technology that is only slightly different from previous practices. Experience shows that radical changes (e.g., from the hoe to tractors or animal traction, and from hand sprinkling to motor pumps) very frequently fail. Purchasing unnecessarily expensive irrigation equipment in the donor's own country is not a sustainable approach. Where surface water and local water tables permit, always opt for micro-irrigation technology, since it potentially can positively affect millions of farmers, not just a few on a big irrigation system.

5. If you still decide to include irrigation credit in your proposed project, try to rely more heavily on the increasingly ubiquitous networks of Decentralised Financial Systems, as opposed to the formal banking sector. (However, since a number of commercial banks

are beginning to be interested in rural finance, at least on a wholesale basis, to proven micro-lenders, do not automatically assume that banks are not interested in micro-credit). DFSs are likely to be located in much closer proximity to the targeted farmers, and are better able to tailor loans to fit their needs, as well as to monitor the loan effectively.

Focus more on the DFSs' institutional development and less on the provision of lines of credit. Project designers do a big disservice to partner DFSs if they overwhelm them with large sums of external "cold" funds relative to their own, locally-mobilised "hot" capital (i.e., savings). Also, don't let the irrigation loan portfolio overly dominate the DFSs' other loan portfolio segments, because to do so would create too much covariant risk. If, despite all the advice provided in this document, you opt for an expensive, imported, power pump-based intensive agriculture, it would be better to work with a bank than to drown local DFSs in foreign money. Too much easy money has already been the ruin of thousands of rural finance institutions around the world.

6. If it is definitely determined that credit is essential to the project, do not spoil local financial markets by building a cheap credit "window" into the project organisation itself using subsidised (less than market) interest rates. Instead, let professionals in successful local RFIs, DFSs and banks manage the entire lending process according to their own policies and procedures, which have stood the test of time. Never try to "force" the lender to grant loans that the applicant is not qualified for according to the lender's established criteria.

   If you decide to "do it yourself" within the project, recognise the high probability of failure and, development-wise, a 100 percent certainty that you will fail to leave an institution that can carry on when your project ends.

7. Farmers must be called upon to self-fund increasing proportions of their irrigation projects, i.e., they must learn to depreciate their fixed assets properly and provide for their eventual replacement, instead of seeking a new loan to finance a replacement pump every 4 or 5 years. Remember that a development project may help farmers finance their first pump, but it is up to the borrower to finance its replacement when the first one must be retired. A corollary here is that the term of the loan (or lease) should correspond to the expected useful life in Africa, not in the equipment's country of origin.

8. Lenders must do a better job of learning from each other, and continue to adapt their products to the specific needs of farmers involved in irrigation. Encourage full participation in the networks of micro-finance institutions that now exist in nearly all African countries. Build in study tours abroad for key personnel to successful irrigation finance programmes. At the client level, try to integrate twinning programmes whereby experienced micro-irrigation clients are associated with those just joining the programme; this has been proven an effective way to spread micro-irrigation technology and techniques.

9. Don't just focus on using irrigation technology to increase production. Re-orient the whole approach to market creation and institutional development. That is, recognise and build in the upstream manufacturing and distribution of micro-irrigation equipment, the inputs (seeds, seedlings, fertilisers, pesticides, small tools, etc.) supply chain, the necessary mass marketing required to make the product a household name, as well as the forward linkages (processing, storage and market outlets). For farmers to benefit truly, it is not sufficient to double or triple production; the product has to be sold without glutting the market. The latter must be addressed during project design. If it is left until implementation, and markets are not found, then time, effort and money would have been wasted.

10. A good M.I.S. is essential to any credit programme. Accordingly, project designers should build into the budget sufficient numbers of licences for a capable M.I.S. such as Microbanker for Windows (MBWin), sufficient computer equipment, and sufficient training for the expected number of users. If, despite all the accumulated evidence and the

advice presented in these ten commandments, you still decide to go it alone and have project staff, instead of DFSs, manage an irrigation credit programme, the M.I.S. commandment is doubly true. In fact, having a good M.I.S. will likely be your only slight hope of success.

A number of current projects are researching these issues in search of effective solutions. Let us continue to learn from these and share from each other's experiences through networking.

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Leasing as an alternative for financing agricultural equipment: Initial experiences from Bolivia

Le leasing comme solution alternative de financement du matériel agricole: Expériences initiales de la Bolivie

Frank Höllinger

Abstract

ANED is a financial NGO working with small farmers and entrepreneurs in the Altiplano region of Bolivia. In 1997, it introduced leasing as a new financial technology to finance investments such as motorised pumps, tractors, ploughs, solar energy panels and other items. Leasing is aimed at meeting the investment capital needs of more progressive individual farmers who are "too big" for traditional group-based microfinance loans and "too small" for mainstream financial institutions. Although still in an initial stage, it appears to be a promising approach to overcome collateral constraints of small farmers and rural entrepreneurs in Bolivia. It might also be an option in other countries, particularly in Africa, where lack of conventional collateral or legal / institutional constraints for enforcement are at the root of a vacuum of investment finance in many rural areas. Key for successful leasing is the careful selection of farmers' clients, a thorough lease appraisal and close supervision of the lessees. Collaboration with NGOs and equipment suppliers providing capacity building and technical training are important tools to reduce client-level risk.

Résumé

L'ANED est une organisation financière non gouvernementale qui travaille en collaboration avec les petits agriculteurs et entrepreneurs dans la région d'Altiplano en Bolivie. En 1997 elle a introduit une nouvelle approche, le leasing, pour financer des investissements en motopompes, charrues, panneaux solaires et d'autres matériels agricoles. Le leasing vise à répondre aux besoins en capitaux des petits agriculteurs les plus progressifs qui sont à la fois 'trop grands' pour avoir accès aux emprunts traditionnels de micro-crédits et 'trop petits' pour traiter avec les institutions financières habituelles de la place. Les résultats initiaux démontrent que le leasing est une approche prometteuse pour surmonter les contraintes de caution et de garantie auxquelles sont confrontés des petits agriculteurs et entrepreneurs ruraux de la Bolivie. Il serait aussi une option dans d'autres pays, notamment en Afrique, où l'absence de garanties conventionnelles et les contraintes institutionnelles et juridiques rendent difficile la mise en application des contrats, ce qui entraîne un vide d'investissement dans de nombreuses zones rurales. La sélection judicieuse des agriculteurs-clients, un bon processus d'évaluation et la supervision rapprochée des bénéficiaires sont les facteurs clefs pour réussir le leasing. La collaboration avec des ONG et des fournisseurs d'équipement, la formation et le renforcement des capacités des clients constituent des outils importants en vue de réduire les risques chez les clients.

1. Institutional overview and financial products

1.1 Background of ANED

The *Asociación Nacional Ecumenica de Desarrollo* (ANED) was founded in 1978 by 11 NGOs engaged in capacity-building and technical assistance to rural people. The aim of ANED is to provide appropriate financial services to rural low-income clients and to administer the funds of these institutions destined for lending.

ANED now has 24 branches in eight of the nine regions in the country. The total loan portfolio at the end of 2000 was US$7.4 million. Slightly more than half of the outstanding amount (including leasing) has terms between one and five years. Around 75 percent of the loan portfolio is for agricultural, livestock and agri-business activities. Over 90 percent of the portfolio is located in rural areas.

1.2 How micro-leasing emerged

ANED initially used two group lending technologies: *Credito Asociativo* and *Credito Solidario*.[1] Group lending is based on small and short term loans and uses group joint liabilities to deal with the lack of conventional collateral. High interest rates and lack of flexibility due to standardised loan products limit the use of this technology to the financing of working capital or very small investments with short amortisation periods.

In the course of time it became more apparent that there was a considerable demand for longer term finance by more advanced farmers and rural entrepreneurs to realise investments in items such as minor irrigation equipment, farm machinery, transport and others. The potential investors demanded these items either for use on their own farms (e.g., irrigation pumps and solar energy panels) or for providing services to other members of the community on a hiring basis (e.g., farm machinery).

Table 1. ANED's outstanding portfolio according to lending modality, end of 2000.

Financing modality	Outstanding (US$)	%	Number of loans	%	Number of clients	Overdue amount (US$)	% overdue
Crédito Asociativo	3,716,994	49.9	3,497	18.4	18,556	376,228	10.1
Crédito Solidario	1,810,141	24.3	13,161	69.4	13,161	200,355	11.1
Individual credit	765,454	10.3	1,483	7.8	2,483	103,288	13.5
Leasing	505,671	6.8	481	2.5	642	42,203	8.4
Credit line	212,228	2.8	20	0.1	735	40,790	19.2
Others	436,375	5.9	318	1.7	3,265	19,273	4.4
Total	7,446,864	100	18,960	100	38,842	782,138	10.5

Despite the potential of many more progressive farmers to manage these investments profitably, they are generally unable to access suitable external financing: For the reasons mentioned above they are "too big" for the traditional microlending technologies offered by ANED and others. On the other hand, they are "too small" to be considered viable by mainstream financial institutions, mainly due to lack of suitable collateral and their relatively small size. Non-financial institutions such as equipment suppliers have equally high collateral requirements – normally a mortgage on an urban property – for accepting deferred payment.

ANED first tried to provide term loans for financing tractors, irrigation pumps and other farm implements under their group lending modality *Crédito Asociativo*. However, contractual conditions did not provide sufficient motivation for repayment when guarantees proved to be inadequate. Legal action has been taken against several defaulting borrowers who had credit for equipment purchase, but almost all loans are irrecoverable.

Table 2. Outstanding loan portfolio (including leasing) according to term, 31December 2000.

Type of Loan	Outstanding amount (US$ '000)	%	No. of loans	%
Working capital	3,819	51	16,333	86
Investment capital	3,627	49	2,627	14
Total	7,446	100	18,960	100

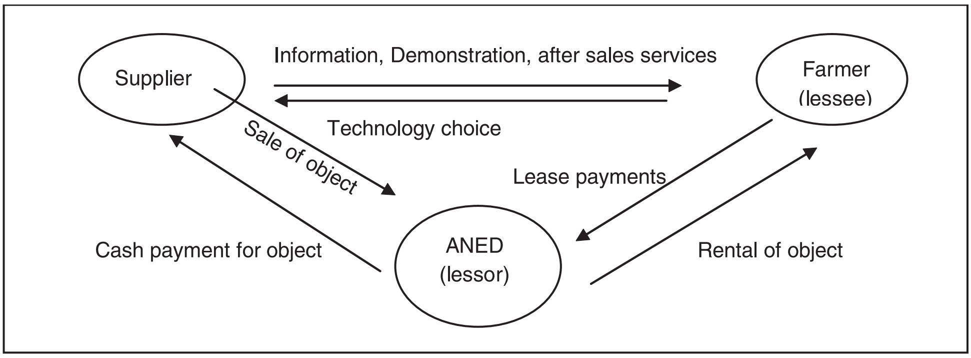
[1] *Credito Asociativo* was developed by ANED to complement the technical assistance activities of other institutions (NGOs, local governments, etc.). Loans were given to pre-existing formal and informal groups consisting of at least ten people. The loans were secured by different types of non-conventional collateral such as joint liability, personal guarantors and pledging of assets. Credito Solidario is granted in small amounts and for short periods to informal groups using joint liability as collateral substitute. Group size is 3–8 persons.

In the second half of the 1990s, ANED therefore developed two new financial products which allow the financing of the investment needs of more advanced farmers and small entrepreneurs: term loans and leasing. Because of the widespread absence of suitable collateral in rural areas, term loans are limited to 3 years and to a maximum amount of US$3,000. Leasing in turn is granted up to an amount of US$30,000 and up to 5 years. This paper focuses on leasing as an innovative mechanism for financing agricultural term investments and illustrates its use for financing tractors and irrigation pumps.

1.3 Types of leasing offered by ANED

The main type of lease used by ANED is the so-called *Financial Leasing* or *Full Payment Leasing.* ANED buys an investment item selected and requested by the client, which is handed over to the farmer for an agreed period on a rental basis. The lease contract has to be registered and contains the main conditions such as lease period, residual value, purchase option, and the amount and frequency of the lease payments. The lease period normally amounts to two-thirds of the economic life of the leased asset. During this period the lessee meets all operational and maintenance costs and pays regular instalments covering capital and interest. After the lease period he has the option to buy the item at its residual value, normally 1–5 percent of the purchase price.

Figure 1. Illustration of how straight leasing works.



Source: Based on Dupleich, 2000.

The second financial product is *Leaseback* (also called *Retro-Leasing*). The client liquefies a specific asset (e.g., land or equipment) by selling it to ANED for a certain amount agreed on in the lease contract. The client can then use this amount to make other productive investments. The sold item is then leased back to the farmer who can continue using it against a periodic lease payment. At the end of the leaseback period the farmer has the option to buy back the item at the residual value. Basic parameters such as leasing rates and buy back options are specified in the leaseback contract.

1.4 Principal advantages of leasing

The core principle of leasing is the separation of legal ownership of an asset from its economic use: the leased item remains the property of the lessor (ANED) who rents it to the client (lessee) over an agreed period. This has two important advantages over a conventional term loan:

- no additional collateral requirements;
- in-kind delivery, no diversion of funds.

The relaxation of the collateral requirements is possible, because the leased asset remains the property of the lessor and therefore stands as collateral itself. In case of default the asset can be repossessed, avoiding lengthy court procedures. In the Bolivian context where settling claims and getting court approval for seizure of property can take up well over one year this proves to be a considerable advantage.[2]

The Bolivian land reform law prevents small farmers whose land is qualified as "peasant holding" from mortgaging it.[3] However, there are no sales restrictions on any type of privately owned land. In such a setting, leaseback as a type of "productive pawning" constitutes an alternative to the conventional mortgaging of land. The farmer sells land (or any other productive asset) to ANED, which then leases it back to the farmer. This allows the farmer to continue using the asset productively on his farm against periodic lease payments. After an agreed period the farmer has the right to buy back the asset from ANED. Depending on the price of the assets and the lease period, the sales receipts can be used by the farmer for working capital or investment purposes.

From the perspective of the financial institution, the ownership of the land which would normally be mortgaged means more security and less transaction costs if foreclosure becomes necessary. Therefore, it could offer more attractive conditions concerning the financial terms of the contract or the valuation of the land/other assets.

A major drawback to the leaseback of land is that a registered title is required to allow the financial institution to realise the market value of the land if the lessee defaults. It also requires the financial institution to have enough access to suitable medium term funds. These requirements reduce the scope for leaseback in Bolivia.

1.5 The leasing portfolio

Leasing started in 1997 on a pilot basis. Since then it has expanded rapidly. The total portfolio amounted to about US$505,671 constituting 7 percent of the total portfolio of ANED at the end of 2000. Currently (end of 2000) ANED has 481 leasing contracts in six regions of the country, 95 percent of them for agricultural purposes. As table 3 shows, the most important items are tractors and motorised irrigation pumps.

Table 3. Most important items financed under leasing at the end of 1999.

Item	Total amount outstanding (US$)	Share in total portfolio	Number of leases
Tractors	331,845	53.2%	19
Motor pumps	178,829	28.7%	294
Truck	17,800	2.9%	1
Ploughs	15,689	2.5%	10
Others	69,430	12.7%	31
Total*	623,591	100.0%	355

* This category includes items such as solar energy panels, sowing machines, harvesters, electric pumps, 4-wheel drives and others.

Despite the considerable growth in leasing, the outreach of the programme is still low. Until now, there have been only a few cases of leaseback. The main constraints for the clients are the absence of suitable property titles, and for ANED, the lack of funds to buy rural assets on a larger scale.

[2] According to Dupleich (2000) the average period is 269 days without rejection of the borrower and 670 days in case of rejection.

[3] The somewhat outdated land reform law in Bolivia makes a distinction between peasant plots that cannot be mortgaged and commercial smallholder plots.

2. How leasing works in practice

2.1 Client selection

An important prerequisite to the selection of individual clients is the selection of suitable regions for the leasing programme. These must have an above-average growth potential in terms of production and marketing conditions. The local credit culture is also examined before ANED expands into a new village or region. ANED does not work in villages where, due to donor grants in the past or political organisation of borrower, the credit culture is poor. In general, the credit culture is better in regions/villages which are farther away from towns.

ANED focused initially on two regions in the Altiplano that show a high potential for success. In both cases, farmers have already received some basic training in handling of equipment and other related issues, and the commercial supply chain was already existing.

In Oruro region, motorised low-lift pumps have been leased to small farmers who grow between 0.2 and 0,5 ha of vegetables. Irrigation pumps have been introduced in the mid–1990s by a NGO, which also carried out a feasibility study for this type of investment in the area and provided some basic training for farmers. Once agronomic and economic viability have been proven and demand from the farmers created, the problem of how to finance these pumps had to be solved. ANED first provided loans under the modality of *crédito asociativo* but experienced repayment problems. In 1997, the first pumps were financed through leasing.

Tractors have also been financed in La Paz region in co-operation with a technical assistance programme funded by the Danish government through Danish International Development Agency (DANIDA). The programme aimed at increasing the productivity of small-scale dairy producers in the Altiplano, for example, through improved fodder production. Tractors have been introduced and some farmers have been trained as operators under this programme. However, a sustainable mechanism to finance the purchase of tractors was missing. ANED's leasing programme was intended to fill this gap.

Apart from technical assistance, ANED could build on a minimum degree of social organisation of the farmers, most of whom were already members of formal groups like associations of dairy producers or farmer irrigation groups. The chairmen of these groups play an important role in selecting members and supervising repayments. Sometimes they also act as personal guarantors.

Client selection was facilitated by the fact that ANED had worked for several years in these regions. Therefore, it already knew the region in terms of agro-ecological and socio-economic conditions as well as the repayment culture. In addition, it had already a client base. However, "graduation" of existing clients, who perform well under group lending, into leasing is restricted to lower cost assets such as irrigation pumps. The necessary skills are passed on in small workshop groups and through after-sales service.

For tractor leases, the most important selection criterion is the experience of the farmers in operation and maintenance and their ability to make a down-payment of 15-25 percent. Most of the clients have already worked as tractor drivers, or have been trained in dairy development projects. Thus new clients who meet these criteria and have a sound loan track can also apply for leases. Information on the credit history of new applicants is acquired through an informal exchange of information between different MFIs working in the region.

2.2 Lease appraisal

The basic assumption is that lease payments should be financed mainly out of the cash-flow generated through the productive use of the leased asset. Additional income sources are harnessed only to a lesser extent, or in case of unforeseeable downswings of the main activities. To assess all factors affecting the farmer's ability to meet periodic lease payment obligations, a detailed household cash-flow is made including all estimated farm and non-farm incomes and expenses. To avoid a financial over-commitment, a trigger is built into the appraisal procedure: the client should not spend more than 30 percent of his total net household income on lease payments.

Flexibility in determining the lease payment plan is key to ensuring timely lease payments. Frequency and amounts of payments are adapted to the main cash inflows according to the marketing dates of the main produce, while taking into account other household incomes. Instalments may also increase or decrease during the life of the lease contract in accordance with the cash flow of the lessee. This could include staggered leasing instalments, advance payments and adjusted payments.

In case of pumps, payments are normally made in 2 yearly instalments over a period of 2 years. Varying amounts of payments according to main or secondary harvest are also possible.

The relatively low costs of the pumps (US$ 500–700) and the similar production and marketing conditions of the farmers in Oruro allowed a higher degree of standardisation of lease appraisal. However, this has ultimately caused some problems because of the direct impact of pumps on production and a limited local market for vegetables. Prices have fallen below the historical levels underlying the appraisal, causing higher overdue rates than in case of tractors. ANED has stopped the approval of new leases in this area as the local vegetable market appears to be satisfied.

In the case of tractors, the high investment costs of up to US$30.000 require a more thorough and individualised appraisal. The applicant has to present a detailed plan showing the projected income and costs in the use of the tractor on a monthly basis. Because of the small farm size in the Altiplano, most cash income is generated through tractor hiring services. Therefore, the applicant must prove to have a minimum identified client base. Payments frequency is agreed individually; often payments every 3 to 4 months are preferred.

Collecting all necessary information for leasing approval normally takes 3 days. A credit committee in La Paz makes approvals on a weekly basis.

2.3 Selection of equipment

The establishment of close links with equipment suppliers is crucial for the success of the leasing programme. ANED tries to establish relationships with at least two suppliers for each equipment item. It then negotiates an integrated package including price discounts for bulk purchases and the provision of training and technical backstopping services to the farmers. The risk of technical breakdown during the initial period is low, because normally the manufacturer gives a guarantee for the first year.

In the selection of equipment, ANED faces a certain dilemma. On the one hand it wants the client to choose the equipment to avoid ANED being blamed for any technical failures, which may be used as a pretext for non-payment. On the other hand, it realises that farmers often have little information and need assistance in selecting the most appropriate type of equipment suitable for their specific needs. This is especially true in the case where the applicant has limited experience with the asset, such as with irrigation pumps.

Although there is a market for used equipment in Bolivia, ANED normally leases new assets.[4] In spite of the higher financial costs there are three main reasons for this:

1) The risk of technical failure and default is much lower in the case of new equipment.

2) Tax legislation discriminates against leasing of second-hand goods as tax deductions are only possible if a receipt for the purchase invoice of the equipment can be substituted. This leads to lower leasing rates for new equipment.

3) An original ownership document has advantages for the lessor should recovery be necessary.

In the case of irrigation equipment, small motorised pumps are imported from Japan (Honda, Suzuki). The farmers can choose between 4 models varying in terms of horsepower (3-5hp), price (US$500-700) and quality. ANED chooses to work with the main importers instead of small local

[4] Some importers and dealers of agricultural machinery and equipment recycle used machines and offer them at prices between US$5,000-7,000. Deferred payments of up to 2 years are offered also to clients who have registered property in one of the major cities.

dealers because of their superior conditions for availability of spare-parts, after-sales service and guarantees against technical breakdown. Hoses are also supplied, whereas wells are mainly dug by the farmers themselves.

2.4 Leasing terms

The lease period depends on the value of the investment good and its expected economic life. For tractors with a purchase price between US$20-30,000 it is normally 5 years, while irrigation pumps (US$500–700) are leased for 2 years.

The interest rates charged by ANED for leasing are comparatively low, currently around 16 percent. This is possible because of the low costs of leasing funds provided by the Inter American Foundation. Currently, ANED is negotiating with the Inter American Development Bank for additional funding. Down-payments of 25 percent of the purchase price are a strong tool to control default and to cope with the high depreciation of the asset during the first year.

2.6 Measures to reduce lease-payment risks and induce timely payments

Some important measures to reduce lease payment risks have already been described. These include:

- collaboration with NGOs/projects providing technical assistance and capacity-building;
- strict client selection criteria;
- leasing of new equipment to reduce risk of technical breakdown;
- contracts with equipment suppliers, which include guarantees against breakdown, technical training and after-sales service;
- in-kind delivery avoids the risk of deviation of funds.

In addition, the following measures aimed at addressing moral hazard risks are applied:

- down payments of up to 25 percent of the new value of the equipment, compensating the likely depreciation during the first year;
- close supervision by inspection visits on a regular basis by ANED's loan officers;
- penalty interest rates (1% monthly) in case of default;
- social pressure is exerted, e.g., through the Chairman of a Dairy Association or by public announcements on the local radio of the names of defaulters;
- defaulting clients receive a reminder letter and after 60 days of non-payment the leased item is repossessed or juridical measures are taken.

2.7 Performance of the programme to date

The default rate of 8 percent is in fact below the average loan arrears rate of ANED (Table 1). This shows that up to now these measures have proved to be sufficient to contain the risk of non-payment of lease at reasonable levels. There have only been two cases of serious defaults where pumps have been sold by the lessees. The strict legal actions taken may have discouraged other potential defaulters. Repossession was only necessary in one case of bad management of a tractor.

Although the second-hand market for used equipment is limited in Bolivia, ANED faces a high demand for leasing. Therefore, defaulting lessees can easily be substituted by new applicants. Insurance coverage has been considered too expensive in relation to the default risk.

However, the overall default rate is somewhat biased towards tractors which dominate the portfolio. Therefore, the recent payment problems for the irrigation pumps mentioned under 2.2 are not properly reflected. However, these problems do not originate in leasing itself but in the difficulties of expanding the leasing programme in the face of limited markets for perishable produce. They illustrate the need for a constant monitoring of market potential and trends during appraisal of financing, even of minor irrigation equipment, to ensure economic and financial viability.

2.8 ANED's future plans

Currently, ANED seeks to strengthen existing operations and to broaden the range of leasing arrangements by enlarging the number of machinery suppliers, thus better diversifying its financial risk. Two options are considered:

1. Deferred payment to suppliers, based on the performance of after-sales services and the absence of lease payment problems due to technical breakdown of the machinery.[5]
2. In case of technical breakdown the supplier has to compensate ANED financially.

The conversion of ANED into a specialised leasing company is also being considered. The advantages of specialisation lie in:

- better technical knowledge of specific types of equipment with regard to their technical and commercial conditions;
- better quality and higher efficiency of appraisal and supervision services, because specifically trained staff can concentrate on rural leasing operations; and,
- import of the most appropriate equipment for the particular needs of target clientele ,which is often not available in Bolivia.[6]

2.9 Challenges

The main advantages and challenges of leasing, as compared to term-lending, are summarised in Table 4.

Table 4. Advantages and challenges of leasing in Bolivia.

	Advantages	Challenges
ANED	• in case of default recovery easier and faster re-possession of leased assets • lower transaction costs (no collateral) • zero risk of diversion of funds	• concentration of leasing portfolio • small second hand market for equipment • no complete coverage of default risks because of high supervision costs
Client	• easier access to medium-term finance for investments • lower transaction costs because of no collateral requirements • better after-sales service of equipment	• strict selection criteria (down payment, previous experience) • high financial costs of new equipment

Leasing is an innovative way to offer medium-term finance to a clientele of emerging small farmers and rural entrepreneurs who are not served by mainstream financial institutions. Despite the successful start the micro-leasing programme of ANED faces also several challenges:

- Outreach: Despite the rapid expansion of the leasing portfolio since 1997, outreach is still low. The potential to increase outreach is constrained by the limited number of farmers who meet the strict selection criteria, especially for farm machinery like tractors. Although

[5] Each time an after-sales visit is made, the farmer should sign a receipt indicating the work carried out and the condition of the machinery in question. These receipts should assist both parties if a dispute arises.

[6] Traditionally the imported farm machinery suits the needs of medium and large farmers who make up the bulk of demand for these items.

the emphasis on prior experience is prudent from a financial institution's point of view, ANED may have to invest more actively in training and capacity-building. This could be achieved through a broadening of the co-operation with NGOs, development projects and suppliers.

A second major constraint is the down payment of US$5-7,000 in the case of the tractors, which may prevent even experienced farmers from having access to lease finance. A combination of leasing with special savings products might help to lower these entry barriers, but ANED as a non-regulated financial institution is not allowed to mobilise savings. Alternatively, insurance coverage would reduce the required amount for down-payment. Larger volumes would enable ANED to negotiate better conditions for prices and after-sales service with the suppliers.

- Diversification: There are undoubtedly good reasons for focusing initially on a few selected assets and regions to gain the necessary experience. However, such a portfolio concentration implies high financial risks. The further development of leaseback might provide some scope for financing assets such as buildings or tree crops.

- Supervision/Inspection: Leasing removes the collateral constraints of conventional term-lending and the problem of asset re-possession in case of default. Nevertheless, there is no clear protection against the risk of accelerated depreciation of the leased item through improper maintenance or loss. Therefore, frequent inspections are necessary if proper insurance cover is not in place. According to ANED, these problems have not yet emerged in a significant scale so far as to justify seeking insurance coverage at current envisaged premium levels. This might be partly attributable to the down payment, the careful selection of clients, and the limited outreach of the leasing programme. With an increasing volume of leasing, supervision will become more difficult and costly. On the other hand, the expansion of leasing might also encourage the development of more suitable and competitive insurance products.

- Sustainability: Because of the limited size and the comparatively high starting costs the micro-leasing programme requires a relatively large margin. Up to now, the programme has been funded at highly concessionary terms by the Inter-American Foundation. This has allowed ANED to cover the high initial cost of developing and introducing a new financial product while charging comparatively low interest rates to clients. Currently, it is difficult to give a breakdown of the costs of the leasing programme because the leasing operations are carried out by the loan officers of ANED together with their other lending activities. To reap the benefits of increased specialisation and outreach, such as economies of scale, access to a larger spectrum of funds is necessary. In the medium-term ANED will have to cut down its intermediation costs to attract commercial sources of funds. On the other hand better access to long-term funds at reasonable cost would facilitate mainstreaming of leasing, allow the use of economies of scale and provide scope for further development of leaseback. Donors could play an important role in further developing and mainstreaming micro-leasing into a commercially viable operation.

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Institutional and financial considerations for self-managed irrigated agriculture in West Africa: Examples from Burkina Faso and Niger

Considérations institutionnelles et financières pour l'autogestion de l'agriculture irriguée en Afrique de l'Ouest: Exemples tirés du Burkina Faso et du Niger

Hilmy Sally

Abstract

The paper presents and discusses findings about the actual performance of nine small irrigation systems in Burkina Faso and Niger. All of these were built by the government, and have since been transferred to the organisations of their users. The paper first discusses the general policy background, including reasons why transfer policies have been widely adopted, and sets of conditions that are considered to be prerequisites for a successful transfer. The specific circumstances in Burkina Faso and Niger are then described, with emphasis on financial and institutional aspects of the transfer arrangements. Performance of the nine monitored systems, over 5 or 6 years, is presented in terms of ten indicators, covering three major management areas: water management performance, agricultural production performance, and organisational / financial performance. In the closing discussion, the author notes the need for continued government involvement after the transfer, but recommends that to avoid continued dependency of the users' organisations on such government involvement, the roles of the three principal partners (government, irrigators' organisation, and individual farmer) need to be clarified.

Résumé

Cet article présente et analyse des résultats des performances observées de neuf petits périmètres irrigués au Burkina Faso et au Niger. Ces périmètres ont tous été mis en place par l'Etat et ils ont été transférés par la suite aux exploitants. Après une discussion de la politique générale d'irrigation dans les deux pays, l'article aborde les raisons qui ont motivé l'adoption des politiques de transfert ainsi que les conditions préalables pour garantir la réussite des transferts. Les situations spécifiques du Burkina Faso et Niger sont ensuite décrites en mettant un accent particulier sur les aspects financiers et institutionnels liés aux transferts. Les performances des neuf périmètres, couvrant des périodes de cinq à six ans, sont exprimées en termes de dix indicateurs qui englobent trois domaines de compétence: gestion de l'eau, performance agronomique, et performance organisationnelle et financière. Pour terminer, l'auteur souligne la nécessité de prévoir une certaine implication de l'Etat même au-delà du transfert. Cependant afin d'éviter une trop grande dépendance de la part des organisations d'usagers vis-à-vis le gouvernement, il recommande que les rôles et responsabilités des trois partenaires principaux, à savoir, l'Etat, les organisations d'usagers, et les exploitants individuels soient clarifiés.

1. Introduction

The withdrawal of governments from direct involvement in the development, operation and maintenance of irrigation schemes has led to a search for alternative ways to improve and sustain irrigated agriculture. Options range from the transfer of management (and, on rare occasions, ownership of assets and facilities) of irrigation schemes to the beneficiaries, to various forms of private-sector participation in the building, operation and maintenance of irrigation schemes.

The management of an irrigation system reposes on a number of inter-related functions carried out by various parties with interests in the system. The functions are driven by the flow of information and resources between the different participants. Decisions are made based on such exchanges and on the respective strategies of the actors. The performance of these functions is also affected, if not conditioned, by the bio-physical, institutional, and macro-economic environment in which the irrigation system is embedded. The functions can be grouped into the following three categories:

- a *water management function*, relating to the operation and maintenance of the irrigation and drainage infrastructure;
- an *agricultural production function,* where the water made available is used for crop production;
- an *organisational function,* broadly covering the planning, co-ordination and implementation of the tasks and activities (including accounting, resource mobilisation and cash-flow management) that must be correctly performed for the smooth operation of the irrigation system.

This paper, based on the results of field research carried out in Burkina Faso and Niger, examines institutional and financing questions relating to the self-management of government-sponsored irrigation schemes. It considers the interactions between these three functions, as reflected in the performance of the nine irrigation schemes in these two countries, and discusses their relative strengths and weaknesses. Prospects for self-management will be assessed and ideas provided to stimulate discussion on the scope and potential for the involvement of private-sector operators and service providers in government-sponsored irrigation schemes.

2. General overview of institutional and financial issues

Irrigation systems are complex with many participants and many objectives. The ease of establishing a widely-supported set of objectives could vary depending on whether the irrigation systems are developed, or controlled and operated by (a) local people in response to their needs, or (b) a public agency with little involvement of the beneficiaries.

The former category better fits the notion of private initiative and enterprise, whereas the latter is typical of government-sponsored schemes. While governments make the initial investments for their creation, they often find themselves confronted with a dilemma thereafter.

On one hand, there is the need (if not the responsibility) to ensure that the returns from irrigated agriculture are commensurate with the investments made; hence, governments may feel that they should continue to be directly involved in irrigation system management. On the other hand, they would not like their financial responsibility to continue indefinitely; especially when there are competing claims and pressures on national budgets from other sectors. They could also face arguments on the following lines: By building irrigation systems, hasn't the government conferred a substantial advantage on their users? Is it then fair to other citizens that the government continues to finance and support the functioning of those systems?

Hence there is a trend favouring government disengagement from irrigation system management, whereby responsibility for certain functions and the related expenditure is transferred to the users. This results in a special situation where private-sector management and production take place on State-owned systems, giving rise to a number of institutional and financial considerations. For example, have the rights and responsibilities of the different parties (government, farmer organisation, individual farmer), as well as the ownership of assets and facilities been clearly enunciated? Have the "rules of disengagement" been discussed with and agreed to by all participants? Or have farmers and even agency officials been taken unawares, and are they thereby ill prepared to cope with such changes? What residual role, if any, must governments play – must it be purely regulatory or should it remain directly involved in some activities such as the provision of support services? What should be the (future) relationship between the farmers and the bureaucracies? The answers to such questions will determine the future course, performance and sustainability of these transferred irrigation schemes.

On the financial front, let us first examine the cost side. The costs can be broken down into the following components:

- capital costs to build the irrigation facilities and accompanying infrastructure;
- recurrent costs to operate and maintain the facilities;
- costs of major repair and renewal of the facilities;
- indirect or overhead costs to cover the functioning of a managing organisation.

Whoever provides the capital would usually own the facilities, decide on any further development and expansion, and determine the expectations about returns to investment, taking into account the bio-physical, social and economic environments. In government-funded irrigation schemes, beneficiaries are usually not called upon to contribute to the capital cost. On the other hand, the motivation and attitude of private investors would be quite different from that of government. In private irrigation, as in any other private-sector undertaking, profitability and returns to investments are major driving forces – willingness to take risks must be rewarded by commensurate returns. Seckler (1989) enumerates six conditions for feasible private-sector irrigation:

1. The additional costs of conversion to irrigated agriculture must be offset by commensurate increases in agricultural production;
2. Availability of good quality land and water in proximity to each other;
3. Reliable and economic supply of inputs and labour to realise the production potential;
4. Markets for the purchase of these inputs and the sale of produce;
5. Reasonable transport facilities between production areas and markets;
6. Input and output prices that are not only at the right level but are also stable.

Similarly, Brown and Nooter (1992) identified the following characteristics that are common to successful irrigation schemes in the Sahel, recognising of course that the criteria for success could vary, given the multiple uses and users of irrigation systems:

1. The use of simple technologies (such as low-lift pumps drawing water from shallow aquifers, rivers or streams), with affordable levels of capital investment, maintenance and replacement costs;
2. The assurance of a secure supply and individual control of water;
3. A supporting infrastructure that facilitates access to inputs and to markets;
4. Institutional arrangements that are private and individual; in the case of collective arrangements, the most effective appear to be extended family groups, with water users' associations and co-operatives at the other end of the scale;
5. A judicious choice of technology and crops that offers high financial returns and makes farming profitable;
6. The farmer is an active and committed participant in project design and implementation.

The extent to which these sets of conditions apply in Africa could provide useful insights into the scope and potential for private-sector investments in irrigation in the continent.

Insofar as income is concerned, a common source of revenue for the management entities of irrigation schemes is fees and charges paid seasonally or annually by the farmers for services rendered. This could take the form of a flat charge, or an irrigation service fee or water charge based on the size of land-holding, or in some cases, on the actual measurement of water deliveries. These amounts are supposed to cover, partially or completely, the cost of providing water and irrigation services. Other mechanisms for generating resources for operations and maintenance include (a) membership fees, (b) profit on procurement and sales of inputs and produce, (c) hiring of equipment, (d) fines and penalties for non-compliance of rules, etc.

3. Irrigated agriculture in Burkina Faso and Niger: The physical context

In Burkina Faso and Niger, as in many semi-arid regions of sub-Saharan Africa, rainfed agriculture, which is practised extensively, is still the source of livelihood for a vast majority of the population. But, given the vulnerability of rainfed agriculture to the quantity and reliability of rainfall, the production and productivity of traditional rainfed cereals such as sorghum and millet are low and highly variable. Increasing populations and expansion into increasingly marginal soils further exacerbate this situation. In response, governments began to make major investments in irrigation as a means of stabilising agricultural production, improving productivity and guaranteeing national food security.

In both countries, public irrigation development began in the 1960s, but really took off in the 1980s in response to the serious droughts that occurred around that time.

Although these two countries are neighbours, and have broadly similar climates, their water resources situations are different. Niger has a major perennial river that crosses the south-western part of the country. Burkina Faso on the other hand occupies a plateau region containing the headwaters of the medium-sized Volta River, and also has many smaller rivers, most of which flow only for a few weeks or months of the year. These differences have determined the different irrigation development paths chosen by the two countries. In Burkina Faso, a large number of storage reservoirs have been constructed, for irrigation and other purposes, while irrigation in the Niger river valley is based on electrically powered pumping stations that deliver water to land located fairly close to the river.

The sizes of the irrigation schemes in the two countries are relatively modest—typically, about 50 hectares in Burkina Faso and 200 hectares in Niger. In both countries, the individual land holdings are also very small, typically 0.25 hectares per household, though there are several irrigation systems where the average size of land holding is smaller. One consequence of this is that, although the irrigation systems are quite small, the size of the farmer organisations is usually very large – certainly a few hundreds of members, and sometimes even exceeding 1,000. Another consequence is that the irrigated land holdings cannot, in general, satisfy all the household's needs, and farmers are obliged to pursue other economic activities such as livestock, fishing, handcrafts, and trading.

A notable feature is the interaction of irrigated agriculture with rainfed agriculture and livestock farming. This can lead to scarcity of labour during the major cropping season, because farmers are obliged to make resource allocation decisions between rainfed and irrigated agriculture, based on their judgement of how best to maximise their overall returns. An analysis of the comparative returns from rainfed and irrigated agriculture in Burkina Faso (Sally 1994) revealed that production from the irrigated farm, although representing only 5 percent of a typical total family land-holding, was nearly equal to that from the rainfed farm. The returns to labour, expressed in terms of the amount of cereal produced per unit of labour (kg/hr), from irrigated agriculture were also shown to be three times as much as from rainfed farming.

So, while irrigation does help to overcome many of the constraints inherent to rainfed agriculture, the challenge is to find out how this can be done in ways that make the best use of the available land, water, financial, human, and other resources, while not engendering adverse social and environmental impacts.

4. Financial considerations

Given the limited financial resources at their disposal, modern irrigation development in Burkina Faso and Niger has been financed mainly by grants and concessionary loans from donor governments and international development-assistance organisations. Inasmuch as neither the governments nor the users could have afforded the capital investment in respect of these irrigation systems, it is also difficult to expect that either party alone will be in a position to bear the costs of major repairs, equipment renewals, or rehabilitation.

Both countries have, therefore, adopted policies aimed at promoting farmer organisations, to which the responsibilities of performing and financing operation and maintenance of the irrigation systems were transferred. At the same time, the governments have been reluctant to abandon all their control over the irrigation systems. They continue to maintain presence and deliver assistance to the farmers.

However, the low levels of literacy and the dearth of requisite management skills in the rural environments of these countries, impose a constraint on the effectiveness of these farmer organisations. They thus face a lot of difficulties in carrying out the tasks and functions that were formerly done by State agencies, especially when there is pressure on these organisations to operate in a self-sustaining manner.

In the reservoir-based irrigation systems of Burkina Faso, the reservoirs are the biggest element of capital cost. But, once installed, these systems can convey and deliver the stored water for irrigation under gravity (with some exceptions where the irrigated command area is located upstream of the reservoir, in which case pumping is required to lift the water). In contrast, in the Niger systems, water has to be pumped from the river, using very costly electrical power.

In Burkina Faso, although the large capital costs are large, farmers are not called upon to contribute to these, whereas in Niger the government does require them to contribute a share of the capital cost. Where operating costs are concerned, they are relatively low in Burkina Faso whereas in Niger they are about five times higher, mainly on account of the energy cost.

The need to adhere to fairly rigid and complex government-imposed financial management procedures, together with their larger size, means that the Niger systems have to employ a range of full-time staff such as accountants, storekeepers, and pump-operators. All expenditure must be recorded and classified among 30 different expense categories. There must be separate accounts for each member of the organisation, and all financial transactions with members must be individually recorded.

Furthermore, irrigation service fees are computed every season based on the costs incurred by the organisation in the previous season. All operation, maintenance and management costs, government-specified fixed charges representing certain percentages of the capital costs of building the irrigation system plus savings towards future renewal of equipment, as well as a contribution towards the overheads of the government irrigation agency, are included. Thus, members of farmer organisations in Niger pay towards all the four major cost components: capital investment, operations and maintenance, future repair and renewals, and government agency overheads. The capital and renewal payments are not transferred to the government but are supposed to be retained by the farmer organisation in interest-earning restricted bank accounts. While the government has tried to ensure that such savings accounts are not used for general purposes, this is difficult to achieve in practice.

In the Burkina Faso organisations, while the government provides overall direction and lays down standard forms of the basic organisation, the accounting system is much less rigorous than in Niger. The levels of recurrent costs and consequent financial and cash-flow pressures are also less. Financial stresses are most acutely felt in the gravity systems of Burkina Faso when flood events occur and the organisation has to face substantial repairs to infrastructure such as flood protection dykes, and perhaps canals or dam spillways. But farmer organisations do not appear to try to accumulate savings to face such events. In fact, although the organisations in Burkina Faso have the freedom to decide on irrigation service fees, they seem to be fixed at levels lower than what is required (Sally 1997). They usually appeal to government or non-governmental agencies to solve such disasters, but as such agencies do not always have budgets for these purposes, there is a growing amount of overdue repair and maintenance work in these irrigation systems, which is done neither by the organisations nor by the government.

Questions related to financial viability are discussed in greater detail in Abernethy et al. (2000).

5. Policy and institutional considerations

The self-management of irrigation schemes is an important policy goal in Burkina Faso and Niger. Both governments have made adjustments to their legal and institutional frameworks to help achieve this goal: farmer organisations have been promoted, government departments and agencies re-organised and re-structured, and agrarian and land reform programmes implemented.

Both countries, however, retain some presence and provide support to farmer organisations via one or more public-sector agencies at central or local level, or both. This is especially useful in irrigation schemes located in remote rural areas where it is not always easy for farmers to obtain agricultural inputs and market their crop surpluses. Those located close to urban areas can satisfy their needs from the private sector and have easy access to urban markets. They will also be in a better position to respond to changes in consumer preferences, such as greater demand for vegetables. In more remote locations, the greater demand for farmer organisations to accomplish functions other than water management and crop production could also give rise to greater pressures on them concerning fee collection and cash flow management. Any shortfall or delays could compromise the performance of the scheme, in the short term as well as a cumulative effect in the long term.

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Although much progress has been made in the legal frameworks, shortcomings and ambiguities still persist about the exact status of ownership of land, water and irrigation facilities, and the rights to use these resources and to transfer them to others. For example, the farmer organisations in Burkina Faso are not in a position to exert any rights over the use of water resources stored in their reservoirs. Evidence of this is that agencies of the government are able to plan other uses of the reservoir, such as domestic water supply to other communities, without needing permission from the irrigators' association. In other instances, a lack of legal status and collateral could seriously hamper the ability of a small farmer to procure loans and credit, however productive he or she may be.

The organisational model typically promoted by governments is the co-operative. But the constitution and internal rules governing them are not always tailored to the specific case of irrigation, but are rather standard models catering to a general kind of rural co-operative. However, membership in the organisation is a necessary pre-condition to qualify for allocation of an irrigated landholding.

The co-operative model is based on concepts of solidarity and collective decision-making that are sometimes inconsistent with some characteristics of traditional rural societies such as domination by and deference to village chiefs and elders. Indeed, some organisations tend to be dominated, or taken over, by a few influential persons or groups. So there is a need for more objectivity and transparency in decision-making and in the administrative and financial management of the organisation. Decisions that are supposed to be taken by the general membership must not be taken by a small group of office-bearers.

Furthermore, the need for a clear definition of roles and responsibilities of the principal actors (the State, farmer organisation and the individual farmer) and actual adherence to what is stated is evident. In particular, the responsibility for major repairs has been left vague with the result that neither the government agency nor the farmer organisation attends to it, leading to the inevitable deterioration of irrigation facilities and degradation of the productive capacity of the irrigation system.

6. Irrigation system performance

Tables 1 and 2 show ten performance indicators for each of the nine irrigation systems in the two countries,[1] as reported in Abernethy and Sally (2000). These performance data were gathered and analysed as part of the comprehensive case studies carried out between 1991 and 1997 of the functioning of five reservoir-based systems in Burkina Faso and four pump-based irrigation systems in the Niger River valley (IIMI 1997; IIMI 1998).

For the Burkina Faso systems, one more indicator is added, the gross product value per cubic meter of storage volume, which is an indicator that gives some idea of the productivity of the major investment cost.

These tables illustrate the difficulty in deciding whether an irrigation system is well managed or not. As already highlighted in the introduction, the observed system performance is the resultant of water management, crop production and organisational functions. So, it is not surprising that some of the irrigation systems studied are above average with respect to some of the indicators, and below average according to some others. Nevertheless, these results will be used to identify strengths and weaknesses in system performance, and possible reasons for these:

[1] The 9 systems have been denoted by letters as follows:

Burkina Faso systems: A = Gorgo; B = Itenga; C = Mogtedo; D = Savili; E = Dakiri;
Niger systems: F= Kourani Baria I; G = Kourani Baria II; H = Saga; I = Tillakaïna

Table 1. Performance of five irrigation systems in Burkina Faso.

Irrigation system →		A	B	C	D	E	Mean
Indicator	Units						
Crop intensity	%/year	93	128	202	94	196	143
Crop yield	Kg/ha/season	4,700	6,200	4,300	5,400	4,800	5,000*
GPV per cultivated hectare	US$/ha/season	759	1,130	793	1,976	738	1,079
GPV per developed hectare	US$/ha/year	706	1,442	1,596	1,848	1,442	1,407
Water consumption	mm/y	1,140	2,560	2,550	1,240	2,650	2,028
Water productivity	US cents/m^3	6.9	9.3	6.0	16.1	6.0	8.9
GPV/m^3 of storage volume	US cents/m^3/year	3.2	2.9	2.3	4.2	1.7	2.9
Inequity of yields	%	35	33	43	34	40	37
Fee collection rate	%	85	96	75	100	92	90
Fee rate/GPV	%	18.6	6.5	6.1	4.7	4.6	8.1
GPV/management cost	--	5.4	15.4	16.4	21.3	21.7	16.0

Note : GPV = Gross product value. * Only rice-based systems (i.e., except D)

Table 2. Performance of four irrigation systems in Niger.

Irrigation system →		F	G	H	I	Mean
Indicator	Units					
Crop intensity	%/year	193.6	180.8	191.2	89.1	163.7
Crop yield	Kg/ha/season	4,020	4,600	5,070	-	4,560
GPV per cultivated hectare	$/ha/season	608	799	1,089	2,235	1,183
GPV per developed hectare	$/ha/year	1,074	1,382	2,032	1,977	1,616
Water consumption	mm/y	3,211	2,838	2,003	2,783	2,709
Water productivity	US cents/m^3	3.76	2.83	9.94	7.92	6.11
Inequity of yields	%	35	36.5	27	44	36
Fee arrears	$/ha	364.5	119.9	144.9	132.0	190.3
Fee/GPV	%	21.5	16.0	12.0	20.4	17.5
GPV/management cost	--	17.5	23.8	31.2	18.5	22.8

Note : GPV = Gross product value.

An assessment of the strengths and weaknesses of irrigation system performance in the two countries follows:

- Land utilisation is good, with moderately high cropping intensities achieved in both countries. But average cropping intensity in Niger is higher than in Burkina Faso. Crop intensities in D (Burkina) and I (Niger) are below 100 percent because they are used only for growing horticultural crops (in the dry season). On the other hand, dry season cropping is not possible in A (Burkina) because the small reservoir capacity, equivalent to only 27,000 m^3/ha, does not allow any water to be carried over between seasons.

- Yields in Niger are high in some schemes but poor in others, mainly due to non-observance of crop calendar. The yields in Burkina are moderate, stationary or declining.

- Although the gross product value per hectare in both countries is reasonably good, the actual income per farm household is small because of the small size of irrigated holdings (around 0.25 ha).

- The fee collection rates are generally high in both countries. Niger while moderate in Burkina Faso. But irrigation service fees are much lower in Burkina Faso (around 5% of gross product value) compared to almost 20 percent of gross product value in Niger. When this factor is taken into account, the Nigérien systems could be considered to be performing moderately better than those in Burkina Faso.

- Water productivity in both countries is low (less than 10 US cents/m^3, except in system D).

7. Discussion

What lessons can be drawn from the above analyses about the prospects for the self-management of irrigation systems, and particularly for the participation of the private sector in government-sponsored schemes?

The irrigation systems in Niger perform better, on average, than the Burkina Faso systems. Does this mean that, in spite of higher operation costs, users in pump-based systems are more conscientious about payments and getting the best returns? Farmers realise that failure to pay fees and charges will result in the stoppage of water deliveries—a strong incentive for members of the organisation to pay their dues. This may also explain why system D in Burkina Faso, which also depends on pumping (from a reservoir) and is, therefore, different from the other four (gravity) schemes in the Burkina Faso sample, ranks better than even the Nigérien systems in many respects.

Though the systems in the two countries have different rules and procedures for accounting and financial management (tight government control in Niger versus more flexibility in Burkina Faso), none of the farmer organisations are financially independent and self-sustaining. They all lack working capital, and none of them are accumulating sufficient savings. As a result, they are unable to cope with the costs of any major emergencies, and there are deficits in major maintenance. Most of these systems would be technically bankrupt, if they were true private-sector businesses.

In the Niger organisations, the critical financial problem is the delayed payments of fees and charges, rather than their non-payment. In effect, farmers do not have to pay for fertiliser and other inputs, obtained from the co-operatives at the beginning of a season, until the end of the following season, which is about one year later. And even then, some members pay only after further delays. There are substantial arrears due to the organisations, which are then obliged to make use of the supposed capital savings accounts, to solve this liquidity problem.

Irrigated farming is not a full-time occupation for farmers in government-sponsored irrigation schemes in Burkina Faso and Niger. However, irrigated agriculture is generally profitable for the farmer – returns to land and labour are much higher compared to rainfed agriculture. But, because the irrigated holdings are small (about 0.25 ha), actual incomes are insufficient to meet the needs of farmer households. They tend to spread their risks by pursuing non-irrigation activities in parallel, especially rainfed farming. This gives rise to difficulties, such as the competition for labour resources at critical times in the crop cycles of both the rainfed and irrigated crops, with adverse consequences for both.

The experience of these two countries also suggests that it is desirable for the government to play a residual role in support of farmer organisations. Whether this should be a purely regulatory role or imply involvement, through an appropriate agency, in such things as technology choice and transfer, credit, marketing, or improving financial procedures is an open question. However, any such involvement must be very clearly demarcated, so that the farmer organisations do not remain permanently accountable to, and dependent on, the government.

The governments in both countries wish the farmer organisations that have been entrusted with the responsibility of managing government-sponsored irrigation schemes to be self–sufficient. For this to succeed, ambiguities about ownership and user-rights in respect of land, water and irrigation infrastructure have to be addressed. Farmers in irrigation systems do not own their land and they do not have transfer rights. Farmer organisations do not have rights over the use of water stored in their reservoirs.

Under these circumstances, the scope for direct large-scale private-sector participation in government-sponsored irrigation schemes seems to be limited. They could of course intervene as service providers (maintenance, repairs, account keeping, fee collection, etc.) and some private-sector operators are already involved in contract farming on some irrigation schemes (e.g., scheme D in Burkina Faso). A key element is that these operators must be able to demonstrate to farmers and farmer organisations, their competence and the benefits that would accrue as a result of their intervention, and to justify the payments farmer organisations will be called upon to make for their services. Otherwise, this may result in further erosion of the organisations' already precarious finances.

On the other hand, other forms of irrigation that are more amenable to small-scale private sector participation with a livelihood-generating and poverty-alleviation focus seem to offer more promise.

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For example, there is now considerable interest and expansion in the promotion and use of affordable and cost-effective technologies such as low-lift muscle-powered pumps, and simple drip kits.

The on-going experiences in the promotion of private-sector irrigation projects in Burkina Faso and Niger will provide valuable insights in this regard.

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The role of the African Development Bank Group in financing irrigated agriculture: On-going examples in Gambia and Ghana.

Le rôle du Groupe de la Banque africaine de développement dans le financement de l'agriculture irriguée: Exemples de la Gambie et du Ghana

Harouna Dosso

Abstract

The paper describes the principles guiding the lending policies of the African Development Bank Group, in regard to irrigation, rural development, and encouragement of the private-sector role. The policy is oriented towards a primary goal of alleviating poverty, which in most countries of the region is more severe in rural areas. Provision of stable, dependable water supplies is seen as a key part of this. The paper illustrates the thrust of this policy with four examples of projects currently supported by the Bank, drawn from Ghana and The Gambia.

Résumé

Cet article décrit les principes qui guident la politique de prêt du Groupe de la Banque africaine de développement en ce qui concerne l'irrigation, le développement rural, et la promotion du rôle du secteur privé. L'objectif global de cette politique est l'allégement de la pauvreté, très forte dans les zones rurales de la plupart de pays de la région. La mise en place de systèmes stables et fiables d'approvisionnement en eau occupe une place privilégiée dans cette politique. La communication illustre l'application de cette politique à travers quatre exemples de projets soutenus par la Banque au Ghana et en Gambie.

1. The role of the African Development Bank Group

The African Development Bank adopted a new Vision in 1999 that defines poverty reduction and sustainable economic growth as the overarching objective of Bank Group activities. Within this framework, the Bank has continued to mobilise resources and to provide technical assistance for its regional members in developing key sectors such as agriculture, education, and health. The Bank emphasised the development of the private sector as the essential engine of growth, and is also seeking to improve the policy environment in its regional member countries by enhancing governance systems and promoting policy reforms. In addition, the Bank Group has sought to promote regional co-operation and integration by providing technical assistance and by financing multinational projects.

Over the 1998-2000 period, the Bank has approved an annual average of US$2 billion for projects, technical assistance grants, guarantees, and debt relief, with equal amounts coming from the ADB (African Development Bank) and ADF (African Development Fund). Support for public-sector investments has focused on agricultural development and improving social services such as education and health. Resources have also been provided to support policy reforms and investments in infrastructure.

1.1 Concerning agriculture and rural development

The vast majority of Africans live in rural areas. Thus, poverty in most countries being a rural phenomenon, the Vision argues for giving priority to interventions in the agricultural and rural sectors as these can have a direct and positive impact on poverty and living standards on the continent. The Bank also considers infrastructure, including feeder roads, rural water supply and irrigation, as a key priority. In addition, the Bank would facilitate rural financial intermediation by supporting bottom-up, demand-driven, micro and rural finance schemes aimed at assisting the poor and vulnerable groups of society.

1.2 Developing the private sector

The development of the private sector has also been a priority. A wide array of instruments has been used for this purpose: term loans to private enterprises with no required government guarantees; equity participation; quasi-equity investments; guarantees; syndication and underwriting. The Bank Group has also extended lines of credit to private financial institutions for on-lending to small- and medium-size enterprises. At the end of 2000, the total cumulative portfolio of private sector approvals had reached over US$500 million. More than US$2 billion in resources has been mobilised in these and other ventures.

2. Bank-financed irrigated agriculture: Lessons learned

We all know that most of the agriculture activities in sub-Saharan Africa are heavily rainfall-dependent, which leads to problems due to erratic and deteriorating rainfall patterns. Although the annual rainfall may appear sufficient, its erratic and poor distribution makes it unreliable for crop production. Throughout the growing season the rainfall is characterised by considerable variability in time of onset, duration and intensity. Food production fluctuates from year to year, which poses uncertainty and risk to survival.

Agricultural production begins with human effort. Successful investments are those that involve rural people as active participants rather than simply as recipients. For instance, the incorporation of farmers into field trials in a research programme can identify problems and potential solutions with the use of particular varieties, cultivation practices or pesticide application procedures. Likewise, institutional configuration often follows from decisions about the scale and technology. For instance, opting for one type of irrigation system (large versus small, pump versus gravity, etc.) constrains the choice of the institutional alternatives. The unique needs of special groups must be taken into account when choosing among institutional alternatives for programme implementation.

From experiences, as supported by the following case studies, the success of agricultural development programmes, and sustainable use of the natural resource endowment, rest on the appropriateness and strength of the initiatives undertaken by the populations of the Bank's regional member countries.

The Bank promotes the development of irrigation as a production technology, through a wide variety of projects in its agricultural portfolio. Irrigation system development has been funded directly and through lines of credit, and as part of the food crop and export crop projects.

The irrigation policy of the Bank is to support irrigation and drainage investments in areas where a significant potential exists for sustainable irrigated agriculture. The Bank's implementation strategy for irrigation differs according to the level of technical, infrastructural, and institutional strength of each country. Loans will be made for projects which:

- Rehabilitate existing irrigation schemes, as a priority over new irrigation developments, whenever feasible.
- Improve the technical and financial management of existing irrigation systems.
- Increase irrigation infrastructure where warranted. Given the high costs of site development in Africa, this must involve careful comparison with costs and returns to rainfed crop production technologies. It also must involve matching site selection, scale, technology, and management structures with evolving national capacity to operate and maintain the irrigation system.
- Increase the institutional efficiency of irrigation and drainage schemes, notably in encouraging decentralisation of irrigation system design and management, including the involvement of irrigation associations and private farmers in main system, as well as on-farm, water management where feasible.
- Increase the flexibility of cropping patterns to improve incentives to farmers to support system operations and maintenance and to improve on-farm water and input management.
- Use advanced irrigation technologies where these are economically efficient in agricultural production.

3. Case studies

In this section, brief descriptions are given of some of the Bank Group's ongoing projects in assisting the development of irrigated agriculture in West Africa.

3.1 The Gambia: Lowland Agricultural Development Project (LADEP)

Project objective:

The lack of any significant means of retaining water on the fields leaves farmers exposed to a significant risk of crop failure if rains are poor or erratic. LADEP, which began in 1996 and is scheduled to be completed in 2004, will create nation-wide sustainable rice development schemes, based on low-technology engineering already proven in the field, and responding to beneficiary demand, where the beneficiaries are prepared to contribute to the development in the form of self-help labour.

The objective of the programme is to increase total production in the traditional rice production systems of the lowland by about 12,500 tonnes per annum in Project Year 8, on a sustainable basis, using a community-based demand-driven developmental approach. By the end of the programme implementation, it is expected that there will be around 20,000 rice farmers who have plots within the perimeters of schemes developed under LADEP. These farmers will benefit from improved food security and drought mitigation capabilities. It is estimated that each household would have a total production of field crops increased from 2,400 kg to 4,600 kg.

Table 1. The Gambia; Lowland Agricultural Development Project; Sources of finance; Programme duration 1996-2004.

Unit: millions of UA

Source of finance	Foreign cost	Local cost	Total
African Development Fund	2.60	1.36	3.96
Government of The Gambia	0.00	0.70	0.70
IFAD	1.62	1.77	3.39
Total	4.22	3.83	8.05

Note: UA = Bank's Unit of Account
UA 1.00 = US$1.26

Table 2: The Gambia; Lowland Agricultural Development Project; Costs of project components.

Unit: millions of UA

Component	Foreign cost	Local cost	Total
Soil and water schemes	2.22	1.30	3.52
Tidal swamp access	0.98	0.63	1.61
Master plan	0.15	0.18	0.33
Subtotal	3.35	2.11	5.46
% of total project cost	79%	55%	68%
Other components	0.87	1.72	2.59
Total project cost	4.22	3.83	8.05

3.2 Ghana : Kpong Irrigation Project

Project objective:

Studies in the 1980s identified the Kpong area as appropriate for irrigation development to improve the local production of rice and other food crops. The Kpong dam would provide a reliable water supply. The project began in 1994.

The main objective is to realise the potential productivity of resources which are currently under-utilised, such as the Kpong dam; develop land for increased and sustainable crop production; and improve living standards in the project area.

The project comprises the following major activities:

(a) provide gravity irrigation supplies from Kpong reservoir and remodel the existing irrigation system for cultivation of paddy by smallholders;

(b) rehabilitate about 2,000 ha of existing irrigated land and further develop about 1,070 ha of gravity irrigation;

(c) upgrade the technical capabilities of the Ghana Irrigation Development Authority (GIDA);

(d) initiate rational farmers' participation in project management and progressive privatisation of agricultural machinery;

(e) provide credit facilities to farmers;

(f) rehabilitate buildings;

(g) improve potable water and electricity.

Project benefits:

The project is designed to be self-accounting and would recover costs of inputs and services provided by the project to the farmers, including water charges and land rent.

The incremental total annual agricultural production at full development would be about 16,500 tonnes of milled rice. The project will directly benefit about 3,000 farming families and increase opportunities for rural employment and economic activities in the area.

Table 3. Ghana; Kpong Irrigation Project; Sources of finance; Entry into force; 1994.

Unit: millions of UA

Source of finance	Foreign cost	Local cost	Total
African Development Fund Loan	17.90	5.34	23.24
African Development Fund Grant	2.08	0.00	2.08
Arab Bank for Economic Development in Africa (BADEA)	6.92	0.00	6.92
Government of Ghana	0.00	3.80	3.80
Total	26.90	9.14	36.04

Table 4. Ghana; Kpong Irrigation Project; Costs of project components.

Unit: millions of UA

Component	Foreign cost	Local cost	Total
Land Development	12.96	2.90	15.86
Construction supervision	0.82	0.21	1.03
Credit	1.90	1.44	3.34
Subtotal	15.68	4.55	20.23
% of total cost	54%	46%	51%
Other components	13.52	5.37	18.89
Total cost of project	29.20	9.92	39.12

3.3 Ghana: Small-scale irrigation development project

Project objective:

This is a 5-year project. The Bank funded a small-scale irrigation study to identify potentially suitable sites. There are vast potential areas with good organic soils along small seasonal-flow streams and in alluvial-soil valley bottoms that are suitable for small-scale irrigation development. The project aims to increase the production and productivity of crops by expanding small-scale irrigation by 2,590 ha.

The project will construct 15 small-scale irrigation schemes of 50 to 200 ha (2,142 ha), 4 water conservation schemes of 40 to 120 ha, and 12 micro-irrigation schemes of 2 to 24 ha totalling about

2,590 ha in Southern and Northern Ghana for the production of food crops. The farmers will be mobilised and organised to establish Irrigation Farmers' Associations (IFAs) to enhance their participation. The participation of women beneficiaries will be encouraged as women mostly do food production. Training will be provided for farmers, extension agents and project implementation staff.

Project benefits:

Reduced dependency on rainfed crop production will alleviate the risks of household food shortages during the dry season as well as years of drought or bad distribution of rain. The project will raise crop production by 16,235 tonnes annually. It will raise rural incomes and provide better nutrition of the participating farmers. Vegetable production by women farmers will be encouraged. Additionally, the research programmes would lead to improved varieties and practices for the total area of irrigation. It is estimated that 6,000 farm households will benefit directly.

Table 5. Ghana; Small-scale irrigation development project; Sources of finance.

Unit: millions of UA

Source of finance	Foreign cost	Local cost	Total
African Development Fund	12.20	2.80	15.00
Government of Ghana	0.00	4.51	4.51
Others	0.00	2.95	2.95
Total	12.20	10.26	22.46

Table 6. Ghana; Small-scale irrigation development project; Costs of project components.

Unit: millions of UA

Component	Foreign cost	Local cost	Total
A. Land development			
Civil works contracts	6.18	3.04	9.22
Farmers' contracts	0.00	3.43	3.43
Sub-total	6.18	6.47	12.65
B. Farmers' support services			
Farmers' training	0.07	0.08	0.15
Extension	0.00	0.11	0.11
Credit	1.40	0.00	1.40
Sub-total	1.47	0.19	1.66
Sub-total A + B	7.65	6.66	14.31
% of total cost	63%	65%	64%
Other components	4.55	3.60	8.15
Total project cost	12.20	10.26	22.46

3.4 Ghana: Special Programme for food security: Pilot Project

Project objective:

The Bank will make available a grant up to UA711,180 to support a pilot project, which targets mainly smallholder farmers in drought-prone areas of the country. Increasing their productivity and production of staple food crops on a sustainable basis will increase their incomes; improve household nutrition and food security. The specific objective of the pilot project is to test production-increasing technologies so as to increase the productivity of smallholder farmers and improve household food security through:

(i) water management, crop intensification, and agricultural diversification;

(ii) capacity building;

(iii) project co-ordination and technical support.

The technical options proposed will be as follows:

(a) small motorised pumps on a shallow well or perennial river for command of 3.0 ha;

(b) treadle pump on a shallow well for small command areas (0.25 ha);

(c) low-cost drip irrigation by pumping (treadle pump) from shallow bore-holes for small plots (0.1 ha).

Table 7. Ghana special programme for food security: Sources of finance.

Unit: millions of UA

Source of finance	Foreign cost	Local cost	Total
African Development Fund	0.227	0.485	0.711
Government of Ghana	0.000	0.057	0.057
FAO	0.050	0.006	0.055
Others	0.000	0.047	0.047
Total	0.276	0.589	0.865

Table 8. Ghana special programme for food security: Costs of project components.

Unit: millions of UA

Component	Foreign costs	Local costs	Total
Water control and crop intensification	0.443	0.250	0.295
% of total cost	16%	43%	34%
Other components	0.232	0.338	0.571
Total project cost	0.276	0.589	0.865

4. Conclusion and recommendations

In general, irrigation will make possible the production of a wide variety of food and cash crops, intensify the cropping pattern and provide flexibility in the cropping period. This will assist in providing food at times of scarcity, ease the marketing and price constraints by spreading production and improve food security, nutrition, farmers' incomes and employment opportunities, thus contributing significantly to poverty alleviation. Small-scale farmer-managed irrigation has the potential, in the longer term, to increase significantly overall production from the agricultural sector; and reduce the pressure on land and also the rate of deforestation; reduce the reliance of food imports and lead to greater national food security.

I would like to conclude by noting that the opportunities and risks of globalisation are here to stay. We can only rise to the challenges and work within the broad framework of closer integration into the world economy. The African Development Bank will continue to mobilise resources and provide technical assistance to its regional member countries. It will also assist them in deepening their policy and structural reforms to attract private capital, in diversifying their export bases, and in capturing larger trade and investment shares in the international market.

The Bank Group will also review its relations with African development institutions to determine how best we can work together towards our common goal. The relationship between the African Development Bank and FAO and regional member countries is a longstanding one that dates back to the establishment of the Bank. The Bank appreciates FAO's efforts to back up technically and train our countries in modern agricultural development matters, and in providing policy advice to African agricultural institutions.

I am confident that in the years to come our partnership will grow and that we will be able to help our countries meet the important challenges ahead. In this way, we can help them take their rightful place in the rapidly changing world economy.

Encouraging capacity-building for private sector irrigation-technology service provision in Uganda

Le renforcement des capacités en vue de la fourniture des services en matière de technologies d'irrigation par le secteur privé en Ouganda

Nick Shirra

Abstract

In the wider context of Irrigation Management Transfer, the results and lessons learnt from recent activities in Uganda illustrate some pertinent issues and highlight a number of actions that countries with similar emerging markets could valuably use. A demand for the service provision of irrigation equipment was demonstrated, in terms of a desire for both diversity of quality products and competitive prices. The challenges to stimulating such service provision, were those of encouraging the private sector to invest in such new, unproven markets. The intricacies and specific challenges to this work are explained and analysed. The paper proposes a list of best practices for promoting private-sector service development, and gives recommendations about ways in which the public sector can assist.

Résumé

Les résultats et les leçons tirés de récentes activités dans le contexte du transfert de gestion de l'irrigation en Ouganda mettent en évidence des sujets pertinents et de nombreuses actions applicables aux pays avec des marchés émergeants semblables. Le demande pour la fourniture des services et le matériel d'irrigation est affichée en termes de diversité de produits de qualité et des prix compétitifs. Comment encourager le secteur privé à investir dans de tels secteurs, encore neufs et non-éprouvés, reste le défi majeur. Les détails et les complexités liés à ce travail sont expliqués et analysés. L'article propose une liste de bonnes pratiques susceptible de promouvoir le développement des compétences de provision de services au sein du secteur privé et offre des suggestions pour mobiliser l'assistance du secteur public.

1. The background to Uganda's development

Since the mid-1980s Uganda has settled into relative political and economic stability. (Pockets of rebel activity have remained only in the north and far west). The country has developed a number of strategies and polices that have aided in attaining economic growth rates, reported to be as high as 7 percent (World Bank 1999). Since 1993 Uganda has had a proactive policy and a great number of activities in the areas of decentralisation and privatisation (Government of Uganda 2000a). District Administrations have been given the responsibility of planning and managing their own development (Government of Uganda 2000b), and of encouraging private-sector provision of services.

Recently, a major agricultural extension service project has been designed that aims to develop the market for the provision of private-sector extension services to farmers. Initially farmers at the sub-county level (there are approximately 850 sub-counties in Uganda) will manage a publicly-funded budget, with which they will purchase extension services. This budget will slowly decrease and the intention is that after a period the demand and supply for such services will have grown sufficiently, so that the system will be self-sustaining through private-sector mechanisms (Government of Uganda 2000c). The Land Titles Act 1998, has been implemented to the extent that land alienated has increased to 15 percent (Government of Uganda 2001).

Furthermore, largely due to the failure of co-operatives in the early 1990s, the majority of farmers' activities are managed individually rather than on a group basis. Although many of the co-operatives were initially viewed as successful and attractive for many farmers to become involved, they soon became victim to corrupt management and as a result farmers have not largely regained sufficient confidence to re-use co-operatives to a significant extent. Individual actions are now the main medium of activity of farmers. Only two large-scale irrigation schemes are currently in operation in Uganda.

With a relatively high average rainfall, varying from approximately 760 mm in the north-east to about 1,520 mm near Lake Victoria, there are generally still two dry seasons and even periods in the length of a week when soil moisture is well below levels for optimum crop growth. Water is required also for livestock, small industries and domestic use. As a result recent individual users' efforts have been put into the better management of water; namely, water harvesting and water delivery systems.

2. Introduction

As a result of NGO demonstrations of treadle pumps, starting in 1997, a demand for the retail provision of such services to individuals emerged, mainly in rural areas. At this early stage, the bottleneck of a lack of retail availability of small-scale irrigation equipment, in the development of the adoption of such practices, was clearly highlighted, as well as a number of other aspects of service provision that are proposed as best provided by the private sector.

Private-sector investment and involvement has proven to be essential at two different levels. Firstly, a commitment for investment by the farmers has been substantiated by the fact that a farmer using his or her own money is more likely to use and benefit from the investment. Something given-away is not always used effectively (one accepts it because it is free), whereas an investment in something, by nature, is usually done with the intention of making effective use of that item. The second level of “Essential Private Sector Investment” again centres around the intention of gaining a return from the investment. The investment of money with an intention of producing something that is of value to others (service or product), on which a profit can be made, is again the essence of such investment.

A debate as to whether the public sector (rather than the NGOs) would have originally invested in the researching of such technologies, importing example-models, developing proto-types and demonstrating such technologies, could be answered by the fact that, over the last 4 years, it has proven difficult to encourage the private sector to invest in such a situation, even when receiving a certain amount of public-sector assistance. However, there is a counter-argument to this, saying that the private sector has not willingly invested because it has been waiting for further assistance and subsidisation from the public sector. Similar observations of private-sector behaviour have been made in other areas of “Business Development Service” promotion (Committee of Donor Agencies 2001).

This paper focuses on the question: What is the most effective amount of public-sector assistance that will encourage the private sector to invest in innovative and effective provision of new types of services? What has been revealed is that too little assistance will not stimulate new markets to emerge, while too much assistance will make the private sector dependent on the public sector to carry out work that it can do without assistance. Such a debate will be addressed in greater depth in the following sections, as well as recommendations about specific public-sector actions that will help stimulate the private sector to provide new services and products in previously unexploited and unexplored markets.

3. The Ugandan example

The development of private-sector provision of small-scale irrigation services and products has gone through a number of stages and challenges in Uganda. The following paragraphs describe the main activities and issues, namely:

- Demonstrations (public education) and market creation;
- NGO insertion in retailer and wholesale systems;
- Manufacturing and product development;
- Marketing and product-package development.

3.1 Demonstrations (public education) and market creation

The initial demonstrations by Non-Governmental Organisations had the effect of developing a demand for such items on a locally available retail basis, and also began to educate farmers about the benefits of using such technologies. These public sector education schemes have proven to be an essential element in the equation; an element for which the private-sector will rarely take total responsibility. It is very unusual that a business will spend money on educating the public to adopt new practices, unless the newly learnt practices will bring significant returns on the investment.

Sales-orientated and sales-benefiting demonstrations are something in which the private sector will generally invest in as long as such an investment bears sufficient returns. Unfortunately the market for small-scale irrigation equipment typically starts small and is of the type that is often slow-growing; poor rural farmers do not often have money to invest in agricultural machinery despite the demand for such.

Heierli and Polak (2000) describe an approach where public-sector funds are used to “create a market” for irrigation products that are believed to have a “poverty-alleviating” impact. Their approach involves vigorous marketing support by the public sector. In opposition to such an approach, we should distinguish between educating the poor about what products are good for them, and the creation of markets so that business will invest in a sector to provide suitable, sustainable services and products to the poor that they can choose from themselves.

In such a context it could be said that Heierli and Polak describe an approach that is top-down, in that public-sector funds promote products that are believed to be good for the poor; whereas the capacity-building of markets, for the private sector to offer a more diverse range of quality products and services to the rural producers, is less of a top-down approach and more of a market-driven approach.

Another recent aspect of the demonstration of such equipment is that the private-sector proved its ability to provide more cost-effective demonstration methods. The private-sector recognised the need for such educational and awareness activities, but also recognised the costly nature of them. It was also recognised that, if low-cost demonstration systems were put in place, both education and marketing requirements could be met at the same time. Most public-sector demonstration methods were of a travelling nature, i.e., from the back of a pick-up truck travelling from town to town. Hotel accommodation, vehicle running costs and staff costs proved to be prohibitive if carried out on a sales-returns basis. The components of an effective sales-returns to investment demonstration system were identified as shown in Box 1.

Box 1. Effective sales-returns to investments in demonstration systems.

Demonstrations should be:

- In a number of permanent locations where they can be seen by persons travelling past the location, so reducing travel and accommodation costs.
- Used by a farmer as part of his daily activities in profitable crop production, so reducing labour costs of demonstration and increasing the proof of real-use value.
- Pro-actively demonstrated, whereby a sales-commission is paid to the demonstrator-farmer for every customer found.

Although not in a highly developed stage, the manufacturer in Uganda who has proven himself to be most committed and innovative started to develop such a system by advertising a competition, where the most suitable farmer who applied could win the use of an irrigation system for a 3-month period. Arrangements were then often, in the long run, for such demonstrations to continue, based on the purchase or long-term hire of a pump.

In summary of issues regarding development of markets, it has been shown such a market is a costly one to stimulate, and is one where often the returns to investment are slow and comparatively small. Therefore, it is advocated here that market-creation and educational aspects of demonstrations be supported by the public sector, and that sales-orientated aspects be private-sector driven, but that the two be implemented together by the private sector.

3.2 NGO insertion in retailer and wholesale systems

The first two NGOs intervening in the sector encouraged independent private-sector retailer development but acted as the wholesaler. Both of these NGOs have since tried to pull even further back by encouraging the private sector to become the wholesaler also. However, a major player, a public-sector funded organisation, tried to control the manufacture, design and development, and wholesale positions in the chain of events. This showed a strong contrast to the efforts of bringing in the private-sector. Such actions quashed investment and innovation by the private sector. The climate for investment by the private sector became, at this time, very inactive with little involvement from the private sector.

Towards the middle of the year 2000, a private-sector investor initiative came into operation with some donor backing. The principal objective of this initiative was to set examples to the private sector that successful investments and innovations were possible. Based on a business plan of a short-term investment nature by the donor, a set number of activities were undertaken that included demonstrations, new retailer establishment, product development and marketing-method development.

Although the private sector had taken an interest in manufacturing and marketing such products from an early stage it took time to get the private sector significantly involved. Some rural retailers invested in a small stock of such items, especially when they knew that they had definite customers. Customers often emerged as a result of NGO demonstrations. However, investment by the private sector remained at this superficial level for quite some time, until a loosening-off by the organisation, in terms of wholesaling activities. Such wholesaling activities were revealed to be a major and central activity that could have effects either of making the sector more independent of the NGOs, or more controlled by the NGOs.

3.3 Manufacturing and product development

After a period of approximately 3 years, a large private-sector manufacturer finally started to show a commitment to producing a quality-competitive product. This was a major step towards independence for the private-sector working in this area in Uganda. Prior to this time he sought donor assistance to start manufacturing. This was an example of the point made earlier, where the manufacturer hesitated for such a long time before he invested his own money because of the possibility of gaining donor funds.

Once the manufacturer found that the donor would not go as far as giving funds for such activities, he finally showed commitment and started to invest. To begin with he employed a rural development specialist / engineer consultant to design an improved treadle pump model that he could market more competitively than any of the NGO-designed models. The manufacturer also invested in developing more effective marketing systems in collaboration with various specialists. Due to the low levels of capital that many farmers have, low-capital investment products had to be offered to farmers.

3.4 Marketing and product-package development

The manufacturer invested money in manufacturing (development of a new production line, training of staff, establishing a stock of materials and of finished products) but did not want to venture into other areas of mass retail marketing or the management of credit on a large scale. However, he did want to see that the items he was producing were sold at a quick rate and was prepared to try out and encourage a few new and innovative retailing and credit methods.

The manufacturer had discussions with micro-finance institutions that showed interest in providing services where specific items could be purchased on credit, but in the end could not really propose a competitive and attractive package. Unsubsidised interest rates in Uganda are at least 32 percent per annum in urban areas and a lot higher in rural areas, for loans offered by formal micro-finance institutions, apparently due to high operation overheads and transaction costs. However, informal savings and credit groups have continued to be competitive and attractive on a large scale, due to their operations usually being carried out on a voluntary basis and where there is often very low overhead costs and very low interest rates. However, these small groups have had to be encouraged to stay small and informal so that overhead costs do not rise. The manufacturer felt he could not formally and safely work with these informal groups.

As a result, the manufacturer has attempted to devise low-capital-purchase systems. The most simple and effective of these has been a hire purchase / leasing system. If a customer could demonstrate certain financial sureties and securities (letter of proposed payment schedule, letter from local councillor, statement of address and statement of collateral) irrigation equipment was effectively given on a basis of about 10 percent annual interest. This was equivalent to about 5 percent increase on the overall cost of the equipment, since most equipment was paid for within 4 months. There were however, limitations to such a scheme, in that the manufacturer has only given this service to persons known to him in the locality and to those that can demonstrate various securities, which has not generally included the majority mass low-income market.

Despite the availability of the package (although only to few), a number of customers have purchased the equipment on a “lay-away system” whereby they gave money to the manufacturer on generally a monthly basis and only took the equipment when fully paid. The manufacturer held the retail price without any increases for 6 months and gave a 5 percent discount for those involved in this scheme.

Another innovative system that has enabled a growth in sales is that of encouraging the growth of water-pumping services. The intention is that if pumps are hired out on a basis of the amount of water transferred, by a person who travels around by bicycle, with the pump on the back of the bicycle. More people will see the pump in use and a demand should grow from persons wanting the pump. Currently 6 US cents per 20 litres is paid for water delivered. For anyone requiring more than 200 litres, the use of a treadle becomes cost-effective and less labour intensive. In order to promote the practice of water-pumping services, he advertised and hired-out pumps from his workshop to young men who wanted to offer such services. To start up the demand for such services, he allowed for 2 days the free hire of pumps to two young men.

In terms of developing marketing-products, the manufacturer has had an emphasis on systems that have improved the achievement of his primary objective of increasing sales. He has not chosen to become directly involved in the management of complex financial services, but, like many companies, he is happy to absorb the transaction cost of credit services in the profit mark-up, even to the extent that items are sold on virtually interest-free credit.

In summary of the actions that have taken place in Uganda over the last 4 years, a number of lessons have been illustrated, particularly in terms of effective and sustainable practices for service-provision. The private sector has produced some innovative and effective products, services, and forms in which these have been offered to small-scale farmers. However, the encouragement and handling of private-sector involvement has been a delicate matter. Although the private sector in Uganda has not particularly had a great deal of pro-active encouragement, too much encouragement (particularly financial) would have done a lot of harm.

4. Proposed assistance

As a result of observations and analysis of a variety of Technical Assistance Programmes (in a variety of countries, and some in irrigation promotion) and from the experiences of Uganda over the last 4 years, it is felt that a certain amount of public-sector assistance could have been more helpful and is very necessary, particularly in terms of educating the public on the benefits of the use of such technology.

Within the Ugandan experience it has been clearly highlighted that the most beneficial public-sector action has been that of the donor supporting the private-sector player (starting middle of the year 2000) in specific planned actions. This assistance was generally seen as successful mainly because it followed some of the best general practices in capacity-building of localised institutions. These best practices should be of the nature described in Box 2.

Box 2. Recommended best practices for giving assistance to private-sector service providers.

- ♦ The public sector works hand-in-hand with the private sector and not in isolation from the private sector.
- ♦ The overall aims of any assistance should be to encourage the private sector to:
  - Invest and be committed;
  - Be innovative in terms of results produced.
- ♦ The agenda of the institution (business) is strengthened and not an external agenda (although activity plans could be written within certain external guidelines).
- ♦ Activities and financial assistance are based on the partner-business's business and marketing plans etc., and any negotiations centre around these plans.
- ♦ Any subsidies are specific time-bound interventions with carefully defined exit-strategies (Committee of Donor Agencies, 2001).
- ♦ Activity plans aim towards self-sustainability. For example, systems are developed where public education can become a cost-free part of marketing.
- ♦ As much as possible, products should be developed by the private sector and not by the public sector; or a joint approach with carefully defined inputs from each party.
- ♦ As limited public-sector assistance as possible, but where quality-effective results still occur, minimalist approaches are strongly recommended.

As a result of this "joint-venture" and capacity-building approach to the private-sector player, many of the planned activities effectively took place and the culture of developing new and innovative practices increased rapidly when the manufacturer became involved. For example, the joint-venture activities included those of developing innovative marketing systems; the manufacturer continued this type of innovative-behaviour when he later became involved. However, it is felt that specific assistance to the manufacturer would have speeded up the provision of innovative and quality services.

Therefore, it is here suggested that any public-sector assistance should comprise the elements and generally be of the funding proportion amounts as suggested in Table 1.

Table 1. Recommended elements of assistance to private-sector service providers.

Requirement	Type of assistance	Approximate proportions of assistance	Approximate time period of financial assistance
Mixed marketing / public education schemes (often sales cannot happen without education first).	Grant or the provision of certain resources such as personnel.	40 – 70% of total costs of overall activity	Until demonstrations have been carried out once in all significant locations.
Specialist technical advice, for example in developing business plans, marketing plans and systems, product and services development.	Grant or the provision of certain resources such as personnel.	20 – 40% of total costs	No time limit as long as the grant is being used to develop something that has a social benefit where the private sector would not normally invest in.
Investing in developing the company's capacity to provide such services or products.	Loans based on prevailing commercial interest rates, and secure collateral	Up to 90% of total costs of investments – but should be based on a viable investment and re-payment plan.	Based on a viable investment, returns to investment, and repayment plans.

The assistance described here aims to give an outline of the nature and extent of what has been found to be effective. However, this description is by no means exhaustive and lessons are still being learnt. Getting the balance right and knowing the entire nature of the situation one is dealing with, is a continual challenge.

Nonetheless, it is still recommended that minimalism is better than maximalism in such a situation of encouraging such service provision.

5. Summary of lessons learned from the Ugandan example

In the past, irrigation scheme set-up and management was often approached in a top-down manner. Such schemes were often of a large size, government-managed and government-dependent. What have been described here are activities and results of a method that, as much as possible, is demand-driven and bottom-up in the type of services and products offered. In consequence the institution providing such services and products is sustainable and relatively effective. However, getting to the point where such private-sector involvement occurs, is not quick and not straightforward. Each specific situation in terms of geographical location, demand for services (strength of demand, nature of services and products demanded, etc.) and the nature of the private sector player is unique and complex in its own right. Managing such situations is a delicate mater. Getting the balance right has proven to be the crux of this type of work.

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Report on Discussions

The present document is a synthesis of the reports on the four themes, namely: (1) small-scale, informal irrigation systems, (2) irrigation management transfer, (3) commercial irrigation farming, and (4) enabling environment, emergence of new operators, and financing of irrigation, as well as the panel discussion on the topic of private irrigation, food security and export earnings.

This report is based on the main points made by the different speakers and paper presenters during each theme, and the questions and answers that arose during the discussions that followed.

Theme 1: Small-scale, informal irrigation

The keynote speaker for this theme was Mr. Moïse Sonou, whose presentation entitled 'Irrigation trends and prospects in sub-Saharan Africa' reviewed irrigation development in Africa in general and sub-Saharan Africa in particular. He pointed out the prospects for future irrigation expansion as well as the trends in irrigation development observed during the past few decades in Africa, characterised by a modest progression in irrigated areas since the 1980s. He also brought to light the main factors influencing irrigation expansion, such as population growth, funding sources and institutional changes.

The presentation gave rise to a number of points of discussion:

- Irrigation statistics do not always take into account the informal irrigation sector. It is, therefore, important that countries put in place more complete and reliable approaches for data collection. However, it must be noted that FAO is already attempting to address this problem by making its AQUASTAT database available to a wide variety of users. Nevertheless, as the basic information for this database is provided by the different countries, the question of reliability of the data remains their responsibility.
- The importance of paying attention to environmental impacts right from the start of irrigation projects to avoid problems such as soil salinisation (even though this is not a significant problem for many irrigation systems).
- Institutional aspects must pay attention to good governance and democracy, which will have implications for the multiple, and sometimes conflicting, uses of water resources in countries.
- There is a need for a new water resources paradigm incorporating approaches that integrate agricultural, domestic and industrial water needs and uses with the need for protection of the environment. Ways and means for promoting negotiation and partnerships among the various actors are required.
- The role of the State must be re-thought; the accent should be on identifying incentives upstream and downstream of agricultural production.

The introductory presentation was followed by seven case studies. The main points of discussion dealt with:

- Institutional aspects: the lack of clarity about the roles and responsibilities of the different actors involved, and particularly the need for the State to exercise a control and regulatory function.
- On the technical side, the need to move towards low-cost technologies taking into account requisite safeguards.
- The availability of good transport infrastructure is a critical socio-economic factor for private sector entrepreneurs.
- Training and capacity-building of the various actors involved in irrigated agriculture.
- Particular attention must be paid to the power and energy requirements of the irrigation sector on a case by case basis.
- Sharing and uptake of all useful experiences should be promoted.

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- The question of the differences in costs of irrigation equipment and irrigation schemes in Asia and Africa should be documented and merits detailed analysis.

Theme 2: Irrigation management transfer

The introductory presentation by Dr. Douglas Merrey entitled “Can irrigation management transfer revitalise African agriculture? A review of African and international experiences” was followed by four case studies from Africa, Latin America and Asia.

In his presentation, Dr. Merrey first asked if irrigation management transfer was a panacea or not. He pointed out the need for rethinking the process of transfer in Asia and Africa with greater responsibilities being given to farmers. He listed a number of factors indispensable for the success of irrigation management transfer:

1. it should fulfil the promise of notably improving the living standards of the producers;
2. the irrigation system should provide the basis for creating such improvements;
3. the economic and financial costs associated with sustainable irrigation management must not be out of proportion with the income of the producers;
4. the organisational set-up should be both simple and flexible and should not give rise to huge transaction costs.

Addressing the African context, Dr. Merrey highlighted some historical aspects such as the dependency of farmers on the extension and support services provided by parastatal agencies. Such schemes were often not sustainable due to the high costs of mechanisation and inputs, absence of credit facilities for farmers, absence of appropriate mechanisms for input procurement and marketing of produce, and most importantly, problems related to land tenure, small size of landholdings, and high water pumping costs. To bring about changes in this situation, he recommended: (a) reinforcing the capacity of producers, (b) reducing transaction costs, and (c) identifying reliable markets.

However, the different case studies highlighted the emergence of certain trends indicating favourable progress in irrigation management transfer. Nevertheless, major political, institutional, organisational and environmental questions still remain unanswered.

Most of the points raised in the course of the discussions pertained to the ownership of the transferred irrigation infrastructure, the rhythm and speed of management transfer, private sector participation, farmer dependency, the lack of firm political commitment as demonstrated by the absence of clear strategies, better organisation of productive sectors, enhancing the professional capability of the different actors, training, extension, and the creation of an environment favourable to management transfer.

Theme 3: Commercial irrigation farming

This theme was introduced by Mr. A. Gyamfi who spoke on the subject of “Commercial irrigation farming” using the example of Ghana. According to Mr. Gyamfi, private commercial irrigation is practised by both companies and groups of producers, and is well established in Ghana. It includes large-scale cultivation of fruits and vegetable cultivation on a smaller scale. The produce is not only exported but also reaches local markets though the main interest of Ghanaian producers is focused on the lucrative European markets.

Since 1980, Ghanaian entrepreneurs have prospected for markets, both overseas and local, using their own resources. Interest in the local market has been driven by the growth in urban population and restaurants, the development of the commercial and tourism sectors, the establishment of agribusinesses, etc. These factors have led to a significant increase in the demand for horticultural produce.

However, real constraints to the development of private and commercial irrigation still remain, and these will have to be eased off if greater private sector involvement in irrigated agriculture is to be encouraged. Among the constraints are:

- high cost of investments;

- land tenure problems;
- lack of qualified personnel;
- lack of basic infrastructure (roads, cold storage facilities etc.,).

Mr. Gyamfi emphasised that although private irrigation presents a number of advantages, the establishment of mechanisms for consultation and partnerships between the public and private sectors is essential to further develop and expand this sub-sector. The main points of discussion that followed this presentation related to:

- the historical background of the producers;
- the suppliers of irrigation equipment;
- cold storage facilities;
- problems related to availability of skills;
- the size of landholdings in relation to different types of irrigation;
- relationships between small producers and agricultural companies.

This presentation was followed by four papers on the themes of private and commercial irrigation. Two of the papers dealt with the potential and constraints related to the production of high value agricultural crops for export in Kenya and Ghana. Fruits and vegetables are produced under irrigation on both large and small scale farms belonging to different socio-professional farmer groups and organisations.

These different producer-groups generally have the capacity of investing in irrigation systems if the economic environment is improved and if suitable incentives are granted by the authorities. These case studies bring to light the following major constraints to the development of private and commercial irrigation in Ghana and Kenya:

- High transaction costs related to marketing resulting in reduced profits for the producer.
- Lack of infrastructure such as cold storage facilities, the costs of which go beyond the financial means of most of the producers.
- Inadequate road networks that considerably reduce the competitiveness of African agricultural products.
- Lack of suppliers and specialised service providers.
- Land tenure and water rights.
- Difficult access to long-term loans and credits.

The other two papers, on the other hand, provide practical examples of how to create a supply chain of irrigation equipment based on clear commercial principles and also local level involvement of the private sector. Simple technologies that can be easily used by smallholder farmers have been introduced. Training is provided to local manufacturers with locally available resources. On account of the low material costs, producers have little need for credit. However, particular attention needs to be paid to preventing over-exploitation of groundwater by pumping equipment.

Theme 4: Enabling environment, emergence of new operators, and financing of irrigation

The theme was introduced by Mr. Charles Abernethy whose paper focused on three key elements: the improvement of the enabling environment, financing mechanisms, and equitable access to irrigation. The paper emphasised that in order to ensure private sector participation in the financing and expansion of irrigation, there needs to be a demand for the products of irrigated agriculture and availability of capital for the expansion of existing irrigation systems and the construction of new systems. In addition, Mr. Abernethy identified a certain number of domains that could be of interest to the private sector. These are:

1. operations, maintenance and management of existing irrigation schemes;
2. providing capital to extend existing irrigation systems;
3. constructing new irrigation facilities;
4. improving existing technologies;
5. providing services such as input supply, maintenance and marketing.

The following actions need to be taken to encourage implementation of these five elements:

1. establish clear and well documented system of water rights;
2. ensure water resources management at the river basin level;
3. introduce specific legislation for effectively carrying out different activities;
4. clearly define ownership, roles and responsibilities, especially in regard to physical activities and water rights in government-sponsored irrigation schemes;
5. establish mechanisms to prevent and attenuate the risks of organisational failure and bankruptcy;
6. provide advisory services regarding markets and marketing to smallholders;
7. enhance the managerial capabilities of producers through training and professional development.

Among the questions raised by participants in the course of the discussions that followed were those relating to:

- the role of the private sector in setting up and providing financial and technical assistance;
- private property rights in relation to irrigation expansion;
- mechanisms to anticipate and manage failures that often result in bankruptcies.

Of the seven papers presented under this theme, five were case studies from Africa and Latin America, one dealt with different modes of irrigation financing in Africa, and the last one presented the activities of the African Development Bank (AfDB).

The case study from Nigeria showed that smallholders possessing motorised pumps made higher profits than those who did not have pumps. But this can only be achieved if certain preconditions are satisfied: access to water, simple and affordable technology and markets, a well-organised crop calendar and strengthening of the capacity of the producers.

The system of leasing of pumps in Bolivia appears to be an experience with a potential for application in Africa provided that the following conditions are fulfilled: strengthening of existing financial institutions and of equipment suppliers, development of medium-term refinancing systems and pilot-testing of project ideas.

A presentation of a roving course designed to train smallholder farmers and extension agents in the use of a decision-support tool for selection of pumping equipment by farmers was based on experiences in Mali, Niger and Burkina Faso. The success of such a tool can be improved by expanding the database associated with the tool to include the characteristics of pump sets available locally.

The presentation on Burkina Faso and Niger was essentially a comparative study of the financing, management, costs and performance of irrigation systems in the two countries. This study showed that yields and returns obtained in Burkina were higher and more stable than in Niger. It also highlighted the need for capacity building of producers, for a reduction in the complexity of access to financial institutions and for clarifying problems in regard to land tenure.

The AfDB presentation, based on examples from Ghana and The Gambia, pointed out that funds allocated for the agricultural sector were most often directed towards sub-sectors such as irrigation, rural development, rural infrastructure, and potable water supply.

The discussions emphasised that the notion of private sector should be enlarged to cover smallholder farmers and also that financing of the sub-sector could, for a start, be based on mobilising savings while recognising that producers have a wide range of needs to be satisfied.

Panel discussion on private irrigation, food security and export earnings

After a brief introduction by the panel president, Mr. I.K. Musa, the panellists, representing FAO, IWMI, ARID, the producers and AfDB, presented their points of view, individually.

Mr Gyamfi, representing the private producers, suggested that the public sector should facilitate irrigation expansion as part of its development policy. There should be consultations, if not concessions, with a view to reducing the high costs of inputs and for facilitating the access to land and water for private producers who decide to invest in the irrigation sector. According to Mr Gyamfi, food security should be based upon year-round agricultural production which, in turn, will require the construction of a large number of irrigation systems.

There is a need for clear strategies and incentives if export earnings are to be increased, and the private and public sectors should work together to achieve this. Each party should respect the programmes agreed upon and special attention must be given to fulfilling quality norms, which is a vital factor in trying to supply external markets.

Dr. Merrey indicated that the programme under discussion between different partner organisations including the World Bank, FAO, AfDB and IWMI, for identifying an investment strategy for irrigation development in Africa represents a good opportunity to address the concerns that have been expressed. He suggested that the following five fundamental points merited particular attention:

1. Currently available water resources are certainly too limited when compared with the variety of other demands and uses, thus making large-scale irrigation schemes very difficult to accept.
2. The expansion of irrigation in Asia took place at a time when cereal demands as well as prices were quite high, which is no longer the case today.
3. There are real opportunities for developing small-scale irrigation in sub-Saharan Africa.
4. The private sector is in a better position to develop the irrigation sector given its results-oriented approach.
5. Governments and donors should create attractive conditions to facilitate the involvement of the private sector.

Mme Tempelman of FAO emphasised that all of us should ask ourselves the fundamental question of how to ensure irrigation expansion while respecting equity. According to her, three aspects related to food security need to be considered:

1. The allocation of resources.
2. The potential impact of private irrigation.
3. Impacts on the household.

Analysis of these three elements shows that expansion of private irrigation could have significant consequences on the costs of exploiting water resources and on land and water rights, especially in the case of smallholder farming. It is quite likely that, when making choices and decisions, options that offer higher financial returns are likely to take precedence over the need to ensure household food security. Female producers run the risk of being further marginalised; even though they make significant contributions to food production and household food security, they have little or no access to land and credit. Furthermore, they have little control over household labour, resource allocation and, most importantly, the sharing of profits derived through agricultural production.

For Mr. Diallo of ARID, three ideas come to light:

1. The necessity to look for ways and means of substantially reducing the costs of irrigation systems to more acceptable levels. For this, it will be necessary to take into account and fight against negative factors such as corruption. This should be done through policies and strategies that are based on the principles of good governance.

2. Smallholder farmers should be allowed access to simple and affordable technologies and thus be in a better position to combat poverty and exclusion.

3. When developing policies and strategies for integrated water resources management, there should be provision to entertain the views and inputs of smallholder farmers who quite often represent the most vulnerable segment of society.

The AfDB representative spoke about the bank's experience in financing irrigation projects and made special mention that their support to sugar cane farming had yielded good results. The AfDB financial instruments are based on long-term loans disbursed through local banks except for large projects, which are paid through AfDB's Abidjan headquarters. All the usual analyses to assess the feasibility and viability of the project are conducted before approval for any credit is made. Environmental impact assessments of irrigation projects today represent a major pre-condition that must be satisfied before any consideration of funding support.

The following points emerged out of the discussions among panel members and other seminar participants:

- There exists a situation favourable to irrigation development, particularly small-scale irrigation, in many places in Africa;
- Given the limited availability of water resources, there is a need for adopting approaches such as rainwater harvesting for irrigation;
- The current situation is highly favourable for the development of small-scale and micro-irrigation, and for the productive use of wetland resources;
- Political authorities should invest in basic infrastructure such as roads and electrification, which are indispensable for attracting private investors and for ensuring the economic viability of irrigation;
- Whatever be the type of activity, special attention must be paid to gender and equity considerations;
- It is important to define effective strategies to ensure the achievement of food security and poverty reduction.

Rapport Général

Le présent document fait la synthèse des différents rapports des sessions tenues autour de quatre thèmes, à savoir (1) la petite irrigation et systèmes informels d'irrigation, (2) le transfert de la gestion de l'irrigation, (3) l'irrigation privée et commerciale, et (4) l'environnement favorable et émergence de nouveaux opérateurs pour le financement de l'irrigation, et de la discussion en panel au sujet de l'irrigation privée, la sécurité alimentaire et les revenus à l'exportation.

Ce rapport est basé sur un résumé des notes introductives des différents conférenciers, les points clés soulevés par les présentateurs ainsi que les questions posées et les solutions proposées lors des discussions et les débats qui ont suivi.

Thème 1 : «Petite irrigation et systèmes informels d'irrigation»

Ce thème a été introduit par M. Moïse Sonou dont l'exposé liminaire intitulé «Tendances et perspectives de l'irrigation en Afrique subsaharienne » fait l'état des lieux sur le développement actuel de l'irrigation en Afrique en général, et en Afrique au Sud du Sahara en particulier. Le conférencier a présenté les perspectives pour l'expansion future de l'irrigation de même que les tendances observées au cours des dernières décennies sur le développement de l'irrigation en Afrique. Ces tendances sont marquées par une faible progression des superficies irriguées surtout depuis le début des années 80. Il a également mis en évidence les principaux facteurs qui ont une influence certaine sur l'expansion du secteur. Il s'agit entre autres de la croissance démographique, des sources de financement, et des changements institutionnels.

Cet exposé a suscité plusieurs points de discussion:

- Les statistiques sur le secteur ne tiennent pas toujours compte du secteur constitué par l'irrigation informelle. Aussi, il devient indispensable de définir les modalités de collecte de données plus complètes et plus fiables au niveau des différents Etats. Cependant, il faut noter que la FAO a déjà essayé de répondre au problème en mettant à la disposition des utilisateurs la base de données AQUASTAT dont les informations sont fournies par les différents Etats. La question de la fiabilité des données reste donc du ressort desdits Etats.
- L'intérêt de prendre en compte les problèmes d'impact sur l'environnement dès le début des projets pour éviter des problèmes tels que la salinisation des terres (même si le phénomène reste encore relativement marginal dans la plupart des périmètres).
- Les aspects institutionnels doivent nécessairement intégrer la bonne gouvernance et la démocratie qui auront des implications sur les usages multiples et parfois conflictuels des ressources en eau dans les pays.
- La nécessite de partir d'un nouveau paradigme sur l'eau qui repose sur une approche intégrée des besoins et usages agricoles, besoins domestiques et industriels, et la protection durable de l'environnement. Il devient alors nécessaire de réfléchir sur les plates-formes de négociation et de partenariat entre les différents acteurs impliqués.
- Le volontarisme de l'Etat doit être repensé avec un contenu nouveau qui mette l'accent sur les mesures incitatives en amont et en aval de la production agricole.

L'exposé introductif a été suivi par sept études de cas. Les échanges qui ont suivi ces exposés ont porté sur les axes suivants:

- Les aspects institutionnels : le manque de clarification des rôles et missions des divers acteurs impliqués et la nécessité de recentrage du rôle de l'Etat sur les fonctions de contrôle.
- La nécessité de s'orienter sur le plan technique vers des technologies à moindre coût mais tout en prenant les précautions nécessaires.
- La question de l'environnement socioéconomique doit intégrer la question du transport qui apparaît comme facteur critique pour les privés.

- La formation et l'amélioration des capacités des acteurs intervenant dans le sous-secteur de l'irrigation.
- La question du choix du type d'énergie pour l'irrigation doit faire l'objet d'une attention particulière et une appréciation au cas par cas.
- Toutes les expériences doivent être valorisées et partagées.
- La question des différences de coûts entre l'Asie et l'Afrique pour les équipements et les aménagements doit être documentée et faire l'objet d'analyses plus fines.

Thème 2 : «Transfert de la gestion de l'irrigation»

L'exposé de M. Douglas Merrey intitulé « Can irrigation management transfer revitalize African agriculture ? A review of African and international experiences » a été suivi de la présentation de quatre études de cas en Afrique, Amérique Latine et Asie.

Dans son exposé introductif le conférencier a d'abord posé la question de savoir si le transfert de gestion de l'irrigation était une panacée ou pas. Il a fait également remarquer la nécessité d'un recentrage du processus de transfert de la gestion de l'irrigation en Afrique et en Asie qui accorderait plus de responsabilités aux producteurs. Selon le conférencier plusieurs critères sont indispensables pour créer les conditions de succès du transfert de la gestion de l'irrigation:

1. soutenir la promesse d'une nette amélioration des conditions de vie des exploitants;
2. le système d'irrigation doit être le socle essentiel pour créer ces améliorations;
3. les coûts économiques et financiers pour une gestion durable ne doivent représenter qu'une infime partie du revenu du producteur;
4. le dispositif organisationnel doit être à la fois, simple et souple pour induire des coûts de transactions faibles.

Décrivant le contexte africain, M. Merrey a relevé les aspects historiques de la dépendance des paysans liée á la nature de l'encadrement fourni par les organismes para-étatiques. Ces projets sont souvent caractérisés par une faible rentabilité due aux coûts élevés de la mécanisation et des intrants, l'absence de crédit aux producteurs, l'absence de marchés d'intrants et de structures de commercialisation, mais aussi et surtout les problèmes de tenure foncière, la taille trop étroite des parcelles, et le coût élevé du pompage de l'eau. Pour une transformation qualitative de la situation, le conférencier recommande : (a) le renforcement des capacités des producteurs, (b) la réduction des coûts de transactions, et (c) la recherche de marchés fiables.

A travers les exposés sur les différentes études de cas, on note tout même, l'émergence de certaines dynamiques insufflant progressivement quelques marges de progrès favorables au transfert de la gestion de l'irrigation. Bien entendu des questions majeures restent toujours sans réponse au niveau politique, institutionnel, organisationnel et environnemental.

La plupart des questions soulevées ont porté sur la propriété des infrastructures des systèmes irrigués transférés, le rythme et le degré du transfert de leur gestion, la participation du secteur privé, la dépendance des producteurs, le manque d'engagement politique affirmé et soutenu concrétisé par des stratégies claires, l'organisation des filières de production, la professionnalisation des acteurs, la formation, l'encadrement, l'environnement favorable au transfert.

Thème 3: «L'irrigation commerciale et privée»

Ce thème a été introduit au deuxième jour du séminaire par M. A. Gyamfi qui a traité du sujet « Commercial irrigation farming» via l'exemple du Ghana.

Selon le conférencier, l'irrigation privée et commerciale est bien établie au Ghana où elle est pratiquée par des entreprises et groupements de producteurs. Elle est organisée autour de la production de fruits dans de grandes exploitations et des légumes dans de plus petites exploitations. Les productions sont destinées autant à l'exportation qu'au marché local. Toujours, selon le conférencier, les producteurs du Ghana se sont principalement intéressés au marché européen qui présente un avantage certain du fait de sa proximité.

Depuis 1980, des entrepreneurs ghanéens financent sur ressources propres des études de prospection de marchés extérieur et local. Une attention particulière a été accordée au marché local caractérisé aujourd'hui par une forte croissance démographique dans les centres urbains, un développement du secteur commercial et du tourisme, l'installation d'agro-business, une augmentation du nombre de restaurants dans les centres urbains etc. Ces facteurs ont conduit à une augmentation significative de la demande en produits horticoles.

Cependant, de réelles contraintes au développement de l'irrigation privée et commerciale existent toujours. Elles doivent être levées si on veut rendre le secteur plus attractif pour les privés qui voudraient investir dans le sous-secteur de l'irrigation. Entre autres contraintes l'on peut citer:

- le coût élevé des investissements;
- les problèmes fonciers;
- l'absence de personnels qualifiés;
- le manque d'infrastructures de base (route, chaîne de froid etc.).

Toutefois, souligne le conférencier, l'irrigation privée présente plusieurs avantages. Cependant pour son renforcement et son expansion future il faudra nécessairement faciliter la création de cadre de discussions entre les structures publiques et privées. Les discussions sur cette présentation ont porté sur les points suivants:

- l'historique des exploitations;
- les fournisseurs d'équipements d'irrigation;
- les chaînes de froid;
- les problèmes de compétence;
- les superficies selon les types d'irrigation;
- les relations entre petits producteurs et entreprises agricoles.

Cette présentation a été suivie de quatre papiers sur le thème de l'irrigation privée et commerciale. Deux présentations ont traité des questions relatives aux potentiels et contraintes des productions agricoles à haute valeur ajoutée destinées à l'exportation au Ghana et au Kenya. Il s'agit surtout de la production de fruits et légumes sous irrigation, provenant de grandes comme de petites exploitations appartenant à différentes organisations socio-professionnelles de producteurs.

Ces différents groupes de producteurs sont généralement en mesure d'investir sur l'irrigation si les conditions d'amélioration de l'environnement économique sont assurées et surtout si des mesures incitatives sont prises par les autorités publiques. Les principales contraintes au développement de l'irrigation privée et commerciale soulevées dans les études de cas au Ghana et Kenya sont:

- Coût élevé des transactions de marché dont la conséquence est la réduction des profits au niveau de l'exploitation;
- Manque d'infrastructures telles que les chaînes de froid dont les coûts élevés dépassent souvent les possibilités financières de la plupart des exploitants;
- Mauvais réseau routier qui réduit considérablement la compétitivité des produits agricoles africains;
- Manque de fournisseurs dans les services spécialisés;
- Tenure foncière et les droits d'accès à l'eau;
- Difficultés d'accès à des prêts sur le long terme.

Les deux autres études ont, par contre, permis d'illustrer par des exemples précis, la possibilité de création d'une chaîne de matériels d'irrigation basée sur des principes commerciaux claires mais aussi pouvant assurer une forte implication du secteur privé local. Des technologies simples, facilement utilisables par les petits producteurs, ont été introduits à cet effet. La formation est dispensée aux fabricants locaux des équipements grâce aux ressources disponibles localement. Du fait des faibles coûts du matériel, les producteurs n'ont nullement besoin de crédit. Cependant une attention particulière doit être accordée aux mesures de prévention d'une sur-exploitation des nappes souterraines voire de leur tarissement.

Thème 4 : «Environnement favorable et émergence de nouveaux opérateurs pour le financement de l'irrigation»

Ce thème a été introduit par M. Charles Abernethy dont la note de présentation intitulée : « Enabling environments, financing mechanisms and equitable access to irrigation » met l'accent sur les trois éléments clés que sont : l'amélioration de l'environnement, les mécanismes de financement, et l'accès équitable à l'irrigation. Selon le conférencier, pour assurer une participation du secteur privé dans le financement et l'expansion de l'irrigation, il faut nécessairement l'existence d'une demande effective d'une part, et la disponibilité du capital pour l'expansion des systèmes existants et la construction de nouveaux systèmes d'irrigation, d'autre part.

Le conférencier a, en outre, identifié un certain nombre de domaines pouvant intéresser la participation du secteur privé. Ces domaines sont:

1. les activités de gestion et de maintenance de périmètres publics existants;
2. la mise en place de capital financier pour l'expansion des périmètres existants;
3. la réalisation de nouveaux périmètres irrigués;
4. l'amélioration des technologies existantes;
5. les services d'appui aux producteurs dans les domaines de la maintenance, de la fourniture d'intrants et d'équipements, du marketing etc.

Pour une bonne mise en œuvre de ces cinq éléments, il faut nécessairement:

1. une bonne législation de l'eau qui soit suffisamment claire et bien documentée et qui sécurise les usagers et bénéficiaires;
2. un besoin de passer au niveau du bassin versant pour la gestion des ressources en eau;
3. une législation spécifique sur la conduite des différentes activités;
4. une claire définition de la notion de propriété, des responsabilités et rôles, surtout quand il s'agit de l'expansion de périmètres irrigués publics où il y'a très souvent des réticences de la part des bénéficiaires;
5. le besoin d'avoir des mécanismes pour prévenir et atténuer les échecs car le secteur de l'agriculture est fortement soumis à divers risques;
6. un besoin d'assistance et de conseil pour les petits producteurs dans le domaine des marchés, cette assistance devant être limitée dans le temps;
7. un besoin de renforcement des capacités managériales par le biais de la formation.

Au cours des discussions qui ont suivi la présentation, les participants ont soulevé des questions relatives:

- au rôle du secteur privé dans la mise en place d'une assistance financière et technique;
- au droit à la propriété privée en relation avec l'expansion de l'irrigation;

- aux méthodes d'anticipation et de gestion des échecs qui conduisent souvent à des dépôts de bilan.

Au total sept documents ont été présentés sur ce thème dont cinq études de cas en Afrique et en Amérique Latine, une réflexion sur les modes de financement de l'irrigation en Afrique, et enfin une présentation des activités de la Banque Africaine de Développement (BAD).

L'étude de cas menée au Nigeria a montré que les petits producteurs disposant de motopompes arrivaient à rentabiliser leur exploitation. Ils dégagent des marges de bénéfices relativement importantes par rapport à ceux qui ne disposent pas de pompes. Cependant ceci n'est valable que si un certain nombre de conditions préalables sont remplies. Nous pouvons citer entre autres l'accès à l'eau, l'accès au marché, une bonne organisation du calendrier cultural, l'accès à la technologie qui doit être simple et peu coûteuse, un renforcement des capacités des producteurs etc.

Le système de location de pompes en Bolivie a été également présenté. Ce système représente, selon le présentateur, une riche expérience relativement simple qui pourrait être intéressante pour l'Afrique si un certain nombre de conditions sont remplies. Il s'agit : du renforcement des institutions financières existantes et des capacités des fournisseurs d'équipement, de la mise en place sur le moyen terme de systèmes de refinancement pour rendre l'opération attrayante, et le développement de projets tests.

La présentation sur les cours itinérants pour la formation d'agents d'encadrement et de développement dans l'utilisation d'un outil d'aide à la sélection de pompes et de moteurs pour les producteurs a été basée sur les expériences au Mali, au Burkina Faso et au Niger. Une base de données regroupant les types de pompes disponibles dans le marché local et leurs caractéristiques techniques favorisera davantage la réussite et l'utilité de cet outil.

La présentation sur le Burkina et le Niger a porté surtout sur une étude comparative sur le financement, la gestion des périmètres irrigués, les coûts et les indicateurs de performance. Il ressort de cette étude que les rendements obtenus au Burkina sont plus élevés et plus réguliers qu'au Niger, qu'il existe un réel besoin de renforcement des capacités des producteurs de même qu'un besoin de réduire la complexité de l'accès aux institutions financières, et une nécessité de clarifier les problèmes de tenure foncière.

La présentation de la BAD, s'appuyant sur des exemples au Ghana et en Gambie, a permis de noter que les crédits alloués au secteur de l'agriculture sont le plus souvent orientés vers les sous-secteurs tels que : l'irrigation, le développement rural, les infrastructures rurales, et l'approvisionnement en eau potable.

Les discussions ont permis de noter que la notion de secteur privé devrait être élargie aux petits producteurs mais aussi que le financement du sous-secteur devrait commencer par s'appuyer sur la mobilisation de l'épargne et reconnaître que les producteurs ont une large gamme de besoins prioritaires à satisfaire.

Panel sur l'irrigation privée, la sécurité alimentaire et les revenus a l'exportation

Apres une brève introduction du sujet par le président M. I. K. Musa, les panélistes représentant la FAO, l'IWMI, l'ARID, les Producteurs et la BAD ont à tour de rôle pris la parole pour donner leur point de vue sur le sujet. Selon le premier orateur M. Gyamfi, représentant les producteurs privés, le service public doit faciliter l'expansion de l'irrigation dans le cadre de ses politiques de développement. Il doit exister, de part et d'autre, des concertations voire des concessions pour réduire le coût élevé des intrants, et des mécanismes pour rendre l'accès à l'eau et à la terre plus facile pour les producteurs qui décident d'investir dans le secteur. La sécurité alimentaire, selon M. Gyamfi, devra s'appuyer sur une production agricole sur toute l'année ce qui par conséquent nécessite la réalisation d'un nombre plus important de systèmes d'irrigation.

Pour augmenter les revenus à l'exportation on a besoin de plus de stratégies clairement définies et des mesures incitatives. Pour cela les secteurs privé et le public doivent aller ensemble. Chacun doit avoir l'obligation de respecter les programmes arrêtés et une attention particulière devra être accordée à la conformité avec les normes de qualité qui représentent une question essentielle si on veut accéder au marché extérieur.

Selon M. Merrey, le programme en cours de discussion entre partenaires, Banque mondiale, FAO, BAD, et IWMI pour dégager une stratégie de développement de l'irrigation en Afrique représente un contexte favorable pour la prise en compte de toutes ces préoccupations. Cependant fait-il remarquer, il existe cinq points fondamentaux qui méritent une attention particulière.

1. Les ressources en eau disponibles aujourd'hui sont certainement très limitées par rapport aux estimations fournies, surtout si on tient compte des autres demandes et usages. Ceci rend le choix pour la mise place des grands périmètres très difficile à accepter.
2. L'expansion de l'irrigation en Asie s'est déroulée à une période où la demande en produits céréaliers était élevée et les prix suffisamment rémunérateurs ; ce qui n'est plus tout à fait le cas aujourd'hui.
3. Il existe une réelle opportunité pour le développement de la petite irrigation, surtout de la maîtrise de l'eau à la petite échelle en Afrique subsaharienne.
4. Le développement du secteur de l'irrigation peut être mieux assuré par le secteur privé à cause de ses obligations de résultats.
5. Les autorités et les bailleurs doivent créer des conditions attractives pour faciliter l'insertion du secteur privé.

Selon Mme Tempelman de la FAO, nous devons nous poser une question essentielle sur comment procéder à l'expansion de l'irrigation privée tout en respectant l'équité ? Selon elle, nous devons pour cela analyser trois aspects relatifs à la sécurité alimentaire. Il s'agit de:

1. l'allocation des ressources
2. l'impact potentiel de l'irrigation privée
3. l'impact sur l'exploitation familiale

L'analyse de ces trois éléments montre que l'expansion de l'irrigation privée pourrait avoir des conséquences significatives sur l'augmentation des coûts d'exploitation des ressources en eau, et également sur le foncier. Les conséquences pour l'exploitation familiales sont réelles. En effet il est fort probable que, dans les choix et décisions à prendre, l'option de privilégier des choix financièrement plus intéressants prime sur la nécessité d'assurer la sécurité alimentaire du foyer. Les femmes producteurs risquent une plus grande marginalisation car bien qu'elles contribuent de manière déterminante à la production vivrière pour les besoins de sécurité alimentaire du foyer, elles ont des difficultés quant à l'accès à la terre, au crédit etc. En outre elles disposent de moins de contrôle sur la main d'œuvre familiale, sur l'allocation des ressources et surtout sur la répartition des profits et bénéfices générés par la production agricole.

Pour M. Diallo de l'ARID, trois idées sont ici dégagées:

1. La nécessité de trouver les voies et moyens qui permettent de réduire de manière substantielle, les coûts des systèmes d'irrigation et les ramener à des niveaux plus réels, donc plus acceptables. Pour cela, il faut nécessairement procéder à une meilleure prise en compte des facteurs négatifs telle que la corruption et lutter efficacement contre celle-ci. Ceci peut se faire à travers des politiques et stratégies basées sur la bonne gouvernance.
2. L'accès des petits producteurs aux technologies simples et peu coûteuses pour mieux lutter contre la pauvreté et l'exclusion.
3. Il faudra, dans le cadre des politiques et stratégies sur la gestion intégrée des ressources en eau, mettre en place des cadres de concertation qui impliquent les petits producteurs qui représentent, le plus souvent, les segments les plus vulnérables.

Selon le représentant de la BAD, qui a parlé de l'expérience de celle-ci en matière de financement de l'irrigation, leur intervention dans le financement de périmètres sucriers a donné de bons résultats. Les instruments financiers de la BAD sont basés sur des prêts à long terme. Ces prêts sont faits à travers des banques locales ; mais pour les gros projets nécessitant de lourds financements, les prêts sont faits à partir la maison mère à Abidjan. Toutes les études classiques de faisabilité et de rentabilité de projets sont nécessairement conduites avant l’octroi de tout accord de crédit. Les études d’impact des projets d’irrigation sur l’environnement représentent également aujourd’hui un préalable pour tout financement de projet de développement.

Le sommaire des discussions et débats entre panélistes et participants au séminaire a permis de dégager un certain nombre de points et de remarques qui sont:

- Il existe une situation favorable pour le développement de l’irrigation surtout de la petite irrigation dans beaucoup d’endroits en Afrique;
- Les ressources en eau sont limitées et qu’un accent doit être mis sur la collecte des eaux de ruissellement et sur leur utilisation pour l’irrigation;
- La situation actuelle est plus favorable au développement de la petite irrigation, à la maîtrise de l’eau à la petite échelle, à l’introduction de la mico-irrigation et à l’utilisation des ressources disponibles dans les zones humides;
- Les autorités politiques doivent investir dans la réalisation d’infrastructures de base (routes, electrification, etc.) indispensables pour attirer les privés et rendre économiquement rentable l’irrigation;
- Nous devons, quelque soit l’activité à mener, tenir compte de la question genre et une meilleure équité;
- Il est important de définir des stratégies efficaces pour atteindre de manière durable la sécurité alimentaire et la réduction de la pauvreté.

Annex A
Programme of the workshop

Day 1: 22 October 2001

08.30 Registration of participants

09.30 Opening ceremony

Major (retired) Courage Quashigah, Minister of Agriculture

Mr. Bamidele F. Dada, FAO Representative for West Africa

Dr. Gesa Wesseler, Project Manager, CTA

Dr. Douglas Merrey, Director, IWMI Regional Office for Africa

10.30 Break

10.45 Theme 1: Small-scale, informal irrigation systems

Keynote paper

Moïse Sonou: *Irrigation trends and prospects in sub-Saharan Africa*

Presentations:

S Bangoura: *Private irrigation development in support of food security in West Africa*

Ringson J. Chitsiko (for Kennedy Mudima): *Socio-economic impact of smallholder irrigation development in Zimbabwe: A case study of five successful irrigation schemes*

François Gadelle: *Development of small-scale private irrigation in West Africa: Lessons drawn from World Bank financed projects*

N. H. van Leeuwen: *Affordable small-scale drip irrigation in Africa: Potential role of the private sector*

Discussions

13.00 Lunch

14.15 Theme 1 (continued)

Presentations:

Boubacar Barry: *Development of urban and peri-urban agriculture in West Africa*

Barbara van Koppen: *Gender analysis for improved irrigation performance*

Felicity Chancellor: *Women irrigators and operation and maintenance of small-scale smallholder schemes in Africa*

15.30 Break

15.45 Theme 2: Irrigation management transfer

Keynote paper

Douglas Merrey: *Can irrigation management transfer revitalise African agriculture? A review of African and international experiences*

Presentations:

Ingrid Hermiteau: *Assisting sustainable irrigation management transfer: Case studies of good practices in West Africa*

Ibrahima Dia: *Private irrigation in the Senegal River Delta: Evolution and prospects*

Charity Kabutha: *From government to farmer-managed smallholder rice schemes: The unresolved case of the Mwea Irrigation Scheme in Kenya*

	Douglas Merrey (for M. Samad): *Impact of irrigation management transfer on the performance of irrigation systems: A review of selected experiences from Asia and Latin America*
	Discussion
18.30	Reception for participants

Day 2: 23 October 2001

08.30	Theme 3: Commercial irrigated farming
	Keynote paper
	A. A. Gyamfi: *Commercial irrigation farming*
	Presentations:
	Sampson Agodzo: *A case study of the Volta River Estates Limited (VREL), Ghana*
	Douglas Merrey (for Tushaar Shah): *Micro-irrigation and the poor: A marketing challenge in smallholder irrigation development*
10.30	Break
	Ade Freeman: *Commercialisation of smallholder irrigation: The case of horticultural crops in semi-arid areas of eastern Kenya*
	Patrice Beaujault: *Marketing of appropriate irrigation technologies to capitalise on favourable conditions for irrigated horticulture in West Africa*
	Discussion
	Lunch
13.30	Theme 4: Enabling environment, emergence of new operators, and financing of irrigation
	Keynote paper
	Charles Abernethy: *Enabling environments, financing mechanisms and equitable access to irrigation*
	Presentations:
	S. S. Abubakar: *Individual pump ownership and associated service providers in fadama irrigation in northern Nigeria*
	Sjon van 't Hof: *Roving course on pump selection in Burkina Faso, Mali and Niger: Lessons learned*
	Chet Aeschliman: *Reflections on irrigation finance in Africa*
	Frank Höllinger: *Leasing as an alternative for financing agricultural equipment: Initial experiences from Bolivia*
15.30	Break
	Hilmy Sally: *Institutional and financial considerations for self-managed irrigated agriculture in West Africa: Examples from Burkina Faso and Niger*
	Harouna Dosso: *The role of the African Development Bank Group in financing irrigated agriculture: On-going examples in Gambia and Ghana*
	Nick Shirra: *Encouraging capacity-building for private sector irrigation-technology service provision in Uganda*

Day 3: 24 October 2001

08.30	Panel discussion on “Sustainable private irrigation, food security and export earnings”
10.30	Break
11.00	Working group discussions Group 1: Small-scale irrigation systems for food security and poverty reduction in Africa Group 2: Irrigation systems transfer within the context of state withdrawal and decentralisation in Africa Group 3: Promotion and development of private and commercial irrigation systems in Africa

Day 4: 25 October 2001

08.30	Continuation of working group discussions
10.30	Break
11.00	Presentation of working group reports
12.30	Lunch
16.00	Closing ceremony

Day 5: 26 October 2001

Field visit to Volta River Estates and to Akosombo Dam

Annex B: List of participants

Name	Position	Organisation	Address	E-mail
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Reflexions on Irrigation Finance in Africa

A Resource Document Presented to an FAO-Sponsored Seminar on Promoting Private Sector Participation in Irrigation
October 1-5, 2001
Accra, Ghana

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October 2001

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GLOSSARY

ACCION	A leading microfinance development organisation working in North and South America
ACODEP	An irrigation project in Mali jointly executed by UNDP and ILO
ADB	Ghana's Agricultural Development Bank or agricultural development banks in general
AGSM	The Marketing and Rural Finance Service of the FAO's Agricultural Support Division
BCEAO	Banque Centrale des États de l'Afrique de l'Ouest
BNDA	Mali's Banque Nationale de Développement Agricole
CBO	Community-Based Organisation
CNCAS	Caisse Nationale de Crédit Agricole du Sénégal
CPI	Consumer Price Index
DFS	Decentralized Financial System
EXTE	Extended (Customisable) Run-Time Edition of the FAO/GTZ Microbanking System
FAO	Food and Agriculture Organisation of the United Nations
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GMBH
IDE	International Development Enterprises, a micro-irrigation development company
ILO	International Labour Organisation of the United Nations
IO	International Organisation
MFI	Microfinance Institution
MicroBanker	The FAO's leading Microbanking System software system used worldwide by rural finance and microfinance institutions
NGO	Non-Governmental Organisation
Nyesigiso	Mali's largest network of (mutual) DFSs
PDIAIM	Programme de Développement Integré de l' Agriculture Irriguée en Mauritanie
PDPI	Projet de Développement des Périmètres Irrigués, an irrigation project in Senegal
PEARLS	WOCCU's State-of-the-Art Computerized Credit Union Monitoring System based on combined performance in the areas of ***P***rotection, ***E***arnings, ***A***sset **Q**uality, ***R***ates of Growth, ***L***iquidity, and Financial ***S***tructure)
PHL	**P**ost-**H**arvest **L**osses due to insect infestations, moisture, theft, etc.
PIYELI	A Grameen Bank-like microfinance institution in Mali
PSAN	Programme de Sécurité Alimentaire et Nutritionnel, a project involving irrigation in Burkina Faso
RAF	The FAO's Regional Office for Africa located in Accra, Ghana
RFI	Rural Financial Institution
RFS	Rural Financial Systems
ROSCA	Rotating Savings and Credit Associations
SPFS	The FAO's Special Programme for Food Security
SRTE	Standard Run-Time Edition of the FAO/GTZ Microbanking System
UEMOA	Union Economique et Monétaire Ouest-Africaine
UNCDF	United Nations Capital Development Fund
UNICEF	United Nations Children's Fund
URCPB	Union Régionale des Caisses Populaires de Burkina Faso
USAID	United States Agency for International Development
VIP	Village Irrigation Perimeter
WFP	World Food Programme of the United Nations
WOCCU	World Council of Credit Unions, Inc.

Reflexions on Irrigation Finance[1]

EXECUTIVE SUMMARY

The purpose of this document is to provide guidance to those involved in designing projects focusing on or involving the financing of irrigation equipment and structures. The first half of the paper (Chapters 1 through 4) discusses the evolution of rural finance in general terms, while the last half (Chapters 6 through 9) focuses on the special case of irrigation finance in Africa. Chapter 5 describes the rapidly-evolving African rural financial marketplace. Chapter 8 ends with a listing of the "Ten Commandments" of irrigation finance, a summary of this paper's main points. Chapter 9 presents illustrative product descriptions for proposed typical micro-irrigation loans. Attachments include (1) a bibliography; (2) a listing of known manufacturers and experts on micro-irrigation; (3) an illustrative power pump rental agreement developed in Mali and (4) a list of inexpensive (mostly non-European) motor pumps prepared by the HIPPO Foundation of the Netherlands. While those readers not interested in the theoretical discussion of the history and evolution of thinking on rural finance in Africa may skip chapters 1-5 and jump right into the discussion of irrigation finance starting in Chapter 6, a thorough reading of the entire document is highly recommended, since Chapters 1 through 5 provide the context and rationale for what is proposed in the final chapters.

For the purposes of this paper, the term "Irrigation Finance" includes all methods and techniques used to finance the purchase, installation or operation of various forms of irrigation, including self-financing by farmers themselves; financing of investment in irrigation equipment or physical infrastructure; seasonal or "campaign" loans for inputs and operating costs; input and equipment supply chains; and leasing. Each of these is discussed.

The specific discussion of irrigation finance focuses primarily on small-scale micro-irrigation for two reasons: (1) most previous large-scale irrigation perimeter development projects in Africa have failed miserably for lack of good management and because of the use of inappropriate, too complex or overly-expensive bilaterally-funded equipment and (2) the author believes that less-complicated, inexpensive and locally-supportable technologies such as bucket or drum-based "drip kits" with drag-hose systems and sprinkling, supported by treadle and rope pumps for larger plots, are much more likely to last beyond the life of the project than the complex, radically-different (to participants new to the "machine culture") mechanized agriculture typically introduced into large perimeters. In many cases, local manufacturers can be identified to make and market these inexpensive but simple and effective micro-irrigation tools, whereas the expensive, imported machinery typically used in large perimeters is rarely mastered by those using it, and will almost certainly never be produced locally.

This paper traces the evolution of "best practices" in the field of rural finance. The "old paradigm" followed by most development agencies in the '60s, '70s and '80s was the (now discredited) top-down "directed agricultural credit", "one size fits all" approach whereby expensive power pumps, mostly originating in Europe, were typically donated and used in large irrigation perimeters, typically for rice production. These technologies were clearly inappropriate for Africa, since they were (1) heavily-subidized, unprofitable, and hence unsustainable over the long haul; (2) they were overly-complex for farmers as yet unused to a "machine culture." Most such credit programmes were poorly managed, often by the project itself (instead of by financial professionals) such that loan collection was not emphasized. To "encourage" farmers, in addition to equipment subsidies, low interest rates were charged on loans such that lenders could not come close to covering their costs, with the ultimate result that most credit programmes failed. Lending capital was donated from abroad, most of the development community (erroneously) believing that poor people cannot and do not save. This heavily-subsidized approach also contributed to the development of a "hand-out mentality" in Africa, so that instead of running their farms as businesses, farmers came to expect any new technology to be given to them free of charge. This was driven home to the author of this paper when, while he was working at FUCEC-TOGO in the mid-1980s, people would come and hopefully ask "whether this is the place where they grant the loans that you don't have to repay."

[1] The author is greatly indebted to and has borrowed liberally from the profound thinking on irrigation finance by Mr. Marc LeBrun, as described in his paper "Financement de l'Irrigation", presented in December 1998 at the FAO/IPRTRID "workshop on the transfer of irrigation technology in support of food security." Many thanks to Mr. LeBrun. The author has attempted to marry his own broad microfinance experience with Mr. LeBrun's knowledge of irrigation finance. The author is equally indebted to and makes considerable use of the "Agricultural Finance Revisited" series of booklets jointly produced starting in 1998 by GTZ and FAO's AGSM Service.

In recent years, a new paradigm of rural finance has emerged and gained broad acceptance among donor agencies and the development community in general, to the extent that project design officers still proposing the failed approach embodied by the "old paradigm" of rural finance will almost certainly be asked to take their proposals back to the drawing boards. The "new paradigm" of rural finance focuses on (1) letting local financial institution professionals manage the loan portfolio; (2) using market (full cost) interest rates; (3) recognizing that farmers have financial needs other than seasonal farm loans; (4) minimization and rapid phase-out of subsidies to lenders and a refocusing of project efforts on market creation and institutional development (focusing on micro-irrigation equipment manufacturers, input suppliers and developing markets for the increased production); (5) greater reliance on client savings as a source of lending capital, thus automatically making the lender much more sustainable in the long run; (6) an increasing reliance on alternative forms of collateral, principally the "joint and several" liability of small, affinity-based solidarity groups; and (7) making lending decisions on the basis of repayment capacity and likelihood.

The paper also discusses in some detail the unique features and special needs of agricultural production and finance, and proposes recommendations on overcoming related problems such as:

- Government interference in the politically sensitive area of agriculture
- The high financial transaction costs of attending dispersed and small farm households;
- The seasonality and the importance of opportune timing of on-farm finance for cultivation practices, input application, harvesting (and related output marketing), the heterogeneity in farmers' lending needs (seasonal and term lending) and the relative long duration of agricultural lending contracts;
- The dependence on sustainable natural resources management and the relative low profitability of on-farm investments;
- The various weather and other production risks, together with marketing risks related to agriculture, that require appropriate risk management techniques, both for producers and financial intermediaries;
- The limited availability of conventional bank collateral that farm households can offer, that highlights the need to increase the security of existing loan collateral or develop appropriate collateral substitutes;
- The reality that farm households are confronted with emergency needs and that their loan repayment capacity is highly dependent on consumption and social security contingencies;
- The need for adequate training of both the lenders' staff and farmer clients.

The paper next chronicles several fundamental changes in the African financial marketplace which have occurred over the past two decades. These include (1) the failure and liquidation of all but a handful of the once-powerful national agricultural development banks (those that survived, like Ghana's ADB and Mali's BNDA, adopted the "new paradigm" before it was too late); (2) the rise of tens of thousands of innovative new types of local rural and micro-finance institutions (credit unions, village banks, Grameen Bank clones, etc., now generically referred to as "Decentralized Financial Systems", or DFSs); and (3) a growing turnaround in thinking and a realization by some commercial banks that rural finance can be profitable for them, too, particularly through wholesaling partnerships with networks of DFS loan retailers. While not all, or even a majority, of commercial banks have made this discovery, there is clearly a tendency in this direction.

Next, the different types of irrigation finance are discussed. These include borrowing to pay for the original feasibility study; loans to finance the up-front investment in equipment and structures; seasonal operating cost loans; leasing; and self-financing. With respect to the latter, the argument is advanced that since micro-irrigation technologies are now so inexpensive, credit is not even necessary in the vast majority of cases. It may accordingly be more prudent in project design to focus limited resources on the development of manufacturers, supply chains, marketing and promotional efforts, and creating markets for increased production, rather than on credit schemes so frequently fraught with heartaches.

The paper next discusses the typical difficulties faced in irrigation finance, which include:

Problems Linked to Faulty Initial Project Designs:

1. Busy project design officers give only lip service to the participative process;
2. Excessively costly and complex technical solutions more appropriate for Europe than Africa
3. Lack of a broad market creation approach that recognizes the need to develop supply chains, carry out extensive marketing and promotion, and develop markets for the increased produce that the project will hopefully produce
4. "One size fits all" project designs, where beneficiaries (almost never referred to as "clients") all receive exactly the same technological package

5. Inadequate emphasis on building effective Management Information Systems (M.I.S.), despite the existence in-house of the FAO's own powerful Microbanking System banking software

Difficulties Linked to the Beneficiaries Themselves:

1. Farmers' pre-existing indebtedness which, in the African cultural context, often takes precedence over "formal" or "semi-formal" sector credit when they must choose which loans to repay first.
2. Farmers' under-capitalisaton renders them very vulnerable to the slightest unexpected event
3. A "hand-out" mentality and inability or refusal to depreciate fixed assets, thus discouraging development of farms as enterprises
4. Illiteracy
5. High rates of post-harvest losses

Difficulties Caused by the Lending Institution

1. Long distances from lending institution branches and borrowers, although with the advent of DFSs, this is decreasing
2. Insufficient capital to meet effective credit demand
3. An increasing cacophony of competing rural financial institutions, with heavily-subsidizing RFIs unfairly crowding out efficient, market rate-based RFIs

Difficulties Caused by Government:

1. An inability to assure an adequate legal, regulatory and supervisory framework for DFSs, especially effective enforcement of loan contracts and periodic DFS examinations. Also, governments all too often take actions inimical to DFS growth and development, such as mass forgiveness of debts during political campaigns
2. Counterproductive usury laws that effectively ***reduce*** lending to farmers, instead of "protecting" them.
3. Political interference in the loan-granting process and efforts to "encourage" certain sectors with subsidies and to force financial institutions to lend to these sectors at uneconomical interest rates.
4. Insufficient development of markets, food processing and transportation systems (especially rural feeder roads) needed to market increased production
5. Deficits that provoke high inflation and interest rates

Difficulties Caused by Donors:

1. Minimum loan size to justify donor investment creates a built-in bias against "thinking small" (i.e., donors have a preference for the expensive, motorized approach to irrigation that only benefits a few, instead of the micro-irrigation approach which can potentially improve the lives of millions of farmers.
2. Small-scale irrigation is essentially a dispersed, local activity where donor funding tends to support centralized, large-scale investments or investments targeted at large institutions (e.g., national research and extension systems) capable of absorbing large tranches of funds.
3. Traditionally, small-scale irrigation has depended on NGOs, CBOs or small businesses to jumpstart the process with training, demonstrations, loans, and mass communication campaigns. Donors have traditionally focused on public sector institutions, instead of on the private sector, despite the fact that the latter are much more likely to "take off" and become sustainable.

After this lengthy discussion of the difficulties with irrigation finance and how they might be overcome, a number of "elements of reflexion" and lessons learned are considered, including irrigation project design issues, credit supply and demand, institutional development, and policy considerations. This discussion ends with a presentation of a summary of the various recommendations made throughout the document. That discussion is reproduced here in its entirety:

In most African countries, there is sufficient liquidity within the banking and DFS sectors to finance all foreseeable irrigation needs. The problem is not one of lack of financial resources, but rather identifying a sound way of accessing and using them such that they inspire the confidence of those responsible for their management. This paper has attempted to provide some guidance on how to create that confidence through the conception of sounder irrigation projects. If you retain nothing else from this presentation, please try to abide by as many of the following "Ten Commandments" of irrigation finance as possible:

1. Right at the project identification stage, make sure that you have correctly identified the farmers' real principal problems before attempting to design the most appropriate solution. While this sounds obvious, in reality, a great many problem statements are incorrect or inappropriate, in great part because the participative process has been short-circuited. Make a concerted effort to determine whether the main

problem is one of "low production and/or yields", or whether it is rather the huge post-harvest losses (PHL). If PHL is large, consider an initial project or phase that specifically addresses PHL. This will so dramatically improve farm profitability that there's a good chance farmers will be able to self-finance most, if not all, of the second phase (micro-irrigation) of the project or of follow-on projects. This would be particularly true if your project design is based on ***leasing*** (straight or lease-purchase) irrigation equipment, as opposed to outright purchase. For more information on proven solutions for PHL, please check out the FAO publications "Warehousing and Inventory Credit" and the "Manual on the Establishment, Operation and Management of Cereal Banks." These books are downloadable for free from the FAO and are available in booklet form for a nominal fee. Corollary No. 1 is that project design officers should not short-circuit the participative process; those most affected by the design must be intimately involved in it from the outset. Corollary No. 2 is to always abide by the K.I.S.S. (Keep It Simple, Stupid!) principal during project design, and adopt the ***least*** complex (and probably least expensive) technical solution consistent with accomplishing project objectives.

2. Recognize that credit is not always, or even in a majority of cases, the most appropriate solution. If a number of inexpensive, locally-manufactured treadle pumps will do the same job as an expensive European motor pump, selling them outright for cash is definitely better and will save all concerned many heartaches resulting later on from credit programmes, particularly from the high defaults typically experienced when using expensive European irrigation equipment. Similarly, during project design, give serious consideration and allocate time to identifying possible local manufacturers and/or retailers of required irrigation equipment. Maybe the "poorest of the poor" will not benefit directly from your project, but production and profitability will almost certainly improve considerably, and the very poor will still probably at least benefit from the need for additional labour to run the more mechanized and/or larger farms.
3. If, after the aforegoing precautions, you still opt for a credit programme or component, make sure that a sufficient quantity of long-term funds is available to finance the projected volume of irrigation lending**.** Don't cavalierly leave the details of this component as something whose details "will be worked out by project staff during implementation." This is an essential component, and you absolutely must be reasonably sure that the funds will be available; because their eventual non-availability would jeopardize your entire project. Corollary 1 is that experience so far with loan guarantees has tended to encourage poor performance by lenders, since the latter will recover their capital whether they perform well or not, and hence you should avoid loan guarantee schemes, if at all possible. Corollary 2 is that there is currently insufficient information to support leasing of irrigation equipment as a valid approach, although efforts in this direction in Mali and elsewhere need to be closely monitored to identify sound new approaches.
4. If, despite the advice given in points 1 through 3 above, you still decide to propose the use of complex, expensive irrigation equipment installations, then use a more rational approach to procurement than has often been the case in the past. First, do yourself a big favour and make absolutely sure that there will be sufficient spare (backup) machines, spare parts, and competent, readily-available repairmen when pumps, as they certainly will, break down. Secondly, make sure you use the most appropriate and cost-effective equipment available to carry out project activities, and not necessarily those preferred by donors, especially in bilateral programmes. Oftentimes, it will be better to introduce an inexpensive technology that is only slightly different from previous practices. Experience shows that radical changes (e.g., from the hoe to tractors or animal traction, and from hand sprinkling to motor pumps) very frequently fail. Let's all do a better job of convincing bilateral donors that if we're really serious about development, purchasing unnecessarily expensive irrigation equipment in the donor's own country is ***not*** a sustainable approach. Where surface water and local water tables permit, always opt for micro-irrigation technology, since it potentially can positively affect millions of farmers, not just a few on a big development perimeter.
5. If, after all the above warnings and precautions, you still decide to include irrigation credit in your proposed project, try to rely more heavily on the increasingly ubiquitous networks of Decentralized Financial Systems, as opposed to the formal banking sector (since, however, a number of commercial banks are beginning to be interested in rural finance, at least on a wholesale basis, to proven micro-lenders, don't automatically assume any more that banks are not interested in micro-credit) or development banks, in those few countries where the latter still exist. DFSs are likely located in much closer proximity to your targeted farmers, and are better able to tailor loans to fit their needs, as well as to monitor the loan effectively. Focus more on the DFSs' institutional development (what we have called in this paper, "accompanying measures") and less on the provision of lines of credit. Project designers do a big disservice to partner DFSs if they overwhelm them with large sums of external "cold" funds relative to their own, locally-mobilised "hot" capital (i.e., savings). Also, don't let the irrigation loan portfolio overly dominate the DFSs' other loan portfolio segments. To do so would create too much covariant risk. If, despite all the advice provided in this document, you opt for an expensive, imported, power pump-based

intensive agriculture, it would be better to work with a bank than to drown local DFSs in foreign money. Too much easy money has already been the ruin of thousands of RFIs around the world.

6. If, in the end, it is definitely determined credit is essential to your project, don't spoil local financial markets by building a cheap credit "window" into the project organisation itself using subsidized (less than market) interest rates. Instead, let professionals in successful local RFIs, DFSs and banks manage the entire lending process according to their own policies and procedures, which have stood the test of time. Never try to "force" the lender to grant loans that the applicant is not qualified for according to the lender's established criteria. If you decide to "do it yourself" within the project, recognize the high probability of failure and, development-wise, a ***100% certainty*** that you will fail to leave an institution to carry on when your project ends.
7. Farmers must be called upon to self-fund increasing proportions of their irrigation projects, i.e., they must learn to properly ***depreciate*** their fixed assets and provide for their eventual replacement, instead of seeking a new loan to finance a replacement pump every four or five years. Remember that a development project may help farmers finance their ***first*** pump, but it's up to the borrower to finance its replacement when the first one must be retired. A corollary here is that the term of the loan (or lease) should correspond to the expected useful life ***in Africa***, not in the equipment's country of origin.
8. Lenders must do a better job of learning from each other and continue to adapt their products to the specific needs of farmers involved in irrigation. Encourage SFDs you work with to participate fully in the MFI networks that now exist in nearly all African countries. Build in study tours abroad for key personnel to successful irrigation finance programmes. At the client level, try to integrate twinning programmes whereby experienced micro-irrigation clients are associated with those just joining the programme; this has been proven an effective way to spread micro-irrigation technology and techniques.
9. Don't just focus on using irrigation technology to increase production. Re-orient your whole approach to irrigation development to one of ***market creation*** and ***institutional development***. That is, recognize and build in the upstream manufacturing and distribution of your micro-irrigation equipment, the inputs (seeds, seedlings, fertilizers, pesticides, small tools, etc.) supply chain, the necessary mass marketing required to make the product a household name, as well as the forward linkages (processing, storage and market outlets). It doesn't suffice to double or triple production; for farmers to truly benefit, remember that the product has to be sold without glutting the market. The latter must be addressed ***during project design***. If you leave it for implementation and markets are ***not*** found, then time, effort and money will have been wasted.
10. A good M.I.S. is ***essential*** to any credit programme. Accordingly, project designers should build into the budget sufficient numbers of licenses for a capable M.I.S. such as Microbanker for Windows (MBWin), sufficient computer equipment, and sufficient training for the expected number of users. If, despite all the accumulated evidence and the advice presented in these ten commandments, you still decide to go it alone and have project staff, instead of DFSs, manage an irrigation credit programme, the MIS commandment is doubly true. In fact, having a good M.I.S. will likely be your ***only*** slight hope of success.

A number of current projects are researching these issues in search of effective solutions. Let us continue to learn from these and share from each other's experiences through networking.

The last chapter of the paper describes a series of standard loan products which could be adapted to the financing of three typical micro-irrigation technologies.

1.0 INTRODUCTION

In this new millennium, the world is faced with an exponential escalation of two mutually reinforcing world problems: increasing water scarcity and stubborn rural poverty. Despite the impressive gains in global food production over the last half century, an estimated 790 million people remain hungry.[2] The "crop per drop" produced by irrigation must clearly increase. But improving irrigation productivity on large farms alone will not solve the continuing problems of rural poverty, which are getting worse instead of better in sub-Saharan Africa. Increasing the agricultural productivity and income of the majority of farmers in developing countries who cultivate less than two hectares is a relatively untapped opportunity for finding practical solutions to rural poverty. Opening smallholder access to affordable small plot irrigation is a critical first step to wealth creation for the rural poor. New affordable irrigation technologies like treadle pumps and low-cost drip and sprinkler systems not only open the door to a path out of poverty; they are also a path to saving water, and increasing productivity through micro-irrigation technologies on small farms.

Accordingly, agricultural finance, in particular one of its oftentimes most costly components, irrigation, is at a crossroads. It currently suffers from a dichotomy in purpose and direction, in view of increasing concerns about the food situation as a result of population growth and accelerated food demand. The need for substantial new investment in agriculture is clear.[3] However, on the other hand, the number of donor-supported agricultural credit programmes is declining and there is little evidence in many countries that government or commercial financial intermediaries are compensating for the reduction in supply of financing to agricultural production, processing, and marketing.

Dynamic and conflicting changes appear to be operating in curtailing the current supply of agricultural finance, at the same time when the financial requirements of agriculture are increasing. An evolving broader view of rural finance within most bilateral and multilateral development agencies has largely replaced the traditional directed agricultural credit approach, with greater emphasis currently on meeting rural non-farm credit demand. Mobilisation of local savings, formerly seen as inconsequential, is now generally seen as an important source of funds for lending, and a necessary ingredient for sustainability, but much progress remains to be made in that respect. Applying market (full cost-covering) interest rates is now also seen as an essential prerequisite in the efforts to achieve operational efficiency and financial viability of rural financial institutions.

Positive changes in the terms of trade for agriculture as a result of more favourable exchange rates, less punitive import and export taxes, lifting of price controls, etc., are now beginning to create in many countries an improved market environment, that may support profitable farm operations and investments in technology, including irrigation, the subject of this paper. Freer world markets present, however, both opportunities and challenges—opportunities to access these markets and challenges of fierce competition and risks inherent in free markets. Despite these positive features, this is still just a prognosis for many countries, where much progress is still to be made.

Paradoxically, when market conditions for agriculture to expand and to contribute significantly to overall economic development are increasingly evident, and at the precise moment when local financial institutions are gradually maturing and improving their ability to more adequately service the rural population, funds available to finance agricultural investments have declined precipitously in many countries. This contradiction is in great measure the motivating force behind the drafting of these guidelines. In fact, the purpose of this document is to take stock of and evaluate previous attempts at the financing of irrigation in Africa, to learn from previous mistakes and to propose a new approach hopefully more conducive to success than past efforts that have so often failed miserably.

For the purposes of this paper, the term "Irrigation Finance" includes all methods and techniques used to finance the purchase, installation or operation of various forms of irrigation, including self-financing by farmers; financing of MT/LT irrigation investment in equipment or physical infrastructure; seasonal or "campaign" loans for inputs and operating costs; input and equipment supply chains; and leasing. Each of these is discussed.

This paper takes the point of view that irrigation and credit should both be considered as two ***components*** contributing to the achievement of a higher objective (usually increased crop production or yields) defined by

[2] Smallholder Irrigation Market Initiative: Creating New Markets via Smallholder Irrigation, World Bank, Winrock International and IDE, 2000, Executive Summary, Page ii.

[3] FAO, Report of the World Food Summit, 13-17 November 1996 (Part I).

the project. Neither component, though, is an end in itself. Their relationship must be placed within the context of an integrated whole system.

Irrigation poses a number of specific problems as regards financing, including:

a) Insufficient funds are usually available for medium to long term investment;
b) Medium to long term interest rates are typically very high, if indeed loans are at all available;
c) Difficulty obtaining the borrower's contribution/participation (a percentage, 10% to 25%, typically, of his/her proposed project);
d) Need for periodic "injections" of funds to replenish or augment the credit revolving fund;
e) Difficulties in using leasing as an option;
f) A tendency in donor-funded irrigation projects to use equipment much more expensive than is appropriate, primarily because bilateral donors insist on using equipment (e.g., European power pumps costing $5,000 or more, when a couple of $100 treadle pumps or a much cheaper Chinese or Indian power pump would have sufficed) manufactured in their own country, thus rendering financial sustainability completely unattainable. The problem is compounded by "one size fits all" technology solutions.
g) Farmers are frequently inadequately trained in the use and proper maintenance of irrigation equipment, and competent repairmen and spare parts and spare (rental) equipment may not be available, and when (as is so often the case) key equipment breaks down, it will accordingly often produce a disastrous harvest.
h) The disuse or mis-use of depreciation, or more specifically, a general lack of appreciation of its role.

At least at this point in time, there is no unique solution to any of these problems, although there is growing evidence that some solutions are in general more effective than others. This paper will discuss some of these findings and make recommendations to guide the work of those involved in developing projects where the financing of irrigation, particularly through the use of credit, is envisaged.

It is important to situate each discipline (irrigation and financing) in its own context, because neither can claim to be more important. They both have a cost, which influences the project's financial results. A frequent impediment to wider use of irrigation is frequently its heavy cost, along with the need to disburse large sums of funds early in the new project to assure that end-of-project production targets are met. Irrigation and financing have their typical weak points, including the following: As concerns irrigation: 1) purchasing bigger or vastly more expensive pumps than necessary; (2) inadequate numbers and networks of farmers involved in irrigation; 3) non-mastery of power pumps or other equipment and water management techniques; and 4) weak or non-existent maintenance and unavailability of spare parts and/or spare pumps to replace those temporarily out of order. On the financing side, one can cite, ***inter alia***: 1) difficult access to credit in many rural areas; 2) where credit ***is*** available, standard, "one size fits all", loan products are frequently inappropriate for irrigation; 3) to "encourage" farmers, interest rates on irrigation loans are set far below the cost-recovery level, thus seriously jeopardising programme sustainability; and 4) beneficiaries are frequently chosen according to criteria other than clients' likelihood and capacity of repayment. Experience shows, however, that these deficiencies can be greatly diminished through the integration into projects of accompanying measures, such as training, information, improved organisation and management, effective monitoring and evaluation, etc.

Irrigation, from the financial point of view, has the advantage of reducing agricultural risk, i.e., the results of insufficient rainfall. On the other hand, irrigation often has very high costs that can easily double (or more) the total cost of production over that of farms ***not*** using irrigation. The cost of irrigation is very high, even when concessionary interest rates are involved. The cost of even a modest irrigation development project involving just a few hundred hectares can easily run into millions of dollars. Some would say that "that's just the nature of the beast," but this writer would argue that such proponents have not learned the lessons of the last 50 years' experience with irrigation in Africa. Most large, expensive irrigation projects have failed for reasons discussed in detail in Chapter 7. These many failures should provoke those involved in designing development projects requiring the introduction or rehabilitation of irrigation systems to think more seriously about lower-cost, less complex alternatives and approaches. Some of these newly emerging options, particularly the growing availability of low-cost treadle pumps, rope pumps, drip systems and sprinklers, will be discussed in this paper.

2.0 THE CHALLENGE OF AGRICULTURAL LENDING

Agricultural lenders face distinct challenges that are related to the specific nature of farm production. In this chapter, some recurring issues in agricultural finance are examined. Before jumping into a specific treatment of irrigation finance, let us consider some of the major factors that affect the design of agricultural lending products in general.

In the first part of the chapter, a summary is given of the past agricultural credit policies including the shift from supply-led and directed agricultural credit programmes towards rural financial market development. In the current prevailing market environment in developing countries, major attention is now given to the assessment of the effective demand for financial services. Moreover, some practices of informal financial arrangements are discussed. The second part of the chapter outlines the unique features of agricultural lending, in particular how rural financial markets differ from urban ones. Major attention is given to an assessment of the specific cost and risk barriers that formal lenders face in agricultural lending.

2.1 RURAL FINANCIAL MARKETS

2.1.1 From Directed Agricultural Credit to Rural Finance

Until the early 1980s, agricultural planners were primarily concerned with the need to increase food crop production. The adoption of the new green revolution technologies was relatively costly, and small farmers were perceived as being too poor to save and to self-finance the required investments in additional farm inputs. As a result, vast amounts of financial resources from governments and donors were poured into agricultural development banks and agricultural credit projects. These programmes were supposed to serve as conduits for the provision of subsidized credit to small farmers, often for specific production purposes.

The provision of subsidized and easily accessible credit constituted a central theme of the agricultural development strategies in the 1970s and 1980s. It was argued that enhanced access to credit would accelerate technological change, stimulate national agricultural production through increased farm output and improve rural income distribution. However, this approach failed to produce the desired results. While the reasons for the failure of these policies were manifold, as general conclusions the following explanations can be given.

Many agricultural development banks were created for political purposes and were not meant to operate as viable financial institutions. As they were established to channel subsidized donor and government funds to farmers, they lacked the market discipline and incentives of commercial banks. The provision of credit depended upon political decisions and interests. Moreover, the irregular availability of loan funds, the setting of interest rate ceilings and the periodic write-offs of overdue loans seriously undermined the effectiveness of these agricultural development banks. It is not surprising that all but a few (Ghana’s ADB and Mali’s BNDA, for example) of the national agricultural development banks failed and were eventually liquidated.

As the performance of these banks was measured in terms of loan disbursements rather than by the actual number of small farmer-borrowers attended and recovery of outstanding loans, they were tempted to grant sizeable loans predominantly to well established larger farmers. This was reinforced by the rent-seeking behaviour of these farmers (and even influential people who weren’t even farmers!), who benefited from the subsidized interest rates that were set by government.

Many agricultural credit programmes were poorly designed and failed to fully appreciate the high costs of agricultural lending. Moreover, as agricultural development banks focused exclusively on agricultural lending, they were exposed to a high concentration of risks. This required frequent rescheduling of overdue loans, thus further undermining the loan recovery efforts and the loan repayment discipline of both bank staff and farmers.

The poor experiences with directed credit programmes in the 1970s and 1980s has led to changes in policies away from channelling supply-led agricultural credit, so that rural financial systems have evolved toward meeting the demand for diverse types of rural financial services. In fact, rural financial market development includes the provision of both farm and non-farm rural lending services as well as essential savings deposit facilities. This implies the creation of commercially viable financial institutions. These act as full-fledged financial intermediaries and compete with informal lenders.

The new policies have led to a shift away from the administration of directed credit programmes that rely on continuous government or donor subsidies. Major attention is now given to the ***performance*** of financial institutions. When it comes to lending to poorer clients, two principal performance indicators have been developed, *outreach* and *sustainability*.[4] ***Outreach*** refers to the extent in which a financial institution provides high quality financial services to a large number of small clients. It includes both a horizontal dimension of "coverage" that measures the number of clients that are served, as well as a vertical dimension of "depth" that refers to clients' income level profiles. Attempts are also made to evaluate the degree to which a financial institution meets the effective demand for financial services of the targeted clientele. The concept of outreach includes thus a quantitative and a qualitative dimension.

A major feature of ***sustainability*** is the financial self-sufficiency or the ability of the financial institution to provide durable services on a cost-covering basis without reliance on external subsidies.[5] Financial sustainability is attained when the return on equity, net of subsidies received, equals or exceeds the opportunity costs of capital.[6] This means that a financial institution must cover the costs of loanable funds, loan administration costs, and provisions for loan losses as well as costs of protection against inflation. Financial institutions are considered commercially viable when they generate profits above and beyond their total financial transaction costs and can finance the development costs that are required to provide new financial products from their retained earnings.

While financial self-sufficiency is a pre-condition to sustainability, other factors have been identified that are necessary to attain full sustainability. These are related to the organisational and the operational effectiveness of financial institutions. They include:

- the development of new financial products to respond to market opportunities;
- the provision of high quality financial services to strengthen the institution's competitiveness. This ensures client trust and loyalty;
- an effective governance and management structure that protects the institution against political interference and distortions that are induced by government and donor interests;
- the ability to access financial markets to fund loan portfolio growth and to strengthen the equity base of the financial institution.

Although the financial systems development approach is now being increasingly accepted and adopted, the debate continues on the nature and the extent of required government interventions in the rural financial sector. For instance, the essential role of governments in establishing an enabling policy environment and laying down an appropriate legal and regulatory framework is generally accepted. But there is much less consensus on the need and the extent to which governments should be involved in the direct provision of financial services in the event of serious market failures. In view of the limited available resources, direct government interventions should be exerted on the basis of operational efficiency and cost-effectiveness. A general rule is that state-owned rural financial institutions should not receive special privileges that create unfair competition.

2.1.2 Credit Demand: Rural Clients

In the increasingly generally accepted financial market and systems development approach, the users of financial services are considered ***clients*** rather than ***beneficiaries***. This is a significant evolution in thinking.

Recent research has revealed that a number of assumptions about small farm households, which formed the rationale for directed agricultural credit programmes, were wrong.

Contrary to earlier perceptions, research on rural households has shown that even small farmers save. In fact, their savings are an integral part of farm household livelihood strategies. Savings are crucial to straddle the period between two successive harvests and to meet contingency expenditures. Household savings can be used for a variety of production, investment and deferred consumption purposes. These include conserving seeds, purchasing new farm inputs, storing of crop produce for deferred consumption and/or selling off later in the season at more lucrative market prices. Cash savings are normally kept at home due to the lack of appropriate

[4] Yaron, 1992, Christen et al., 1995)
[5] Yaron's Subsidy Dependence Index is widely used to assess financial sustainability. It measures the dependency of financial institutions on subsidies. See Yaron, J., 1992, and Yaron, J., et al., 1997.
[6] Krahnen and Schmidt, 1994.

bank deposit facilities. Deposits can be mobilized also through informal arrangements such as savings groups and money collectors.

Another misconception is that rural people are unable to pay market interest rates for credit. Widespread use of informal credit suggests that, even farmers with their own savings periodically borrow from informal sources at high effective interest rates, often at annual percentage rates of from 100% to 360% or more. For instance, they prefer to sustain durable relationships with moneylenders who can provide timely (but very expensive) access to small loans. Given the risky nature of agricultural production and the incidence of contingency expenditures, farmers are anxious to have access to a range of potential sources of finance even at high cost. Farmers' ready willingness to pay 100% or more in interest to informal sources belies the previous belief that farmers cannot afford to pay the typically 30% to 50% interest rates charged by full cost-recovering rural financial institutions. Most professionals involved in rural credit in developing countries have accordingly lain to rest their lingering penchant towards "giving a break to poor farmers" by offering subsidized interest rates.

Research has shown that small farmers tend to be risk-adverse and are conservative in their decision-making.[7] They cope with risks by diversifying their household income from both farm ***and*** non-farm activities. Small farmers save in various forms, accumulate physical assets and participate in networks defined by social relations and mutual aid arrangements. An analysis of the cash flows of low-income rural households indicates that an often-complex interdependency exists between the farm and the family household. Non-farm activities may account for a large share of the farm household income in rural areas. Non-farm employment has an important function by generating earnings that are used as working capital, or savings. In the case of poorer households they are an income source for survival during "hungry seasons".[8]

Agricultural planners used to focus their attention on efforts to increase food production, as they failed to recognize the importance of non-farm income sources for small farm households. Consequently credit programmes did not consider the effects of diversified and off-farm income generating activities on the overall farm household net cash flow. Planners underestimated the capability of farmers to self-finance their returning investment requirements and to repay their loans. Frequently, "one size fits all" agricultural loan programmes gave loans to anyone in the "target" population, whether they needed it or not.

The recognition of the existence of rural savings and the need to grant loans for rural off-farm activities has highlighted the prospects for rural financial market development. Appropriate savings deposit facilities and diversified loan products are essential strategies. In fact, their provision would serve to strengthen rural financial intermediation and satisfy the effective demand for different types of financial services. Moreover, the success of rural financial institutions does not depend only on the range of services they are able to provide, but also on their competitiveness with informal lenders.

Informal financial arrangements are important in the rural economy. They have continued to flourish despite the presence of subsidized donor and government credit programmes. An analysis of their nature is essential to better understand the economic situation of farm households and their demand for financial services.

2.1.3 Credit Supply: Typology of Rural Lenders

The table below presents the types of rural lenders that can be found in African countries.

Typology of Rural Lenders
Formal lenders
• Agricultural development banks
• Rural branches of commercial banks
• Co-operative banks
• Rural banks/community banks
2. Semi-formal lenders

[7] Hazell, P, Pomareda, C. & and Valdes, A. 1986.
[8] For poor small farmers with little scope for production and income diversification, credit may be required to reduce their vulnerability to contingencies. Farmers may consider financing production innovations only after the financial requirements of the household have been met (see Hulme, D. & Mosley, P. 1996. "Finance against Poverty", Volume 1 and 2. London and New York).

Typology of Rural Lenders

- Credit unions
- Co-operatives
- Village or semi -formal community banks
- NGOs

3. Informal lenders

- Relatives and friends
- Moneylenders
- Rotating savings and credit associations

4. Interlinked Credit Arrangements

- Input suppliers/Crop buyers
- Processing industries

The range of rural and agricultural lenders is far more limited than in urban financial markets. This results from the unique features of agricultural production, finance and the history of financial sector development.

Commercial banks are not involved in rural finance. Except in rare instances, they have not voluntarily established extensive rural branch networks, nor have they developed specific financial services for the poorer rural clientele. In some cases, they extended limited services to larger agro-industries in rural areas. This was the background against which governments in many developing countries constituted specialized agricultural development banks. The structural adjustment programmes, financial sector reform and the changed environment of market liberalisation and privatisation greatly affected these specialized banks. In fact, most of them have been either restructured or have ceased their operations altogether, mostly the latter.

Beyond formal rural lenders, there are many small, decentralized, semi formal or informal financial intermediaries. Examples of these providers include village banks, community banks, co-operatives and credit unions. Usually their involvement in agricultural lending is constrained because their lending operations are primarily savings-based. They lack sufficient longer-term financial resources for agricultural lending. There is evidence that many small farmers now rely on semiformal and informal arrangements for financing their on-farm production. This shift has emerged following the demise of the directed agricultural credit programmes and the liquidation or restructuring of most agricultural development banks. Of particular importance are the traditional forms of trade finance and the contemporary agribusiness institutional arrangements like ***contract farming***.[9]

In the past, informal rural lenders have suffered from a negative reputation, largely due to the lack of competition in local financial markets. The often-usurious behaviour of moneylenders contributed to this view. While not totally unfounded, improved understanding of the dynamics of informal financial markets has increased the awareness of the distinct advantages that they offer.

Informal lenders include moneylenders, input suppliers and traders. They lend for distinct purposes and offer credit at different terms and financial conditions. Lending also occurs between family members and friends. These loans are often interest-free. Group-based credit arrangements exist in the form of rotating savings and credit associations (ROSCAs) plus credit co-operatives. Informal savings arrangements include individual money collectors and savings societies that are organized between friends, neighbours and employees.[10]

[9] In contract farming, companies generally provide seedlings initially, as well as inputs (most on credit) over the years as the trees mature and become more and more productive, with the initial start-up costs being repaid over periods of as long as 22 years. These programmes often raise their participants out of poverty, but tend to work well only when growers have no choice but to sell their produce to the sponsoring companies; if parallel outlets for produce exist, many farmers will almost inevitably sell their produce there and default on their loans. Another problem is that all these commodities are priced in hard currency, so farmers' incomes tend to fluctuate widely from year to year. For a thorough discussion of contract farming, please see the FAO's new publication, "Contract Farming", available from AGSM at FAO headquarters in Rome. Additional information can be obtained from Ladman, J.R., et al., 1992. Because it easily marketed widely, the most common irrigated crop—rice—is probably not a candidate for contract farming, but horticultural and other high-value crops may be. In this vein, FAO has a number of very useful publications on improving horticulture, especially "Horticultural Marketing: a resource and training manual for extension officers", FAO Agricultural Services Bulletin No. 76, 1989.

[10] Bouman, F.J.A., 1995, pp. 371-384.

Informal financial services providers fill the gaps in financial markets. They serve predominantly lower income people who are perceived by formal financial institutions as "unbankable" due to their inability to comply with conventional loan collateral requirements. Higher income people also use informal credit when the availability of bank credit is limited. It is used for consumption purposes. Distinct advantages are afforded by informal credit. There are no restrictions imposed on the purpose of its use, provided in very small amounts and it is typically available with a minimum time delay.

Informal lenders have overcome the high cost and risk barriers which face institutional lenders when they attempt to serve small clients. Their local presence ensures a convenient and timely access of clients to financial services, increases their familiarity with the borrower's needs and his/her loan repayment capacity and reduces the costs of loan follow-up. As they are interested in maintaining a good credit reputation to ensure continued access to credit resources, clients have a strong incentive to repay their loans promptly.

Although informal credit and savings services play a crucial role, they also have limitations. In fact, well-functioning banks have institutional advantages for client coverage. They are also able to provide full financial intermediation services and can offer a wide range of financial products through regulated contracts. Formal rural financial institutions need to revitalize their poor public image from the past. They have to build and maintain the confidence of their clientele. This is essential if they intend to compete with informal lenders who can be costly, but are easily accessible and provide opportune services. In particular, formal rural lenders need to demonstrate their viability and sustainability by reducing the high costs and risks that are associated with agricultural lending.

2.2 COSTS AND RISKS SPECIFIC TO AGRICULTURAL LENDING

Agricultural lenders who serve small farmers face high financial transaction costs when granting small loans. High lending risks are suggested by the frequent inability of small farmer-borrowers to provide acceptable forms of loan collateral.

2.2.1 Costs of Agricultural Lending

In this section special attention is given to the challenges that agricultural lenders face in managing their financial transaction costs and risks.

Dispersed Clients

Low population density coupled with dispersed location of rural clients make the provision of formal financial services costly. From the lender's perspective, the long distances between communities and the inadequate rural transportation facilities in many developing countries increase the costs of loan appraisal, loan monitoring and enforcement of loan repayments.[11] The use of mobile loan officers and/or branch offices can be effective in lowering transaction costs. But mobile facilities may be subject to security risks if bank staff is required to transport money. The establishment of a rural branch network reduces the security risks, but branches are costly to maintain and to supervise.

Financial transaction costs of institutional credit can also be high for rural borrowers. This results from the high opportunity costs of lost working time. A borrower may have to pay several visits to the bank branch office to conclude cumbersome loan application procedures that require a long time for processing. Clients often have to spend much time and money to obtain the required documents and to find loan guarantors. For very small loans, these costs can significantly increase the effective lending interest rate.[12]

While the decentralisation of field operations has been effective in reducing the transaction costs in some countries their success depends on the local environment, infrastructure conditions and the management skills of the financial institution.

Seasonality and Loan Term Structure

The seasonal nature of agricultural production and the relative long gestation periods before crops can be harvested and sold have direct implications for the financial transaction costs of the lender. Agricultural loans are normally larger and are required for longer periods. Matching assets and liabilities is more difficult than for non-farm activities. Agricultural credit is also often repaid in "lumpy" instalments. These are one or two loan

[11] Gurgand, M., *et al.* 1996. Rural Finance in Sub-Sahara Africa, Savings and Development. No. 2, pp. 135-169
[12] Klein, B.,1996.

repayments rather than regular weekly or monthly instalments common in micro-credit. This irregular pattern implies more difficult monitoring of repayment capacity and willingness. Moreover, an uneven distribution of the agricultural lending operations over the year increases the fixed costs of personnel. The earnings from lending may not be sufficient to cover these costs. Liquidity requirements in periods of high seasonal loan demand also increase the price of loanable funds. In times of low demand, excess liquidity needs to be invested in low or non-earning assets. This will increase the opportunity costs of these funds. In summary, lenders face high agricultural lending costs.

Heterogeneity of Farming
The diversity in farm and non-farm income-generating activities of rural households requires better knowledge of the farm household financial situation. Loan officers must have more information than may be needed in the case of urban lending. This can extend the bank staff time (and expenses) needed for loan appraisal. It may also require the setting of individual loan repayment terms. It is likely to increase the costs of training agricultural loan officers.

2.2.2 Risks Associated with Agricultural Lending

Financial institutions face four major risks:

1. *Credit or loan default risk* - refers borrowers who are unable or unwilling to repay the loan principal and to service the interest rate charges
2. *Liquidity risk* - occurs when a bank is not able to meet its cash requirements. Mismatching the term of loan assets and liabilities (sources of loanable funds) exposes banks to high liquidity risks.
3. *Interest rate risk* - risk that a loan or other investments will decline in value as interest rates change.
4. *Foreign exchange* risk - defines exposure to changes in exchange rates, which affect international borrowings denominated in foreign currency.

This paper on better irrigation lending practices focuses mainly on agricultural credit or loan default risks. Readers interested in finding out more about the other risks (liquidity, interest rate and currency risks) associated with funding should consult volume 4 of the GTZ/FAO series of publications entitled “Agricultural Finance Revisited” and Giehler, 1999.[13]

Risks impact borrowing farmers and the financial institutions that lend to them. Active management can reduce these risks. Risks and uncertainty are pervasive in agricultural production and are perceived to be more serious than in most non-farm activities. Production losses are also impossible to predict. They can have serious consequences for income generation and for the loan repayment capacity of the borrowing farmer. The type and the severity of risks which farmers face vary with the type of farming system, the physical and economic conditions, the prevailing policies, etc.

Agricultural lending implies high liquidity risks due to the seasonality of farm household income. Surpluses supply increased savings capacity and reduced demand for loans after harvest and deficits reduce savings capacity and increase demand for loans before planting a crop. Also, agricultural lenders face particular challenges when many or all of their borrowers are affected by external factors at the same time. This condition is referred to as covariant risk, which can seriously undermine the quality of the agricultural loan portfolio. As a result, the provision of viable, sustainable financial services and the development of a strong rural financial system are contingent on the ability of financial institutions to assess, quantify and appropriately manage various types of risk.[14] Credit risks in agricultural lending are summarized below.

Production and Yield Risks
Yield uncertainty due to natural hazards refers to the unpredictable impact of weather, pests and diseases, and calamities on farm production.[15] Risks severely impact younger, less well-established, but more ambitious farmers. Especially affected are those who embark on farming activities that may generate a high potential income at the price of concentrated risks - e.g., in the case of high input monoculture of maize. Subsequent loan defaults may adversely affect the creditworthiness of farmer borrowers and their ability to secure future loans.

Market and Price Risks

[13] Giehler, T. (forthcoming).
[14] Von Pischke, 1994.
[15] Ellis, 1988.

Price uncertainty due to market fluctuations is particularly severe where information is lacking and where markets are imperfect, features that are prevalent in the agricultural sector in many developing countries.[15] The relatively long time period between the decision to plant a crop or to start a livestock enterprise and the realisation of farm output means that market prices are unknown at the moment when a loan is granted. This problem is even more acute for perennial tree crops like cocoa, coffee and oil palms because of the gap of several years between planting and the first harvest. These economic risks have been particularly noticeable in those countries where the former single crop buyer was a parastatal body, typically called a marketing board. These organisations announced a buying price before planting time. Most marketing boards disappeared following structural adjustment reforms and privatisation of agricultural support services. Private buyers rarely fix a blanket-buying price prior to the harvest, even though various interlinked transactions for specific crops have become more common today. These arrangements almost always involve the setting of a price or a range of prices, prior to crop planting.

Risk of Loan Collateral Limitations

Problems associated with inadequate loan collateral pose specific problems to rural lenders. Land is the most widely accepted asset for use as collateral, because it is fixed and not easily destroyed. Its owners often prize it well above its monetary market value, and it has a high scarcity value in densely populated areas. Smallholder farmers with land that has limited value, or those who have only usufruct rights, are less likely to have access to bank loans. Lenders regard moveable assets, such as livestock and equipment, as higher risk forms of security. The owner must provide proof of purchase and have insurance coverage on these items. This is rarely the case for low-income farm households.

Moreover, there are a number of loan contract enforcement problems, even when borrowers are able to meet the loan collateral requirements. Restrictions on the transfer of land received through land reform programmes limits its value as collateral - even where sound entitlement exists. In many developing countries the poor and especially women have most difficulties in clearly demonstrating their legal ownership of assets. Innovative approaches, especially the use of solidarity groups jointly and severally responsible for repayment, which draw on the practices of informal lenders and provide incentives to low income borrowers to pay back their loans have been developed in micro credit programmes.

Moral Hazard Risks in Distorted Credit Cultures

Potentially serious risk problems have arisen from the effects of failed directed credit programmes. The impact on the loan repayment discipline is pervasive. Borrowers who have witnessed the emergence and demise of lending institutions have been discouraged from repaying their loans. Further, people have repeatedly received government handouts under the guise of "loans" that everyone knew didn’t have to be repaid. Thus, loan clients have been conditioned to expect concessionary terms for institutional credit.

Under these circumstances, the incidence of moral hazard is high. The local "credit culture" is distorted among farmers and lenders. Borrowers lack the discipline to meet their loan repayment obligations, because loan repayment commitments were not enforced in the past. Lenders, on the other hand, lack the systems, experience and incentives to enforce loan repayment. There is also an urgent need to change bank staff attitudes and the poor public image of financial institutions in rural areas.

Another effect of a distorted credit culture on the risk exposure of agricultural lenders is the priority that borrowers give to repaying strictly enforced informal loans. These are settled before they comply with the obligations associated with "concessionary" institutional credit. This is explained by the fact that losing the access to informal credit is viewed as more disadvantageous than foregoing future bank loans (due to the uncertain future of rural financial institutions). Very often informal lenders have stronger enforcement means than banks.

Risks from Changes in Domestic and International Policies

Policy changes and state interventions can have a damaging impact on both borrowers and lenders. For the latter they can contribute significantly to covariant risks. Many low-income economies under structural adjustment programmes have slashed their farming subsidies. This has had, for instance, a serious effect on the costs and the demand for fertilizer. Reducing government expenditures as an essential part of structural adjustment programmes may also affect employment opportunities in the public sector. If extension services are suddenly discontinued, agricultural production levels may even fall.

A further discussion of a number of strategies for reducing the above-mentioned risks is found in Chapter 4, “Lessons Learnt from Previous Experiences with Agricultural Credit.”

3.0 UNIQUE FEATURES OF AGRICULTURAL FINANCE

The environment for rural financial intermediation has changed significantly in recent years with an enhancement of the role of markets and increased privatisation in most African countries. However, an immediate result of most of these reforms has been that fewer small farmers and other rural households qualify for credit or that those who do qualify will have to pay more for loans. At the same time, in view of the high proportion of the population engaged in agriculture in developing countries and the strategic importance of (in particular) basic food production, policy makers are highly sensitive to public interventions in favour of the farmer population. It is vital, however, that financial institutions are not "misused" to fulfil social equity purposes and that public interventions in this direction, while fully justified, are obtained through alternative mechanisms.

Reforms will continue in the current context of economic deregulation and market development. A principal aim of financial sector reform is to ensure that market-based and a varied supply of financial services (financial widening) are available to an increasing number of both commercial farmers and farm households, agri-processors, traders and other rural non-farm entrepreneurs (financial deepening). To achieve these objectives will require a good understanding of rural economics, the existence of an appropriate policy and legal framework for rural finance and access to financial as well as to non-financial support services.

Together with the need for an appropriate policy and legal framework and appropriate rural financial structures, this section discusses the unique features and special needs of agricultural production and agricultural finance and recommends that government policy makers, international development agencies and bankers focus on the following specific agriculture-related issues:

- Government interference in the politically sensitive area of agriculture
- The high financial transaction costs of attending dispersed and small farm households;
- The seasonality and the importance of opportune timing of on-farm finance for cultivation practices, input application, harvesting (and related output marketing), the heterogeneity in farmers' lending needs (seasonal and term lending) and the relative long duration of agricultural lending contracts;
- The dependence on sustainable natural resources management and the relative low profitability of on-farm investments;
- The various weather and other production risks, together with marketing risks related to agriculture, that require appropriate risk management techniques, both for producers and financial intermediaries;
- The limited availability of conventional bank collateral that farm households can offer, that highlights the need to increase the security of existing loan collateral or develop appropriate collateral substitutes;
- The reality that farm households are confronted with emergency needs and that their loan repayment capacity is highly dependent on consumption and social security contingencies;
- The need for adequate training of both bank staff and farmer clients.

Each of these issues is now discussed in greater detail:

3.1 INVOLVEMENT OF GOVERNMENT IN A POLITICALLY SENSITIVE ENVIRONMENT

Recognize that agriculture and food in particular is a vital national interest, and hence to varying degrees will often be the focus of heated political debate and may be manipulated by governments for short-term personal interests, i.e., getting re-elected. African governments certainly have a legitimate role in agricultural and rural finance development , but the proper role is not as a direct intervener in agriculture, but rather one of promoter and regulator to make sure that the public's hard-earned savings lodged in depository institutions are safe. Government also clearly has a legitimate role in assuring that there is enough food available for the country's population throughout the year. However, for self-serving political reasons, sometimes governments overstep these boundaries. Often, for example, governments will seek to keep farm gate (and hence urban market) prices unnaturally low to placate influential urban populations (they know that revolutions and ***coups d'état*** happen in the cities, not in the countryside). But by doing so, they inevitably and ironically assure just the opposite. By creating disincentives for farmers to grow more, less instead of more is produced. Similarly, government proclamations of universal credit moratoriums, particularly just before (re)elections is also becoming an alarmingly frequent occurrence in some countries. This kind of short-term political move by elected leaders can destroy overnight rural financial systems that have taken a generation or more to build up. For this reason, project design officers should seek to negotiate proscriptions on this type of irresponsible behaviour by governments during the implementation of proposed agricultural finance projects.

3.2 ACCESS OF SMALL FARMERS TO FINANCIAL SERVICES

Most small farmers and other rural entrepreneurs, due to their dispersed location and the general poor rural infrastructure, experience great difficulty in accessing urban-based banks. Rural client dispersion and small loan volumes lead to high financial transaction costs both for banks and borrowers, and increase the perception of high risks, which banks usually associate with small rural clients. In addition, current bank practices and procedures may discourage rural clients from using formal financial services and, in many cases, rural people are even unaware of the availability of financial services or of the conditions under which these are available. Moreover, small farmers have to make many visits to banks at office hours which may not be convenient to them, while banks lack essential information on the credit history of potential clients, the viability of on-farm investments, the self-financing capacity of farmers and their repayment capability.

Transaction costs in rural areas are high compared to urban areas, due to problems of collateral provision, low and irregular income flows and the small amounts involved in the transactions. Adams and Nehman identified three types of borrow transaction costs: non-interest charges by lenders; loan application procedures that require the applicant to deal with agents outside the banking system, such as agricultural extension staff, local officials and co-signers; and travel expenses and time spent promoting and following up the application.[16] Due to these factors the costs of reaching the rural poor and small scale farmers are high for financial institutions, which charge high interest rates when compared to market rates in the formal banking sector. The overall costs of formal borrowing therefore, in many cases, may result in borrowing from the informal sector becoming more attractive to small-scale farmers. The challenge still remains to design and expand the provision of loan products to better service the farming community and to lower transaction costs to improve the terms and conditions of lending for agriculture. This will demand improved management of existing rural financial intermediaries, and innovations or ‘new methods” in financial intermediation for the agricultural sector.

Banks may decide to open rural branches, but the demand for bank services need to be large enough to warrant setting up such a rural branch network. Efforts to expand the range of financial services by including savings mobilisation and current accounts may lead to economies of scale and thus to higher efficiency. Simplification of loan procedures may minimize the travel time and costs for individual borrowers, while group lending based on joint and several liability of group members and liaison with NGOs are other means of reducing costs. In all cases, the availability of decentralized financial intermediation services is a precondition for effective on-farm lending.

3.3 HETEROGENEITY, SEASONALITY AND DURATION OF ON-FARM LENDING

Individual farmers have different investment needs, and may apply for seasonal and/or investment loans to meet specific financing requirements. For example, a livestock enterprise may require financing of land improvements (fencing and water), buildings to house the animals, purchase of animals (breeding stock), animal feed, crop production and other operational production costs (labour, machinery, veterinary costs, etc.). Further, each of these expenses occurs at a different time and, in accordance with the enterprise revenues and cash flow, requires a specific repayment schedule. For example, milk production has a relatively constant revenue stream and cash flow, while beef production experiences only periodic sales. Crop expenses re incurred for land preparation and planting and continue through cultivation, harvesting, storage and marketing, while income revenues generally occur only at the time of crop selling and are often received in one lump sum. Diversification of farm enterprises and off-farm income contribute to smoothing out farm household expenditure requirements and income flows. Indeed, the cash flow at farm household level is greatly influenced by the heterogeneity of production, trading and consumption and social security transactions within the household.

Timely availability of farm inputs such as seed and fertilizer, in accordance with cultivation practices, is essential in farming, and requires flexible financing mechanisms. In particular, non-permanent working capital requirements may be ideally met by a bank overdraft or a special credit line for working capital, which has the potential to reduce transaction costs for both the client and the bank. However, it requires that the banker knows his client well and has sufficient confidence in the farmer’s management capabilities. In particular, in the case of investment loans, banks require good investment loan appraisal studies and timely and accurate farm records. Banks should also be in a position to supervise the execution of the investment/financial plan. Training of

[16] Von Pischke, J.D. 1991

farmers and bank staff in preparing and evaluating farm plans as well as in loan follow-up constitutes an important technical assistance function that may be provided by donors and/or governments, without violating the principles of free markets, by respecting the autonomous decision power of financial intermediaries in providing loans for viable on-farm investments.

Encouragement of savings and building up the financial reserves of farmers will strengthen their self-financing capacity. Complementary bank credit may be useful in particular to finance increased working capital and new capital investments, while leasing financial arrangements may be attractive for the acquisition of farm machinery and similar "lumpy" investments.

3.4 PROFITABILITY AND RISKS OF ON-FARM INVESTMENTS

The major factors that affect banker and farmer behaviour in on-farm lending operations are the expected profitability of and the risks related to on-farm investments. Risks can be of a different nature and include those associated with the impact of unfavourable weather on production (drought, hail, floods, etc.), diseases or pest damage, economic risks due to uncertain markets and prices, productivity and management risks related to the adoption of new technologies, and credit risks as they depend on the utilisation of financial resources and the repayment behaviour of farmer clients. The relative importance of these different risks will vary by region and by type of farmer. For example, marketing risks are greater for mono-crop cultures in developing countries, which depend on volatile world markets. Eastern European transition economies which go through a major re-structuring from a centrally-planned to a market economy, need, in particular, training and technical assistance in business management in order to reduce both market and credit risks. These risks will also decrease as the level of education of farmers and the availability of information on markets, prices and loan repayment behaviour increase. In some cases, especially for relatively high technology farming that involves significant investments, agricultural insurance may be useful as a risk management tool. But it should be used only for specific crop/livestock enterprises and for clearly defined risks.[17]

Risks are also related to the duration of loans, since the uncertainty of farm incomes and the probability of losses increases over longer time horizons. Thus, given the average short maturity of loanable resources in deposit-taking financial institutions, and considering the time horizon of agricultural seasonal and investment loans, commercial bankers are normally reluctant to engage themselves in agricultural lending. To protect themselves, banks should carefully match the maturity of their loans with that of their loanable resources and apply measures to protect their loan portfolio from potential risk losses.

Additional risk protection measures that present added costs to borrowers include insurance coverage against insurable risks such as specified adverse weather events leading to crop damage (as noted above) or insurance against fire (buildings and crops) and theft (movable assets). Government or donor-financed loan guarantee schemes, in general, have not led to significantly increased bank lending (additionality) and they should be carefully designed in order to secure appropriate risk management and sharing as well as a cost effective administration. On the other hand, mutual guarantee associations have proven their usefulness. Banks also control their financial exposure by limiting their loans to only a portion of the total investment costs and by requiring that the borrower engage sufficient equity capital as well as by a careful diversification of their loan portfolio in terms of lending purposes, market segments and loan maturities. It is worth underlining that successful (micro) financial institutions operating in rural areas, especially densely populated rural areas, do not concentrate their portfolio in agriculture to the exclusion of non-farm activities. This is because portfolio diversification is a key to sustainability and successful risk management. The risk-reducing practice of group lending is discussed below.

3.5 LOAN COLLATERAL

A conventional bank practice that protects the lender against possible borrower default is the requirement of loan collateral such as real estate or chattel mortgage.

Banks use loan collateral in order to screen potential clients (as a substitute for lack of customer information) and to enforce and foreclose loan contracts in the event of loan default. The preferred form of conventional bank collateral is mortgage on real property, which, however, requires clear land titles and mortgage registration. In general, real estate and land are considered to be "low risk", while chattel mortgages of movable assets such as machinery and animals incur a greater risk, unless these items can be clearly identified, and are

[17] Roberts & Dick. 1991.

properly insured against theft, fire and loss. In the absence of conventional types of collateral such as land, livestock and machinery, other forms of supplementary collateral are often accepted by banks, such as third party guarantees, warehouse receipts and blocked savings. Without secure loan collateral, it is expected that there will be a contraction in the supply of bank credit and this will result in reduced access of small farmer and rural clients to finance.[18]

In the informal credit market, where intimate client knowledge, often, inter-linked trade/credit arrangements exist, non-tradable assets or collateral substitutes, such as reputation and credit worthiness, are much more prominent. Group lending based on group control and joint and several liability of group members, and group savings are suitable forms of collateral substitutes. Donors and NGOs increasingly use these. It may be effective if groups are homogenous in their composition, interests and objectives and when problems of moral hazard can be avoided. However, in many countries, groups of farmers do not easily meet these criteria. In addition, also due to the long duration of agricultural loans and high costs of group training, individual lending in agricultural finance, in general, is much more widespread and might be more appropriate than group lending. Moreover, successful experience with group lending is chiefly for non-agricultural purposes.

Emerging successful microfinance institutions have built up their loan portfolio following a modern “credit technology.” Modern credit technologies targeted at a resource poor clientele assign greater importance to keeping risks in check (e.g. by maintaining loan amounts small and of short duration) and to well-designed repayment incentives. One of the most powerful incentives to loan repayment is the prospect of access to subsequent loans. Thus, the typical loan disbursed by these institutions is for a short term (3-12 months), and loan amounts start small and grow slowly in accordance with a client’s repayment performance. With regard to agricultural finance, such modern “credit technology” may be suitable to livestock farming, where the cash flow generated is more continuous. However, this is not the case with crop production as the extent to which new credit technology may be utilized is inversely dependant upon the importance of crop sales on family income.

3.6 THE NEED FOR EFFECTIVE TRAINING

From numerous expert reports and meeting documents it is evident that agricultural credit expansion is hampered by farmers’ lack of knowledge about the availability and conditions of credit, and by the shortage of well-trained bank staff, who have experience in dealing with small farmers and rural people.[19] Training therefore should focus both on bank staff and farmer-clients.

Banks’ field staff should have appropriate education and training in business and farm management, agriculture and banking[20]. In their work, they should interact closely with agricultural extension agents and organisations, who provide essential non-financial support services to small farmers and rural people. Such liaison should involve sensitising farmers about the availability and conditions of bank credit and assist farmers in preparing proper farm and business plans and submitting loan applications. Extension agents and similar technical staff, however, should not be involved in loan approval and loan recovery, which remains the exclusive task of banks.

Banks should accept staff training as an investment, forming part of overall manpower development. This needs to be reflected when recruiting staff, bearing in mind that poor recruitment practices may result in poor recruits which cannot be easily rectified by training. Measures should also be taken to provide adequate incentives to bank staff who work in rural areas. Salary levels and fringe benefits, compensation for overtime work, appointment and career perspectives need to be in line with similar employment in the urban sector in order to promote agricultural lending. Bank staff performance-based incentives should focus in particular on loan recovery and savings mobilisation. For instance, the Lima Bank in Zambia, a specialized public agricultural credit institution, experienced poor loan repayment, and Heney[21] stated that Zambian farmers felt no commitment whatever to this financial institution and used it only as a means of having easy access to cheap government funds. The Lima Bank staff reflected a similar low commitment to rural clients and work performance and no mechanism of staff incentives existed. This bank has now (1997) been liquidated.

The main objective of farmer training should be to increase the benefits of borrowing for production purposes and should be oriented at improving the business skills of individual farmers. Topics to be included are farm planning and farm management, risk management, bookkeeping and cost accounting, savings and liquidity

[18] Binswanger and McIntire, 1987.
[19] Laure, 1973; Roberts, 1980
[20] Roberts, 1980.
[21] Heney, 1992.

management, the role and use of credit, the costs of credit (interest and related financial charges), collateral requirements, loan repayment obligations, legal measures against loan defaulting, etc. Such training can be prepared by banks and delivered to the farmers in conjunction with or by agricultural extension staff.

Grassroots groups, member-owned financial intermediaries such as credit and savings associations and co-operatives require a more specialized type of training in group organisation, joint liability, financial and business management, savings mobilisation and protection, assessment of investment profitability and risks, building up of capital reserves, lending procedures, accounting and management information systems. Agricultural bank staff and private sector business of NGOs may provide essential training support to initiating groups, when the requirements of training are greatest and when additional costs are the least affordable.

Non-financial services such as information, training and extension can be provided by the state, by the private sector or by a combination of these. The problem is finding the right combination and identifying how to institutionalise these arrangements. Many drawbacks in the provision of support services in developing countries can be traced to their high costs, to inefficiency and to non-involvement or non-commitment of the final beneficiaries, when they are provided directly by the public sector. The private sector strengths are in identifying the immediate needs of different clientele, in organizing the supply of services to meet the demand, and in managing effectively the financial transactions involved. However, there is still an important role for the public sector in providing a proper policy and legal environment within which private sector business activities can take place.

3.7 SUMMARY

The following table summarizes some of the main distinguishing features of all types of agricultural credit:

Unique Features of Agricultural Lending
1. Lending activities in a politically sensitive environment
• Agriculture is a politically sensitive sector.
• State interventions unfriendly to lenders often occur in rural financial markets.
2. High financial transaction costs for lenders and borrowers
• Long distances to serve a dispersed rural clientele.
• Poorly developed transportation and communication infrastructure.
• Little knowledge about heterogeneous farm households.
• Expensive management and supervision of rural bank branch networks.
• High additional costs for borrowers: opportunity costs (e.g. lost working time), transport costs, bribes, fees, etc.
3. Loan Portfolio Management Problems
• The provision of long-term credit can lead to matching problems between assets (loans) and liabilities (funding sources).
• Reduced turnover of agricultural loan portfolio over the year.
• Seasonality in agricultural credit demand.
4. Farm households are integrated production and consumption units
• Demand for loans depends on the self-financing potential, access to savings deposit facilities and risk management ability of borrowers.
• Due to the fungibility of money, borrowed funds can be used in the farm household for consumption, education, social insurance, production and investment purposes.
5. Risks associated with agricultural lending
• Similar economic activities of borrowers generate covariant risks due to market and price fluctuations, yield uncertainties, changes in domestic and international policies.
• State interventions (e.g. waiver of loan overdues).
• Low loan repayment discipline in externally-funded credit schemes.
6. Lack of required loan collateral
• Small farmers have few physical assets (e.g. land).
• Farmers and especially poor rural women have difficulties in clearly demonstrating their legal ownership of assets.
• Legal contract enforcement problems arise even when collateral is available.
7. To be successful, agricultural credit programmes need to place a high priority on training of the lenders' staff and of farmers in the new technology being developed.

It is probably appropriate to briefly situate credit within the larger context of rural financial systems (RFSs). At the same time, the latter must respond to the need for transaction security, the need for intermediation and the need for close proximity. Fundamentally, RFSs are based on balancing sources and uses of funds (cost of volatile capital), prudential management (financial risk of illiquidity) and market conditions (subvention of operating deficits). As such, the need for RFSs is not disputed. RFSs permit, according to the traditional definition, to anticipate the (hopefully positive) results of the agricultural campaign through the supply of the means to gather necessary production factors through the mobilisation of individual savings or collective savings (redistributions from governments or donors). Vis-à-vis usurers (whose role is far from negligible), RFSs offer the advantage of professionalism, as demonstrated by improved security and financial sustainability.

Traditionally, the banking sector has little interest in intervening in rural areas (except in the case of agro-industries), a disinterest based on three well-known factors: 1) an elevated agricultural risk (insufficient rainfall); 2) the high cost of maintaining widespread physical infrastructure; and 3) the high cost of managing many small accounts. Conversely, the commercial banking sector is primarily interested in wholesale lending to microfinance networks with a proven micro-onlending capability.

4.0 LESSONS LEARNT FROM PREVIOUS EXPERIENCE WITH AGRICULTURAL CREDIT

During recent years, financial services have been provided to an increasing number of low-income people and micro entrepreneurs because of innovative developments in "microfinance". Microfinance refers to that part of the financial sector that responds to the financial demand of low-income households. Until now, microfinance institutions have operated mainly in urban areas. They provide small and short-term loans predominantly for trading, services and micro enterprise activities. The lessons learned from the failures of the earlier directed agricultural credit projects plus the principles of the new financial systems development approach have been particularly influential in microfinance. Important progress has been made in the areas of institutional and organisational set-up and operational strategies. Effective new lending technologies have been designed for low-income clients.

In this chapter, the key lessons that have emerged as the "best practices" in the field of microfinance are examined. The chapter is divided into three sections. The first reviews the supply and demand features of micro credit. The second section examines some key factors, which have emerged from the cumulative experiences of micro credit. Particular attention is given to the review of the micro credit technologies and the contribution that they make towards managing the costs and risks of small loans. The last section highlights the main limitations that are encountered in transferring the micro credit practices to agricultural lending.

4.1 TYPOLOGY OF MICRO-LENDERS

A variety of organisations and institutions are active as providers of micro credit services. They can be broadly divided into three groups: non-governmental organisations (NGOs); credit unions and co-operatives; and banks.

NGOs and MFIs

The majority of the micro credit programmes are operated by NGOs. These include national organisations, many which receive assistance from international donor organisations. The international NGOs operate programmes through affiliated local agencies. They have a clear commitment to work with poor people. NGOs have the advantage that they are familiar with the household livelihood strategies and the financial situation of their target population. They are well established in local communities, with good access to the population.

However, NGOs have encountered many challenges in the administration of credit programmes. As predominantly social assistance organisations, few possess the required professional expertise or the business culture to efficiently execute savings and credit operations. In fact, they will have to undergo a substantial transformation if they intend to become specialized financial service providers. They will have to alter their public image. Instead of serving "beneficiaries", they must learn to establish contractual relationships with ***clients***.

Since the mid-1980s, a number of NGOs have established themselves as specialized microfinance institutions (MFIs). While some have discontinued their social services, others have created separate affiliated organisations to provide financial services. Specialized NGO micro lenders have been at the forefront in the development of appropriate institutional and organisational structures. They have initiated the design of innovative micro credit technologies.

Despite the significant advancements in the field of microfinance, the majority of the NGOs serve only a few hundred or at most a few thousand clients. Most provide loans and usually have only one or two loan products. Although most require mandatory savings deposits from their clients that form part of their loan collateral, only a minority mobilize ***voluntary*** savings. There has been growing interest in operating savings deposit facilities as a means to mobilize loanable funds, to enhance their customer services and increase sustainability. However, NGOs are often not permitted to accept deposits from the public. This is because they fall outside the formal banking regulation and supervision system, and thus operate without a formal banking licence.

This restriction has recently motivated some NGOs to transform themselves into regulated financial institutions. This process, known as ***up-grading***, gives microfinance institutions the freedom to expand their range of financial services. It also enhances the chances of accessing financial markets for additional loanable resources.

Bancosol in Bolivia was the first NGO to achieve the status of a regulated financial institution. BRAC in Bangladesh and K-Rep in Kenya have also obtained bank licences.[22]

Credit Unions and Co-operatives

Historically, credit unions used to serve people who experienced difficulties in accessing commercial banks. Credit unions tend to be more formal in their structure than NGOs, including the possible establishment of regional and national networks. The constitution of central finance facilities also enables the reallocation of surplus (liquidity) funds between member credit unions. In many countries, credit unions have been included as a special category in the banking law. They are subject to separate regulation and supervision mechanisms.

Most credit unions and co-operatives limit their services to members, whose savings provide the financial basis for their lending operations. This has the advantage that they can better screen prospective borrowers and appraise, monitor and recover loans. As in the case of informal savings and credit groups, members are self-selected, and peer pressure is exerted to attain full and timely loan repayment. Social pressure and superior information on member clients are effective mechanisms. This functions as long as members know each other and the scope of the financial operations remains manageable.

Despite their advantages, credit unions and co-operatives face notable challenges. The provision of financial services is restricted to members and thus limits their outreach and growth potential. Because loanable funds are generally limited to the mobilized member savings, the credit union is restricted in its efforts to satisfy the total effective credit demand of its members. Loans are often granted for smaller amounts than were applied for. They are often only available after outstanding loans have been reimbursed. This restricts borrowing opportunities and therefore the effectiveness of the loans. The lack of professional management, and cronyism among members and leaders can undermine the loan portfolio quality. Moreover, where borrowers dominate the co-operatives' policies, there has been a tendency towards setting lending interest rates too low. This practice may undermine the financial performance and the potential for loan portfolio growth.

Absent of these difficulties, credit unions and co-operatives have demonstrated potential as a viable institutional model for providing micro credit services. In recent years, the World Council of Credit Unions, Inc. (WOCCU), has demonstrated considerable success in accelerating membership and savings growth, as well as greatly improved financial performance, through its "Model Credit Union" techniques and its PEARLS performance measurement system. For more information, please contact WOCCU.[23] Changes in the regulatory and supervisory framework for credit unions together with technical assistance services from international credit union development organisations, such as WOCCU and DID[24], have been identified as key factors in strengthening their performance.

Banks

The involvement of commercial banks in microfinance is relatively recent. Banks employ a variety of strategies in serving low-income clients, who are normally perceived as "unbankable". Micro-credit may be granted ***indirectly*** or ***directly***.

Indirect ways in which commercial banks lend to small clients include the so-called *linkage* programmes with NGOs or other intermediary organisations. In these cases, banks provide loanable resources and the intermediary organisations on-lends the resources to members of self-help groups for micro enterprise activities. In these arrangements, banks have limited contacts with the final borrowers. They are not actively involved in the loan product design or credit administration. They rely on the NGO for all aspects of loan appraisal, loan monitoring and loan recovery.

While this model has increased the access of low-income clients to bank loans, it has proven to be only moderately successful in the provision of sustainable banking services. The bank has few incentives to develop

[22] Some NGOs have successfully borrowed from banks to finance their loans to clients. The ACCION International Bridge Fund has promoted NGO lending from commercial banks by providing a guarantee scheme. A stand-by letter of credit is issued from one bank (in this specific case the Citibank) to another (local banks in Latin America). As a result, the NGOs can get a loan from the local bank, which is backed by the standby letter of credit. If the institution fails to repay, the lender can call on the Citibank upon presentation of the unpaid matured notes. The stand-by letter in this case makes up 130% of the guarantee provided by ACCION. The ACCION guarantee fund which backs the stand by letter of credit is capitalized by private individuals and institutional investors often with philanthropic motives.

[23] Try WOCCU's web site, http://www.woccu.org or the document "Credit Unions Retooled", downloadable from WOCCU's web site and also available in hard copy from WOCCU, P. O. Box 2982, Madison, WI 53701, USA.

[24] Développement International Desjardins, 150, avenue des Commandeurs, Lévis-Laucon, Québec G6V 6P8 Canada

appropriate and cost effective credit technologies. It relies on a number of organisations, each with different objectives and performance standards.

More interesting has been the recent involvement of some commercial banks (e.g., Financial Bank in Benin and Chad) in direct lending through the design of new loan products and services for low-income clients. This process is referred to as ***down-scaling***. It implies the creation of a specialized micro credit department in the bank. This development is particularly attractive in view of the outreach and the financial expertise contained in commercial banks. Well-established financial institutions enjoy public confidence, as clients recognize and perceive the banks as reliable and stable organisations.

The involvement of banks in microfinance can offer, for example, their amplified intermediation potential. However, if bank operations are inefficient and bank staff are unable to change their traditional banking culture and attitudes, tedious barriers remain to directly serving low-income clients. Indeed, in these cases, it may be preferable to create a new micro finance institution that has a clear corporate mission and set of objectives. This is necessary in cases where banks have a poor reputation due to failed directed credit programmes, or when their operations have been undermined by government interference.

4.2 STRATEGIES FOR REDUCING COSTS AND MANAGING RISKS

Micro lenders have developed solutions for the problems of high risks and costs associated with lending to micro enterprises and low-income clients. Over the years, a series of best practices and guiding principles have been formulated to enhance the outreach and sustainability of microfinance institutions.[25] In this section, an analysis is made of the key lessons that have been learned from micro credit practices. Particular attention goes to procedures that reduce costs and risks. The final objective is to assess if and to what extent these practices and lessons learned can be transferred to agricultural lending.

4.2.1 Cost Reduction

Micro lenders face the problem of high costs that are associated with the granting of small loans. In fact, loan administration costs do not vary by loan amount. By definition, small loans are less profitable for a lender. Moreover, in many networks, there are few branches in formal financial institutions. Generally, setting up and operating branches is very costly. Operation costs should be covered by the profits generated by the branch office. As a result, financial transaction costs are high for borrowers, who may have to travel long distances to the bank branch offices. Micro lenders, however, have found ways to reduce the high costs of providing small loans. Various strategies are presented below.

Standardisation of Loan Products and Lending Procedures
Micro lenders simplify their operations by offering only a few highly standardized loan products. They usually provide short-term working capital loans and, only occasionally, grant investment capital loans to established borrowers. Often they have adopted a "credit-only" approach and some provide technical assistance, business training or assistance with project preparation to their clients. Some have established collaboration agreements with partner agencies for the provision of non-financial support services.

Loans are kept small and are extended for only a few weeks or months, especially to first-time clients. Borrowers with good loan repayment records are rewarded almost automatically with repeat loans. Some micro-lenders increase the size of repeat loans by using pre-determined formulas. Although the provision of small and short-term loans to first time borrowers is costly, the financial transaction costs can be considerably reduced for well-known recurring borrowers.

Micro lenders usually charge borrowers interest rates and fees that are much higher than those used by conventional formal lenders. Interest rates need to be positive in real terms to protect the loan portfolio value against the effect of inflation.

One major problem with this approach is the phenomenon of "drop-outs." Large numbers of clients tend to "drop out" when they reach the maximum authorized loan amount. Finding new clients to replace them becomes an increasingly expensive proposition for such micro lenders.

[25] The best practices and guidelines presented here are derived from key literature including Yaron, 1992 and Yaron *et al.*, 1997; Christen *et al.*, 1995; Donors' Working Group, 1995; ILO, 1996; Rhyne and Holt, 1994; Schmidt and Zeitinger, 1994; Ledgerwood, 1998

Productivity of Loan Officers
Loan officers are expected to serve a large number of clients. Typically 200-300 borrowers are assigned per loan officer. In order to achieve this, staff performance bonuses are widely used. These incentives are related to the loan volume handled, the quality of the loan portfolio and the number of low income or remote clients that are attended in some cases. While these incentives increase the loan administration costs, well-trained and motivated staff are essential to increase the overall productivity of the financial institution. This lowers the lender operational costs in relative terms.

Group versus Individual Lending
Microfinance institutions provide loans either through groups or lend directly to individuals. Proponents of the group lending approach highlight the cost-reducing aspect of this methodology. On the other hand, the defenders of individual lending emphasize the advantages of flexibility in meeting the loan demand, achieving a high loan product quality and reducing credit risks.

Group Lending
There are two modalities of group lending. A micro-lender may lend to a collective entity such as a co-operative or a village bank, which in turn on-lends the funds to its members. More frequently, however, the term is used for ***joint liability*** or ***solidarity group lending***, whereby the lender provides loans to individual borrowers who are organized in groups. In both cases, group members are collectively responsible for the full and timely repayment of the loans.

Group lending can have the advantage of increasing the lender's outreach capacity by reducing the loan administration costs. In the first kind of group lending mentioned above only one loan is administered for each group. Moreover, group lending reduces the lender costs by maximizing the use of insider information and by relying on peer borrower screening. Group members also perform loan monitoring and loan repayment enforcement.

However, the costs of group formation are high in most cases. This is especially true for lenders who do not work with existing groups. They have to support the whole group formation process. Also, group maintenance costs are high as group members' needs and circumstances diverge over time, thus weakening cohesion. Loan officers may have to participate in regular group meetings to attempt to strengthen the loan administration responsibilities of the group, the group cohesion and the sense of peer responsibility amongst the group members.

Individual Lending
Micro-lenders use a modified version of the traditional bank lending technology that has been adapted to the characteristics of providing small and short-term loans to low income borrowers. The screening of potential clients is carried out by assessing their individual loan repayment capacity and their willingness to repay. Innovative micro-lenders examine the enterprise household cash flow and check the credit history of the loan applicant to get a complete picture of his/her loan repayment capacity and creditworthiness.

The process of collecting detailed information on individual clients is a costly exercise for micro-lenders. However, using a standardized checklist of loan applications can lower these costs. Moreover, once the high start-up costs of establishing a lender-client relationship have been made, the costs of obtaining additional information or updating existing information are much lower.

Some micro-lenders attempt over time to introduce more individualized lending terms for the members of joint liability groups. These initiatives are interesting since they combine the cost savings of working with groups with the high quality of providing individual lending services to group members. In many cases, the group and the lender perform loan follow-up and loan repayment enforcement, which may result in relatively high costs to all.

4.2.2 Risk Management

Micro-lenders manage the risks of lending to low income borrowers by selecting a specific target clientele. These clients are normally urban micro-entrepreneurs who have some experience in the business activity for which a loan application is made. Delegation of lending authority to the branch office level is enabled to specific amounts. This ensures that loan officers who are close to the customers have influence in the lending decision.

Another element in the risk management strategy of most micro-lenders is the requirement that borrowers contribute a minimum equity share of the total investment costs or down payment. In individual lending the duration of the loan and the loan repayment instalments are also adjusted to the repayment capacity of the individual borrower. This reduces the loan default risk. Loan collateral substitutes are normally accepted, as the target clientele will rarely possess conventional bank collateral. First borrowers have to build up a track record of good loan repayment performance before larger loans are granted. Major risk management mechanisms of professional micro-lenders are adequate liability and asset planning and management, the use of internationally accepted accounting standards, and computerized integrated accounting and management information systems, such as the FAO/GTZ MicroBanking System, now available in a new Windows version. These improve the basis for timely and cost-effective decision making.

Target Clientele

Concentration on Urban Clients
Micro-lenders mostly serve urban and peri-urban clients. This category calls for easier management of lending costs and risks. The infrastructure and commodity markets in urban settings are normally more developed, providing a better environment for profitable micro-businesses than in rural areas. Urban clients have a higher degree of literacy. More frequent contact between bank staff and clients are likely to decrease the risk of loan default.

Concentration on Financing of Trade Activities
Micro-lenders provide small and short-term loans that need to be repaid in frequent instalments. This implicitly means that micro-credit concentrates on the financing of those activities that have a high turnover and generate regular income flows. Trading and services activities answer these criteria. In fact, they represent a large portion of the loan portfolio of most micro-lenders.

Selecting Experienced Micro-Entrepreneur Borrowers
Micro-lenders limit the risk of loan default by selecting borrowers with a proven track record. A customer whose business has survived for a minimum time period is more likely to be successful in the future. These borrowers also take their loan repayment obligations seriously and are potential long-term clients for micro-lenders.

Decentralized Branch Network
"Bringing the bank to the people" has proved to be a successful component of micro credit strategies. There are many ways to achieve this ranging from loan officers who regularly visit their clients, to the use of mobile bank units in branch offices or agencies. A decentralized delivery structure of financial services decreases information costs and reduces loan default risk. It also allows the growth and the diversification of the loan portfolio. It creates client confidence and promotes a sense of responsibility. For instance, the establishment of branch offices in markets helps to better integrate financial institutions into their local communities. This facilitates the provision of higher quality services and contributes to the long-term sustainability of the microfinance institution.

Group Versus Individual Lending

The problem of risk management differs by group and individual lending approaches.

Group Lending
Group lending builds upon the collective responsibility of group members to repay their loans. Proponents of group lending argue that this methodology enables lenders to reach more low-income clients at relatively low costs. However, borrower risk is greater since every group member bears his/her own risk and that of all other group members. The exposure to pay for fellow member loan defaults encourages borrowers to apply for the same loan size rather than fitting loans to the loan repayment capacity of individual group members. This may cause "negative solidarity" in the group, which means that the whole group defaults if one member fails to repay his loan.

Usually, group lending offers less flexible terms and loan repayment instalments. All group members receive and repay their loans in the same cycle. Even when graduation to individual lending is permitted, the lack of sufficient written records on borrowers hampers individual loan appraisal.

Group information advantages and peer pressure are proportional to the diversity and proximity of the members. The greater the heterogeneity of the group and/or in cases where group members live in dispersed locations the group influence is weaker. On the other hand, homogeneous groups may result in high covariant risks to the lender. There is also the potential for abuse of power and corruption by a powerful group leader. Conversely, if a good group lender leaves, then the group will be severely impaired.

Individual Lending
The main differences between the provision of micro-credit to individual borrowers and conventional bank lending technologies include the use of collateral substitutes. These comprise co-signers, third-party guarantors, household goods and other proxies. Also the loan repayment capacity of prospective borrowers is appraised.

The personalized nature of individual lending facilitates the granting of loan products that fit the client demand and his/her loan repayment capacity. At the same time, this approach encourages the development of a closer relationship and strengthens the mutual trust between the lender and borrower. It may increase the compliance with contractual loan obligations. Better client knowledge also simplifies the appraisal of repeat loans and reduces the risk of loan default. Accumulated client information may reinforce current financial services and can lead to the development of new loan products.[26]

Adjusting the Lending Terms and Conditions

Equity Contribution
Loans should never finance the total investment costs requested. Lenders require an equity contribution from the borrower to complement the external resources. This equity participation increases the stake that the borrower has in submitting a realistic loan application, thus actively promoting the success of his business. In the case of small working capital loans, it may be difficult or even arbitrary to define investment purposes. As a result, the calculation of equity participation may be difficult.

Assessment of Loan Repayment Capacity
Good micro lenders examine the loan repayment capacity and the creditworthiness of new borrowers. In assessing the loan repayment capacity they consider all income sources and expenditures of the micro enterprise household unit. The source of funds for repaying the loan does not need to be the income that will be generated by the investment that is financed with the loan. Loan officers who appraise loan applications should be properly trained, as they play a key role in the decentralized decision-making process.

Micro lenders often rely on information from local networks to verify the reputation and creditworthiness of prospective borrowers. These networks can be equally useful for enforcing loan repayments. They effectively publicize information on delinquent borrowers. Community networks have proved their value in Indonesia as well as in other Asian countries. There, the system of local organisation and the importance of personal reputation make this approach particularly effective.

Loan Repayment Schedules
Frequent loan repayment instalments, often weekly or monthly, facilitate a close monitoring of the borrower loan repayment performance. As clients build up a good track record, the loan duration and the loan repayment intervals for repeat loans are often lengthened. Some micro lenders grant increasingly individualized loan products, once the borrower has established good creditworthiness. This is often referred to as "graduation" to a next product level or client status.

Loan Collateral Substitutes and Repayment Incentives

Loan Collateral Substitutes
As most micro credit clients cannot offer conventional bank collateral, loan collateral substitutes are accepted (See *Individual Lending).* The personal value that the collateral substitute has for the borrower plays an important role. In view of the practical and legal problems that are associated with the seizure of these assets in

[26] A potential drawback of individual lending is that a lower number of clients is served. Although individual lenders employ both conventional guarantees and loan collateral substitutes, the minimum guarantee requirements may still remain beyond the capacity of most low income households. Under these circumstances, the use of group loans may be the only alternative.

cases of loan default, micro lenders often place more emphasis on assessing the creditworthiness of a prospective borrower. They prefer to closely monitor his/her loan repayment performance.

Loan Repayment Incentives
Micro lenders normally grant *small* first-time loans to new customers. Only when the first loan is paid back in time can the borrower receive a slightly larger loan. A track record of good loan repayment performance is accumulated. As a result the risk of loan defaults may be reduced. The possible access to new loans is a major loan repayment incentive for micro credit borrowers. Rewards for full and timely loan repayments on the one hand and charging of late payment fees and penalties on the other are effective means of promoting good borrower discipline.

Loan Portfolio Management

Management Information Systems
Accurate and timely information systems are crucial for good operational management. Successful micro lenders have invested wisely in the acquisition of adequate banking software, such as the FAO's Microbanking System, to computerize their accounting and management information systems consistent with their specific requirements. The required sophistication of bank automation depends on the volume and the scope of the financial services. It also depends on the organisational and operational structure of the financial institution. Ideally, loan portfolio monitoring and reporting on loan disbursements and reimbursements of branch offices should be integrated with liquidity fund management. This ensures that the necessary information is available to the head office in a timely manner.

Computerized and integrated loan accounting and management information systems that produce frequent reports guarantee that loan officers and bank management can respond promptly to potential loan delinquency problems. It is the responsibility of field staff to examine the reasons for overdue loans. Based on their reports, an immediate decision should be taken on corrective follow-up actions. In cases where legitimate reasons for overdue loan repayments exist, loan rescheduling may be allowed.

Decentralized Decision-Making
Successful micro lenders delegate loan authority and decentralize staff responsibilities in the financial institution. At the same time, adequate checks and balances need to be established to monitor decentralized decision-making. In order to encourage the prompt collection of outstanding loans, staff performance bonuses should be based on pre-set loan recovery rates as well as on the number and the volume of loans that are granted.

4.3 LIMITATIONS OF MICRO-CREDIT LESSONS FOR AGRICULTURAL LENDING

Despite the considerable achievements that many microfinance institutions have obtained, micro credit operations face some serious limitations. These refer to application of these practices beyond serving urban micro entrepreneurs chiefly in the trading sector. The purpose of this section is to identify some of these constraints as they are related to rural and agricultural lending. Certain data introduced previously in this chapter will be recapped.

Dependence on External Environment

A favourable macroeconomic and market-oriented business environment together with sound financial sector policies contributes to a thriving financial system. Pre-conditions for the provision of sustainable financial services are stable macroeconomic policies and an adequate legal and regulatory/supervisory framework for financial sector development. In particular, deregulation of interest rates allows micro lenders to charge lending interest rates that are high enough to fully cover the high costs of providing small and short-term loans to large numbers of low-income clients. Policy distortions that impose artificially low interest rates on loans to high-risk economic sectors, such as agriculture, actually ***discourage*** financial institutions from serving it.

It is not surprising that the fastest microfinance growth has occurred in Bangladesh, Bolivia and Indonesia. In recent years these countries have experienced a stable macroeconomic environment with micro enterprise development policies. Moreover, the micro credit urban and rural clientele in these countries are located in areas that have a high population density and low-income people often engaged in non-farm activities. The difficulties of microfinance institutions in other countries may be traced to less favourable conditions with fewer possibilities to invest in profitable non-farm income-generating activities.

Microfinance institutions with a narrow capital base also face serious problems to protect themselves against unexpected external shocks, such as floods and droughts. Financial support by donors has been vital in many cases to help these institutions overcome emergency situations.

Type of Clientele Served

Some micro lenders serve urban and rural customers. They tend to concentrate their activities in urban and peri-urban areas. The population density is higher and the provision of financial services is simpler and less costly than in rural areas. Many of these institutions serve women who, though usually poorer than men, comply better with their loan repayment obligations.

Although microfinance institutions often claim that they lend to the poorest of the poor, in practice most of them do not serve clients who belong to the lowest income groups. Some require one year of operations for micro business activities before they will consider clients eligible for a first time loan. Others insist on evidence of stability and continuity in family household living arrangements.

In the future, competition in microfinance may become more intense if commercial banks decide to enter this market segment. Some of the more successful micro credit clients now demand larger loans. These funding requests may be too big to be managed conveniently by most micro lenders that use standard lending technologies. This situation has led some micro lenders to revise their target market. They grant individual loans and/or serve a rural clientele.

Microfinance institutions such as PIYELI in Mali have successfully extended their lending operations beyond their current urban markets into rural areas. The new borrowers are mostly micro entrepreneurs in small municipalities, but they have also started to serve small farmers. These microfinance institutions are using current micro-credit technologies for this new type of clients. Institutions are starting with careful screening and selection of potential farmer-borrowers.

Loan Products and Lending Technologies

Micro credit borrowers tend to be engaged in commercial activities such as street vending. Non-farm business activities generate more regular income and permit loan repayment in frequent and small instalments. First-time loans are small to avoid encouraging borrowers to introduce potentially risky, major changes in their existing business activities to accommodate the receipt of a single loan. Relatively few microfinance institutions lend exclusively for farm activities. These have longer and less stable production cycles and often present a marked seasonality in their revenues.

Micro lenders use a variety of strategies to reduce their lending costs and risks. Both individual and group lending technologies are used in an effort to normalize the high costs and risks associated with lending to low-income people. However, costs and risks of servicing groups of urban micro entrepreneurs are usually lower than working with small, dispersed farmer groups.

5.0 THE NEW AFRICAN RURAL FINANCIAL MARKET

Two events have taken place in the past couple of decades that have radically changed the face of rural finance in Africa:

5.1 THE RISE OF DECENTRALIZED FINANCIAL SYSTEMS (DFSs)

The "quasi-banking" sector, including credit unions, village banks, rural banks, etc., has developed rapidly in Africa in the past 20 years. The phenomenal growth of such "semi-formal" financial intermediaries has been particularly remarkable in French-speaking West Africa, in no small measure because of the major effort undertaken by the central bank (BCEAO) to promote and strengthen the "decentralized financial systems" (DFS) sector. Networks of "mutual" or cooperative financial intermediaries has been, in general, much more successful in Africa than the Grameen Bank clones, although there are notable exceptions, such as PIYELI in Mali. There are, in addition, a multitude of other types of unique semi-formal institutions providing financial services, although these tend to focus primarily on urban and suburban areas. Without entering into the details of the veritable explosion in growth of decentralized financial institutions in Africa, it is important to recall their principal characteristics:

- Close proximity to clients ("members" in mutual institution parlance), typically within 7.5 Km of the DFS's main (and usually only) office.
- Organisation in areas where the critical mass of 360 to 450 households/clients can be assured (organisation of DFSs in areas with less than this number of likely potential clients have generally proved unsustainable).
- Society's most vulnerable people can be effectively reached.
- DFS networks are mostly free to set their own interest rates within limits determined by regulations, but at levels sufficient to encourage savings mobilisation and generation of sufficient income to cover the (market) cost of capital, operating costs, bad debts and reserve build-up, thus assuring financial sustainability.
- Independent management
- Break-even within approximately four years.
- Increasingly organized within the framework of regulations more appropriate for DFSs than the banking or cooperative regulations most had to live within formerly (e.g., instead of focussing principally on the capital ratio, i.e., total equity capital divided by total assets, prudential norms focus more on asset/liability issues, growth, liquidity ratios, and financial structure.
- Appropriation by the "base", i.e., the DFSs are generally owned by their members (who are also shareholders), and the apex, or secondary, service organisations (federations, associations, financial wholesalers) are in turn owned by the DFSs. DFSs need certain fundamental services to thrive and even survive: bookkeeping systems, service bureau and form supplies, training, credit life insurance, information, representation, auditing and examination and, fundamentally, liquidity services. All of these are difficult for individual DFSs to procure elsewhere. For that reason, apexes are frequently the weakest link in networks, but are also frequently more developed than their members DFSs.

While there are more and more successful, fast-growing DFSs all the time, growing competition is also evident between networks, and many less-competitive or less-sustainable DFSs and even entire networks are disappearing, often through merger with more successful networks, but also through liquidation, the latter frequently following the end of the donor financing that initiated the network. The donor community has, moreover, largely agreed on the components and ingredients of successful DFS development, as well as the measures of their success or lack thereof. Lastly, large national, regional, continental and international microfinance networks have developed either spontaneously or through donor encouragement, thus allowing, with the assistance of the Internet, periodic meetings, and training programmes, a wider sharing of techniques and experiences through personal networking.

Notwithstanding all these notable developments on the DFS scene, and the existence of over 15,000 individual DFSs in French-speaking West Africa alone, tens of thousands of other African communities still have no effective access to institutional financial services, and DFSs are, accordingly, still far from being able to satisfy the needs of their members and potential members for financial services:

- The DFS networks quarrel internally and with other networks and even with donors about "principles" and philosophy, such as whether they should accept infusions of "cold" (i.e., donor) funds.

- Development of the legal and prudential frameworks has not been uniform, thus putting poverty-stricken rural savers' deposits at risk, this despite the valiant efforts of institutions like the BCEAO, the (French-speaking) West African central bank.

- Much institutional development and integration remains incomplete, especially the development of apexes (service organisations, including federations, unions, associations, etc., that provide necessary services that individual DFSs have difficulty procuring by themselves) and in particular network-specific refinancing units (central funds, central liquidity facilities, etc.) using recycled DFS excess liquidity or external lines of credit to finance other cash-short DFSs.

- In general, most networks are still largely incapable to providing the magnitude of financial services that governments and donors would like to see, thus leaving project development officers and design teams in a quandary as to how best to assure that targeted groups receive the necessary assistance. If donors push the DFSs too hard by inundating them with money, the whole system tends to collapse, so donors have had to learn to be patient, and not be in too much of a rush to "deliver" credit.

Nonetheless, the practice of providing farm loans directly through project "windows" without passing through an established financial intermediary like a bank or SFD has practically disappeared. This change in practice came about not a moment too soon; the history of such project credit "windows" had been dismal, with most experiencing close to 100% loan default rates. Clearly, in close to 100% of the cases where project staff not well seasoned in the lending process get involved in credit, the projects fail to recover their loans. And even when loan recovery is relatively good, since the credit does not originate in a DFS, the whole credit process ends abruptly when project funding ceases, thus failing on the sustainability criterion. Apart from the fact that project staff don't have the expertise that a seasoned financial intermediary has, project credit "windows" also fail because of their unusually high costs and an incongruence between technical (agricultural development) goals and the objectives of financial sustainability and banking rigor. Most donor project development officers have now learned this bitter lesson, and are seeking ways to involve existing financial intermediaries, including banks, but primarily focussing on DFSs, since they are generally in much closer proximity to the targeted rural populations. Recognizing that many of these structures are not yet completely developed, donors accordingly provide limited technical and financial resources to assist the DFSs to do more, hopefully without overwhelming them with too much cash. Technical assistance will generally involve collaborating with the proposed network(s) to design financial products appropriate for both the DFS and the activity to be financed, as well as (in certain cases) helping DFS networks to connect with urban-based commercial banks willing, typically with guarantees, to provide wholesale loans to individual DFS network's central refinancing units. Financial assistance generally takes the form of subsidizing improved physical infrastructure (buildings, leasehold improvements, equipment, signage, etc.) to improve image and credibility, as well as rapidly declining operating grants to permit DFSs to staff up to meet the increased volume of operations.

One of the strengths of the DFSs is that they generally require a detailed business plan for each farmer or group of farmers, studies that are prohibitively costly for urban-based commercial banks to undertake. When considerable reflexion goes into the business plan, there is much more client buy-in, solidarity and, not inconsequentially, production gains, which permits farmers to feel comfortable about repaying their loans. One of the problems with the former paradigm of agricultural credit was that it was the project that decided what each participant needed, and provided it to each of the targeted individuals, whether that was what they really wanted/needed or not, i.e., "one size fits all." As it turns out, even if a group of farmers all cultivate the same crops, their resources are not evenly distributed. The soil of some will be inferior to others, some will have hilly or rocky ground, others will have easy access to water, whereas still others' access to water is difficult. In short, the "one size fits all" approach did not meet the borrowers' real needs, which led to poor farm results and, because they didn't benefit economically, the farmers were not too disposed to repay loans for something that was not what they wanted in the first place.

The role of the State in the development of effective and efficient DFSs is not negligible. Governments have a role in assuring an appropriate and sound legal and regulatory environment, assistance with infrastructures (particularly feeder roads to evacuate produce when agricultural credit succeeds and outputs substantially increase), and as a promoter and motivator. Considering the relative novelty of DFSs in some countries, many African governments are not yet living up to this ideal. Regulatory instruments vary widely in sophistication, ranging from complete non-existence to fairly well developed, such as in Burkina Faso, Mali and Senegal, and more recently, in Mozambique and Uganda where there has been some success in formalizing the ROSCAs[27] so prevalent throughout sub-Saharan Africa. Because of a sustained, decade-long effort undertaken by the BCEAO, in collaboration with the Canadian organisation, Développement International Desjardins (DID), with CIDA funding, the regulatory environment is probably the most effective and sophisticated in the countries which are members of the BCEAO and UEMOA. Outside that sub-region, especially, but even within that region, however, one notices considerable competition between multilateral and bilateral donors, as well as NGOs, and there is accordingly a concomitant need for better coordination, a role previously handled if at all by the State, but increasing being assumed by national microfinance associations. Some of the latter are becoming exceedingly effective in assuring effective communication of techniques between networks, in effect, a "tide that's raising all boats." Another shortcoming of many DFS networks is that they have tended to copy techniques and technology used by the commercial banking sector, instead of developing systems more appropriate for their particular type of business. A great many, probably the majority, have also adopted commercial banks' traditional fear of agricultural risk. The worldwide "microfinance" movement that focuses primarily on developing small and micro enterprises, most of which are in urban and peri-urban areas, strengthened this reticence.

In general, then, the prevailing tendency for development agencies involved in agricultural credit is to no longer create financial intermediaries (i.e., DFSs), but rather to support local DFSs' initiatives through technical training; helping them overcome administrative hurdles or roadblocks (which frequently are the objects of "conditions" attached to project disbursements); office construction, improvement or moving to more spacious new quarters; vehicles, particularly in low population density areas, where "ambulant" DFS offices have been judged to be sustainable (notably, URCPB in Burkina Faso), etc. In many cases, the project assumes DFS operating deficits on a declining basis for three or four years, five at the most. Finally, and last but not least, the Project may also provide capital, either grants to permanently increase the DFS networks' revolving credit funds, or through lines of credit, which may or may not be on commercial terms through local banks, and which may or may not involve guarantees. Because they have tended to render banks "lazy", the use of loan guarantees is being used less and less. A fundamental principle project designers must learn to observe is that they interfere in the daily management, operations and policies of the DFS ***at great risk*** to project success. For a project-funded rural credit "scheme" to succeed, it has been clearly learned that DFSs must be free to operate with ***their own*** rules and procedures. At the most, we may help them adapt some of their current products to the particular needs of our target group, but in the end, if the DFSs are not completely in agreement and if they have not fully participated in the development of the scheme, and "bought in", the likelihood of failure is exceedingly high. In French-speaking West Africa, the cost of thus supporting individual local DFSs has varied from around 5 to 12 million CFA Francs (about $7,000 to $18,000), not counting any lending capital funds provided.

5.2 COMMERCIAL BANKS, TOO, ARE DISCOVERING THAT MICRO-CREDIT CAN BE PROFITABLE

Following successive structural adjustments, privatisation or liquidation of marketing boards and agricultural development banks, and liberalisation of agricultural markets, commercial lending to government and parastatal bodies naturally declined. A number of African commercial banks, such as Financial Bank, accordingly have been seeking new markets, and have begun experimenting within the micro-lending market. Most banks still are still not too interested in the costly retailing of micro-finance services to widely dispersed poor populations, though. They are most interested in partnering with and providing wholesale loans to NGOs, SFDs, MFIs and RFIs that already have a track record in lending and successfully recovering loans to the poor. Less liberal-minded commercial banks will require donor guarantee funds before agreeing to finance RFIs. Such guarantee funds tend to render participating banks somewhat lazy, and both lending and recovery tends to become sloppy, since the bank will get its money back even if the loans go into default. For that reason, guarantee funds are generally not recommended in agricultural lending programmes. Still other commercial banks still won't consider at all the financing small micro-loans to low-income farmers, even when the deal is sweetened with a guarantee fund..

[27] ROSCAs are Rotating Savings and Credit Associations, where generally a small number of friends periodically contribute (typically monthly or weekly) a fixed sum and give the entire sum collected at each meeting to one of its members, according to some established order. ROSCAS are also variously called susus, njangis, stokfels, tontines and many other names. Some act as intermediaries and grant loans to members, so that income is generated and which is split among all members at the end of the year, and there are a thousand and one variations on this theme. ROSCA's could conceivably be used to finance irrigation equipment, but the author is unaware of any actual cases of that. For more information on ROSCAs, see Bouman, 1994.

The lesson here, though, is that times have changed. That is, while in the past, loan applications for agricultural credit would have been disregarded by nearly ***all*** commercial banks in Africa, now many are willing to consider the possibility and negotiate. If they think they can profit by lending to a well-managed RFI, they may well be convinced to do so. So, when designing your next agricultural development project, instead of just assuming that commercial banks won't be interested in financing micro-loans to the agricultural sector, go and meet the banks' lending officers, and you might be pleasantly surprised. The conditions and paperwork may be formidable, but they may well be doable. Project design officers should not be overly optimistic about being able to successfully negotiate a deal with a commercial bank, but don't dismiss the possibility out of hand, either.

Another source of finance in a few African countries are the handful of remaining Agricultural Development Banks (e.g., ADB in Ghana and BNDA in Mali). These banks have been reorganized, and have moved to market interest rates, which make them quite expensive. However, as previously discussed, most small farmers are not overly sensitive to interest rates; ***timely access*** to the funds they need is much more important to them than the funds' cost.

So, again, in designing your agricultural development projects, don't forget to discuss your plans with the local ADB, in those few cases where they still exist, and with commercial banks. You may be surprisingly well received by them.

6.0 TYPES OF IRRIGATION FINANCE

Individual or group irrigation projects can generally be financed four ways: self-financing by the farmer(s); through borrowing (credit); by leasing of irrigation equipment; and through outright grants of equipment to farmers. Some projects have used combinations of these different methods. Since it is generally no longer accepted as a sustainable approach, farm equipment grants are not further discussed in this document. The other three types of irrigation finance, however, are all discussed below.

6.1 SELF-FINANCING

In the era of large irrigation projects involving the importation of expensive European power pumps, the question of self-financing was generally not relevant. Poor farmers for the most part could access such technology only through credit, grants or leases (the latter being very under-developed in Africa). However, along with the development of very inexpensive ($20 to $100) micro-irrigation technologies (treadle pumps, drip systems, low-pressure sprinklers, etc.) in recent years, it now becomes possible for many African farmers to buy this technology outright directly from their meagre savings, instead of taking out loans. In fact, one of the principal advantages of the new micro-irrigation technologies is that once they are being mass manufactured, their prices are low enough for a majority of African farmers to buy them for cash. Irrigation projects can accordingly completely sidestep the many heartaches of agricultural credit programmes. The very poorest farmers may still need credit to avail themselves of this technology, though.

From an equity point of view, this author would argue that if one is going to invest several million dollars to develop irrigation systems in a given African country, it makes more sense to invest in a technology with the potential of improving the lives of millions of poor farmers, instead of just a few hundred workers on a single large perimeter, as previous irrigation projects have tended to do.

6.2 IRRIGATION CREDIT

In practice, credit has been used to support irrigation in three ways:

1. The original feasibility study
2. The investment cost (acquiring equipment, such as motors, pumps, hoses, sprinklers, drip systems, wells, ditches, canals, etc., including transport and installation costs)
3. Operating costs (labour, fuel for equipment, maintenance and repairs costs, etc.)

Drip System in Use

Type 1 credit is extremely rare, since the prevailing view of financial institutions is that it's the job of the borrower to determine whether his business venture is likely to succeed or not. Furthermore, if it turns out to be not feasible, and the loan is not granted, how is the borrower supposed to repay the cost of the study? Type 3 loans are commonly referred to as "agricultural campaign" or seasonal "operating cost" loans. The up-front investment cost (type 2) loan normally finances only the portion not covered by the prospective borrower's contribution (however calculated, typically from 10% to 25% of total cost) or by a government or project subsidy, if any. A wide variety of repayment terms exist, depending on local conditions, beliefs and expectations, as well as on lenders' preferences. Repayments sometime start small and accelerate over time, but the opposite case also exists where substantial repayments are expected after the first harvest, if not monthly. Similarly, a variety of approaches to calculating interest have been used, some strictly market-based, some subsidized, or lower negotiated terms are negotiated with the lender (typically a commercial bank) using the "carrot" of a loan guarantee to negotiate a lower-than-normal interest rate. Sometimes, particularly in the case of DFSs, the lender has a policy of charging the same rate of interest on all loans. In many cases, governments and central banks impose, paradoxically, lower rates for agriculture than for other sectors, supposedly to "promote and encourage" the sector. Since the risk of lending to agriculture is actually higher than in other sectors, rational lenders would normally use ***higher*** rates of interest in that sector. The end result of this flawed policy is that financial institutions actually lend ***less*** to agriculture than if the rates were completely deregulated, the exact opposite of the intended result. Nearly all development agencies now agree, however, that interest rates should be market-based and full cost-covering. Project design officers proposing subsidized interest rates for irrigation loans in a proposed new project will almost certainly see their proposals quickly rejected by donors. "Let the market rule!" is now clearly the law of development finance. It is generally accepted now that subsidies, if at all required, should be concentrated in the areas of ***market creation*** and ***capacity-building***, technical assistance and the financing of physical infrastructures, NEVER through artificially-low interest rates. Let us now examine each of the three types of irrigation credit in some detail:

6.2.1 Financing of the Initial Investment

The financing of the initial purchase of equipment and/or construction is the most common and most widely used form of Irrigation Credit. This type of credit has historically suffered from two principal problems:

- A failure to understand that equipment rated to last 10 years in a developed country, say in Europe, may only last three to five years in the harsh environment of a developing country, and also because users tend to use their equipment over and above the limits prescribed in their manufacturers' specs, in an attempt to maximize water output, but which ironically end up greatly decreasing the equipment's useful life. This leads to repayment schedules stretching far too far out into the future, so that the machine is usually already on the scrap heap long before the loan's final due date. It also means that the residual value of repossessed equipment in the case of loan default is far less than the book value of the loan, causing substantial losses to the lender.

- Not forecasting and building in the need for replacement equipment in case of breakdowns. If the project provides, say, 100 pumps on credit to 100 rice farmers, and some of them break down during the production period, and the pumps are not rapidly repaired or replaced, the crop will most likely be ruined, and the loan will not be repaid. So, project design officers, make sure you build in replacement equipment, and an appropriate mechanism for farmers to access them (probably involving rentals). The other half of this problem is not forecasting adequately the need for replacement ***parts*** and making sure that there is someone competent, preferably private sector technicians, readily available to repair the equipment. Ideally, the equipment is manufactured, or at least assembled, within the country, so that one doesn't have to go through the lengthy process of ordering the replacements from Europe, Japan, China or India, the principal sources of imported irrigation equipment. Although one would think foreseeing the need for maintenance, repairs and replacements is obvious, a great many irrigation projects have failed precisely for this reason.

The above two problems can also be seen as two aspects of a single overall problem, i.e., the lack of a "machine culture" in most of Africa. The "deepening" of machine culture will take generations, and it is unrealistic for project design officers to think that a 3-5 year project is going to be able to successfully introduce the masses to complicated foreign machinery, technology and systems.

Typically, in the past, depending on the degree of subsidisation by the State or the project, the loan repayment schedule for the construction of wells is normally set up over a two to three year period. In the past, mechanized water extraction and delivery systems, on the other hand, have often been quite expensive, and were usually set up to be repaid over a much longer period, typically 3 to 5 years for gasoline or diesel motor pumps, and about 7 years for electric pumps. It should be noted that subsidisation of the initial investment in irrigation, common practice during the colonial period and in the three decades after independence, is rapidly disappearing. This makes such equipment effectively much more expensive for the borrowing farmers, and also motivates project design officers to seek out more inexpensive sources of such equipment. Another fast-growing tendency in the irrigation area is the currently controversial but sometimes successful practice of ***leasing*** (more later on this subject). There are also some ongoing, but as yet inconclusive, experiments with wind and solar powered irrigation equipment. With respect to the latter, however, clearly differences in wind patterns and the quantity of sunshine would make these options much less feasible in certain areas. Neither these latter options, nor leasing, are treated in great detail in this paper.

In summary, as concerns funding of irrigation equipment other than simple wells, the usual practice up to the present time is for the borrower to fund 1/3 of the investment cost (after deduction of subsidies, but that is becoming increasingly rare) from his own resources, thus demonstrating his commitment to the project, and 2/3 funded by a loan, itself typically repaid over a five year period.

The Special Case of Financing Agricultural Engineering Projects (Ditches, Terraces, etc.)

The financing of agricultural engineering projects (irrigation canals, drainage and levelling) has different characteristics and, accordingly, typically involves somewhat different financial terms. First of all, there is more frequently some government involvement and financial participation, typically through the project, generally no more than 50% of total cost (as in the PDIAIM project in Mauritania, for example). Beneficiaries are generally required to contribute from 10% to 25% of the cost, which may permit some in-kind (labour) inputs to meet the requirement. The balance not paid by government or farmers' contributions become loans to these same farmers. The repayment period for this type of loan is typically 10 years, and sometimes using subsidized/lower than market interest rates, although experience has shown that practice to be unwise, and it is treated almost universally now with disdain. Moreover, the involvement of the State in this type of project is now almost totally reserved for large perimeters, especially rice, and benefit only a small number of farmers.

There is some data which show that the annual fixed cost (i.e., depreciation) represented by this kind of investment in a 40 to 100 hectare perimeter is between 8% and 15% of the total production cost (including depreciation and interest).

6.2.2 Annual Working Capital Loans

In general, loans to finance the cost (fuel, maintenance and repairs, and labour) of operating water extraction and delivery systems are geared to the production cycle, like any other agricultural loan. This type of loan also typically requires the borrower to finance a significant portion (typically 25% to 50%) of his/her operating costs over the production cycle, typically of from 5 to 10 months. Unlike the case of initial equipment financing, most financial institutions currently financing this type of loan require formal guarantees (hypothecations), such as blocked savings accounts, hypothecated harvests, valuables (jewels, etc.) or guarantors. Increasingly, especially in the microfinance world, "joint and several" agreements signed by all the borrowers of a group is being considered as sufficient guarantee.

Further, experience shows that the effect of borrowing to invest in water extraction and delivery equipment typically increases operating costs by from 30% to 60% over what they would have been in the absence of the new equipment. For this reason, those few financial institutions that have substantial experience in this area, such as the CNCAS in Senegal, typically establish tables specifying the maximum amount of operating costs they are willing to fund per hectare. These are only general indications, however; it is impossible to provide norms in this area, since costs such as fuel vary so widely from country to country. Suffice it to say that if someone has borrowed to finance the original investment, the cash flows are such that he/she will probably also need an operating cost loan, too, and the key to success here is to try to minimize those costs.

6.3 LEASING OF IRRIGATION EQUIPMENT

Leasing of irrigation equipment is not well-developed in Africa. In fact, the only African irrigation leasing programme that the author of this document is aware of is a pilot programme operated by the GIE[28] Hari Goumo in Timbuktu, Mali. This programme was started with the help of the Belgian NGO "Iles de Paix". A number of European motor pumps costing approximately $6,700 each were brought in, with donors subsidizing 50% of the cost, the balance becoming loans to be repaid by the GIE Hari Goumo. The latter, in turn, rented out the pumps at the rate of about $670 per season. Iles de Paix had proposed to rent the pumps by the hour, but those renting them quickly revolted against that approach, preferring a flat fee for the season. The pilot project eventually failed, for the following reasons:[29]

- The European motor pumps were not economical in the African environment. They were too expensive to ever be profitable. One of GIE Hari Goumo's partners, the HIPPO Foundation of the Netherlands, has shown (see Attachment 4), though, that essentially identical pumps can be purchased from India or China for as little as a third of the cost of European pumps. If these were used, the use of power pumps might well become a profitable venture. Part of the problem here was that pumps rated to last 10 years in Europe will be lucky to last half that long in Africa, but the rent was based on a ten year life.
- Lessees tended to over-use their pumps, which caused them to break down very quickly. For example, instead of using them to irrigate the maximum 6 Has rated for the pump, farmers would irrigate 12 Has.

[28] Groupement d'Intérêt Economique
[29] Arby, D., pp. 8-11

They would also use them for a longer number of hours than the specs called for, trying to maximize the throughput and "get their money's worth." The lessor had no system to monitor the proper or improper use of rented equipment.

- Similarly, farmers did not properly maintain their power pumps. For example, instead of changing oil every 150 hours, they replaced the oil after 400 hours; changed the oil filter just once before returning the pump, instead of the prescribed once a month; and using cheap, dirty oil and fuel, instead of more expensive name brand oil and fuel available from reputable petrol stations. This also contributed greatly to the early demise of these expensive pumps.
- Lessees were expected to pay half the rent in advance, and half at harvest, but most failed to pay the last half at the end of the season.
- When, as they often did, pumps broke down, backup loaner pumps were not available for farmers to use while their own pump was being repaired. This alone caused many rice farms to fail utterly.

The members of the GIE Hari Goumo have recognized all these errors and problems, and are seeking funding for a second attempt, this time including a number of measures to overcome difficulties encountered in the initial efforts at motorized irrigation. Measures which the GIE Hari Goumo proposes to make leasing of motor pumps more of a viable approach include the following:

- Creation of one or more private structures (NGOs or for-profit companies) specialized in the rental of a variety of power pumps, so that the user obtains a pump appropriate for his/her size of farm.
- Assistance (material, financial and technical) by lending institutions and NGOs to create the necessary support structures, train their personnel in the proper maintenance and repair of the chosen brands of power pumps, assuring proper stock management so that spares will always be available when break-downs occur, and to assure that there is a constant surveillance of how the pumps are being used.
- Standardize on a single brand of power pump, while permitting a number of different models for different size farms, thus facilitating training, repairs, maintenance of sufficient stocks of spare parts, etc.
- Uniformisation of rental rates among all those renting power pumps
- While leaving the details of rental payment procedures to each lessor, experience has shown that collection of even part of the rent at the end of the season is problematic, so payment of the entire rent in advance is highly recommended.
- Intensive training of all pump operators in the correct use and maintenance of their power pumps.

Let us hope that the next attempt by GIE Hari Goumo will be more successful. It will be interesting to follow the case's evolution, and if it proves more successful than previous efforts, it may become a model to be replicated elsewhere. It should be recognized, however, that the Timbuktu area has a considerable history of using power pumps, going way back to colonial times. GIE Hari Goumo has inventoried well over a thousand power pumps which have been used in Timbuktu region alone since the 1950s, almost none of which are still functioning. Still, this puts Malian users a little ahead of most other power pump users in Africa in their integration into the modern "machine culture."

With this one rather inconclusive case of irrigation equipment rental, it is not possible at this time to definitely recommend leasing as a viable option in Africa.

Those interested in pursuing this approach, however, should take note of the lease agreement (Attachment 3 to this paper) used by GIE Hari Goumo, and try to improve it based on the above discussion.

7.0 PROBLEMS IN IRRIGATION FINANCE

Experience to date with the FAO's SPFS provides some information on problems encountered and lessons learned from past efforts in the area of financing irrigation development projects. Those familiar with agricultural credit will undoubtedly note that many of these problems are not intrinsic to irrigation, but rather apply generally to all types of agricultural lending. The difficulties encountered generally fall into four categories:

7.1 THOSE LINKED TO FAULTY INITIAL PROJECT DESIGNS

Probably a majority of irrigation finance problems are the direct result of defective project design. Some of the most common project design errors include the following:

7.1.1 Giving Lip Service Only to the Participative Process

Despite considerable effort and lip service by various parties, the ***participatory process*** continues to be mostly artificial. Most often, it consists only of "sensitisation" meetings explaining technical decisions already taken elsewhere by "experts." Many of these schemes hatched by foreigners with little knowledge of local customs and conditions, often too complex for potential participants to understand and become effective partners. Beneficiaries, often only represented by a few leaders, are typically presented with a ***fait accompli*** (the programme will provide you with such-and-such equipment, which will cost you so much, and which will provide you so much income and profits…). A sensitivity ("what if…?") analysis is almost never presented to help potential borrowers assess the risk of success or failure.

With the exception of certain World Bank efforts (notably the PSAN project in Burkina Faso and the PDPI project in Senegal), which seem truly well appreciated by beneficiaries[30], generally irrigation projects have deliberately bypassed this preliminary phase so absolutely necessary for success of briefing beneficiaries on what is going to happen. These two projects succeeded because they not only fully involved participants in the conception of the programme, but also in the specifics of project implementation, and even in project monitoring and evaluation!

Nearly everyone gives lip service to beneficiary participation in project design, but very few project designs, in reality, adequately involve those who will be most affected by their execution. This is frequently due to the need to write project proposals quickly, and as the old adage goes, "haste makes waste."

7.1.2 Inappropriate/Excessively Costly and Complex Technical Solutions

When faced with the choice between a simple, inexpensive solution and a costly, complex one, many professional project design officers desirous of displaying their command of the subject matter, have a tendency to choose the latter, thus violating one of the most fundamental rules of development work, the KISS ("Keep it simple, stupid!) principle. As one micro-irrigation expert puts it, "Western entrepreneurs and trained engineers have difficulty unlearning enough of what they've been taught to innovate, design, and market micro-irrigation systems that are affordable enough for poor farmers to take advantage of them."[31]

Typically, the family income is only two or three hundred dollars a year, far too little to afford the modern irrigation devices available off the shelf that are often promoted by development "experts." However, without improved irrigation, they cannot fully benefit from green revolution inputs. Furthermore, many development experts expect that in an open marketplace, small inefficient farms will be taken over by larger and more efficient farms. In the face of rapid population growth, however, actual farm size in developing countries is instead steadily decreasing! The failure of the development community to take these simple facts into account is a major factor constraining emergence of practical solutions to both improved irrigation performance and to hunger and poverty.

In addition, bilateral donor-funded agricultural development projects frequently also have an inherent, built-in problem. That is, statutes in the donor country require that equipment used in development projects be

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30 LeBrun, P. 7

31 Paul Polak of IDE, quoted in "Engineering Low-Cost Micro-Irrigation for Small Plots", by Jack Keller, Deepak L. Adhikari, Michael R. Petersen, and Sudarshan Suryawanshi, Page 1.

manufactured in the donor country. It doesn't matter that the donated equipment may be five times as expensive as alternative irrigation equipment made locally in Africa or imported from India or China. It also may not matter that a much less complex and vastly less expensive solution may be more appropriate. Previous experience with complicated equipment or technologies such as power pump-ased irrigation and animal traction in areas with little tradition of using them has often been disastrous, as project designers have greatly underestimated the difficulties of introducing such new technologies in milieus where the population has no experience with machines or care of animals. For example, instead of using expensive European motor pumps, it may be possible to pump the water much more cheaply and with less dependence on foreign technology, spare parts, etc., by using alternative equipment like locally-made treadle pumps and rope pumps. Accordingly, those of us in the business of designing irrigation development projects or project components need to make a much more eloquent and convincing effort to convince bilateral donors that if they really want to sponsor sustainable development, then they should agree to less costly and less complex designs, i.e., that most of the time, "small truly is beautiful." Donors have to be made to realize that their insistence on using equipment manufactured in their country of origin will at least seriously undermine the project's probability of success, and at worst render profitability and sustainability completely impossible.

Some project design officers' continuing preference for expensive and complicated irrigation solutions is difficult to understand, particularly since the benefits and advantages of focusing more on micro-irrigation equipment have so been well documented:

- By replacing surface systems and practices that have traditionally been used to irrigate small plots with low-cost micro-irrigation systems, the area of land that can be fully irrigated from a given volume of applied water can be significantly increased. However, of perhaps even greater importance from a basin-wide water resources perspective, the production per unit of water depleted by evaporation and transpiration is often increased by 30 to 50%. The improved use of increasingly scarce water resources is well suited to peri-urban irrigators, with water consumption reductions of up to 60% in comparison to traditional (furrow) irrigation. Furthermore, the availability of affordable micro-irrigation systems in small kits unlocks these potential benefits for literally millions of resource-poor farmers who have access to as little as 20 to 500 m^2 (1/8 acre) of land. In addition, it opens the potential benefits of irrigation even to small holders where water supplies were considered insufficient or too costly to acquire for traditional irrigation methods to be practical. These technologies are significantly lower in cost, available in small packages, operate at very low pressures, and are easier to understand and operate.[32]
- Labour savings
  - Through reduction of time spent in water control in the field
  - Through reducing the gross water requirement for a given area and therefore the time spent in water acquisition
- Opportunity to exploit a limited water supply
  - From a manual or small motorized pump
  - Where water must be carried over a distance
  - From a small or erratic stream or canal flow.
- Improved conveyance and application efficiency, leading to a saving of water and a reduced risk of raised water tables
- Improved control over the timing and depth of irrigation, permitting more accurate application of fertilizer, and hence leading to possible improvements in yield and quality of output; Potential benefits of tapping shallow aquifers and not mining deep water.
- Effective irrigation of coarse or shallow soils and sloping lands (avoids need for land forming/terracing)
- Reduction in the land taken up by the distribution system
- Better use of poor quality water, provided appropriate management practices are adopted
- Reduced risk to health by elimination of standing water
- Unaffected by wind (as regards drip systems)
- Avoids leaf scorch and reduces risk of foliar fungal disease (as regards drip systems)
- Localized soil wetting reduces evaporative losses and weed growth between rows
- Operates at relatively low pressure thereby saving energy, and in many cases eliminating the need for expensive pumps
- Simple to install and easy to operate by men, women and children and ideal for vegetable cultivation, but is also used extensively to irrigate small plots of HYV paddy. In Asia, at least, water-saving micro-irrigation

[32] Keller, et al., p. 1.

of wheat, tobacco and jute enabled irrigators to harvest remarkably higher yields compared to rain-fed farming.
- The benefit:cost ratio on treadle pump investment is in the neighbourhood of 5:1; the Internal Rate of Return (IRR) is variously estimated to be around 100%; the payback period is usually less than a year. For a marginal farmer with US$50-100 to spare, there are few 'capital investment propositions' more attractive than a treadle pump.[33]
- Scalable, divisible and portable technologies with low capital investment requirements ($100 or less, sometimes under $10) with potential for poverty alleviation via wealth creation
- Improved household nutrition levels
- Low operation and maintenance costs.

Specific areas with the greatest potential for successful micro-irrigation include:
- Areas with chronic water shortages
- Hillside farming systems in proximity to good urban markets
- Fadamas, dambos, and goulbis
- Peri-urban zones of major cities.

As previously stated, a key factor in the disappointing performance of many poverty alleviation initiatives is their failure to address the fact that most of the farms in developing countries are less than two hectares in size. The key to tripling the global harvest through modern seeds and inputs has been irrigation, but until recently commercial irrigation devices have been too large and too expensive for small farmers. This has left them on the outside, looking in on many of the accomplishments of modern agriculture. Yet because small farmers are themselves poor, and are disproportionately concentrated in food deficit rural areas, increased productivity and income is central to practical approaches to poverty alleviation. For most small farmers in developing countries, affordable small plot irrigation may be the first step to wealth creation.[34]

Similarly, in some cases, the basic problem to be solved by the project is misdiagnosed during the project identification and design process. For example, the "problem" to be resolved by a proposed new project is often stated in terms of "low production or low yields." However, with post-harvest losses typically 30% or more of the entire harvest, a more viable project concept might well be warehousing grain until prices rise shortly before the next harvest. If farmers could sell that lost 30% or more rather than losing it to spoilage, or sell the ***entire*** crop at a much higher price later in the year, their profitability would increase dramatically without having to get involved in complex, expensive, and unproven imported technologies. If post-harvest losses aren't directly addressed by your proposed project, just remember that even the doubled or tripled production your costly and complex project may produce is also subject to PHL.

7.1.3 Lack of a Market Development Approach

The strategy of subsidizing the cost of conventional irrigation systems to farmers with small plots has generally been proven to be unsustainable. It has not been a very efficient mechanism for addressing the needs of farmers of small plots, nor has it resulted in the expected improvements in irrigated agricultural performance. A growing number of irrigation experts believe that for economically sustainable success, the uptake of micro-irrigation systems for use on small plots should be ***demand driven*** and without direct subsidies. Thus the systems must be financially feasible (or affordable), and farmers should be willing to pay the ongoing costs (including reasonable profit margins) associated with producing and marketing them once the market demand is well established.

Funding the development of low-cost systems and establishing the demand driven markets for them is proving to be a very appropriate and cost-effective role for donors, replacing the direct subsidies provided to farmers in previous irrigation projects. Product development, supply chain and market development, and product promotion are technologies that Western countries providing technical assistance are quite effective at.[35]

What characterizes the present approach to smallholder irrigation development (as opposed to earlier approaches of appropriate technology) is the shift in emphasis from the technology development phase (although this phase

[33] Shah et al., p. 29.
[34] World Bank, Winrock International and IDE. 2000. Executive Summary, Page iii.
[35] Heierli, U., page 3 and Heierli, U. and Polok, P., pp 1-31. Readers wishing a more in-depth explanation of the "market creation" approach around which donor thinking on irrigation finance is coalescing should consult these two documents. The diagrams on the following pages have been adapted from those developed by Mr. Heierli.

is still important) to the phase of developing a private sector-led supply chain and rural mass marketing of the equipment. The overriding principle of all the successful approaches is that they ***treat farmers as entrepreneurs*** motivated by profit who make investment decisions based on information available to them. Successful technology transfer depends on finding farmers who fit this profile and using them as demonstrators who will influence their less entrepreneurial or more risk averse neighbors.

Components of the Market Creation Model:

1. ***Feasibility Study*** building on previous local irrigation experience and emphasizing the participative approach, as well as identifying opportunities for marketing increased production (especially high value crops where local smallholders may have a comparative advantage) resulting from irrigation.
2. **Development of the Technology Package**, involving decisions about importing vs. local manufacture, types and sizes of micro-irrigation equipment and kits, principal crops to be promoted, aiming at a limited product line that is affordable to poor farmers and ***that can pay for itself in a season or, at maximum, a year***.
3. ***Supply Chain Development***. Once the product(s) are identified, they must be procured or manufactured, preferably the latter, as the Kenya experience shows (see following page). Although drip tape is not produced in many developing countries, PVC pipe and other plastic products are widely produced. Micro-irrigation kits can easily be produced using micro-tubes, which can be manufactured with a minimal upgrade at a PVC pipe factory. The method of manufacture is linked to the selection of technology and these decisions must be made in tandem. Also, it is critical to determine how and by whom the products will be distributed. It is desirable to have as wide a distribution network as possible, not just to one target area within the country. Local agricultural outlets, hardware stores, etc., are logical candidates for retailers. The structure and relationship of manufacturer, wholesaler and retailer needs to be determined for each programme. Questions of quality control, guarantees and other issues need to be resolved. Various types of supply chains have been developed, and it is essential that all parties in the chain make a profit to ensure sustainability.

   In the development of supply chains, provisions are made for private sector enterprises to supply the associated inputs (seeds, fertilizers, soil amendments, plant protection agents, etc.) that the smallholder farming community will need to take maximum advantage of the water-related technologies. In addition, provisions are made for the private sector and/or government agencies and NGOs to provide necessary farmer training.

   The availability of credit is a major factor in the successful mass dissemination of productivity-enhancing technologies for the smallholder; special consideration is given to building into the supply chain mechanisms for credit for the smallholder.

4. ***Rural Mass Marketing***. In order to convince farmers to buy new technology, major efforts must be put into marketing. This may take different forms depending on the country.

5. ***Agricultural Production: Adding Value to Product, and Output Marketing***. With micro-irrigation, farmers may be producing high value crops with which they are unfamiliar. They may need training on variety selection and management practices. Farmers may also need training in the use of post-harvest practices and on-farm processing in order to add value to their products, and to gain access to profitable and stable markets. Promotion of high value crops may involve policy dialogue with the host government to facilitate relevant infrastructure development and the creation of new markets. Marketing may also involve improved storage and preserving (drying, pickling, cooling, freezing, canning, etc.) of high value crops carried out on an industrial scale.

6. ***Impact Measurement and Feedback***. In order for the programme to work effectively, managers must be able to monitor impacts in order to continuously adapt the program to meet its objectives. Programs may need to adapt new technologies, tap new markets, or find new sources of donor funding. In order to respond to changing conditions, programme staff members need to monitor sales, redefine the target smallholders and measure the impact that the technology is having on incomes, employment, and other factors. This data needs to be fed back to the programme to enhance profitability, build sustainability, and ensure greater incomes for the target smallholders.

   The process involves a number of actors with a variety of skills to be obtained through the establishment of a network that would include a variety of organizations including donors, NGOs and other implementers, host governments and the private sector. There is a strong need for coordination of the programme to assure that parties work together towards a common goal. A network secretariat would have a major objective of promoting coordination among all the actors involved in promoting smallholder irrigation.

Two case studies in Africa (Kenya and Zambia) illustrate the importance of some of these components:[36]

In Kenya, bucket kits were distributed by the Kenya Agricultural Research Institute (KARI). This experience provides two important insights into problems associated with production and distribution. The bucket kit is manufactured in the U.S. and shipped to Kenya in container-lot quantities. Although the shipping costs per kit are relatively low, delays hinder the availability of kits. An entire container is expensive, so the programme must depend on a large influx of funding to import the kits. This means that the programme is not run as a sustainable business. Second, the kits have been distributed only at the national headquarters of KARI and several other outlets. They are not available through the private sector at local outlets. Although the programme has conducted a good demonstration programme both at the national headquarters and at local agricultural field days, it lacks a consistent advertising campaign. Only sporadic advertisements and newspaper articles have announced the availability of the kits. This has resulted in uncertainty and reliance on distribution through NGOs, which buy a number of kits for their target farmers. Finally, spare parts are not readily available as there is no national supply chain of kit retailers.

Market Linkages. The Zambia Dambo development project provides a number of interesting lessons learned. First, the programme emphasized local production of treadle pumps, which lowered costs from $200 to between $60 to $70 per pump. The contractor, IDE (International Development Enterprises), has operated the project in 4 areas of Zambia with 128 retailers, with emphasis on demonstrations to reach farmers. Farmers have been linked to micro-credit. The dispersed nature of the population and poor transportation and other infrastructure has hindered adoption. The most significant lesson is that farmers who are linked to established horticulture markets realize the highest incomes. Generally, limited access to markets has prevented many farmers from full adoption of the technology. Zambian farmers tend to be dispersed, and although access to land and water in dambo areas is good, farmers are generally located far from markets, and are constrained by poor road infrastructure.

The various components required in a “market creation” approach are illustrated in the diagrams on the following two pages.

Given the complexity of the market creation approach, and if sufficient funds are available, it would seem desirable to place the overall management of the development of such systems in the hands of experienced micro-irrigation consulting firms, such as IDE, EnterpriseWorks, HIPPO Foundation and SE3WE (these firms’ coordinates can be found in Attachment 2), that already have considerable experience in Africa. For a listing of known micro-irrigation equipment manufacturers, consulting firms, and other experts, please refer to Attachment 2. The first stop in your search should probably be the IPTRID (International Programme for Technology and Research in Irrigation and Drainage) secretariat located in FAO headquarters in Rome (see Attachment 2 for contact information).

7.1.4 “One Size Fits All” Project Designs

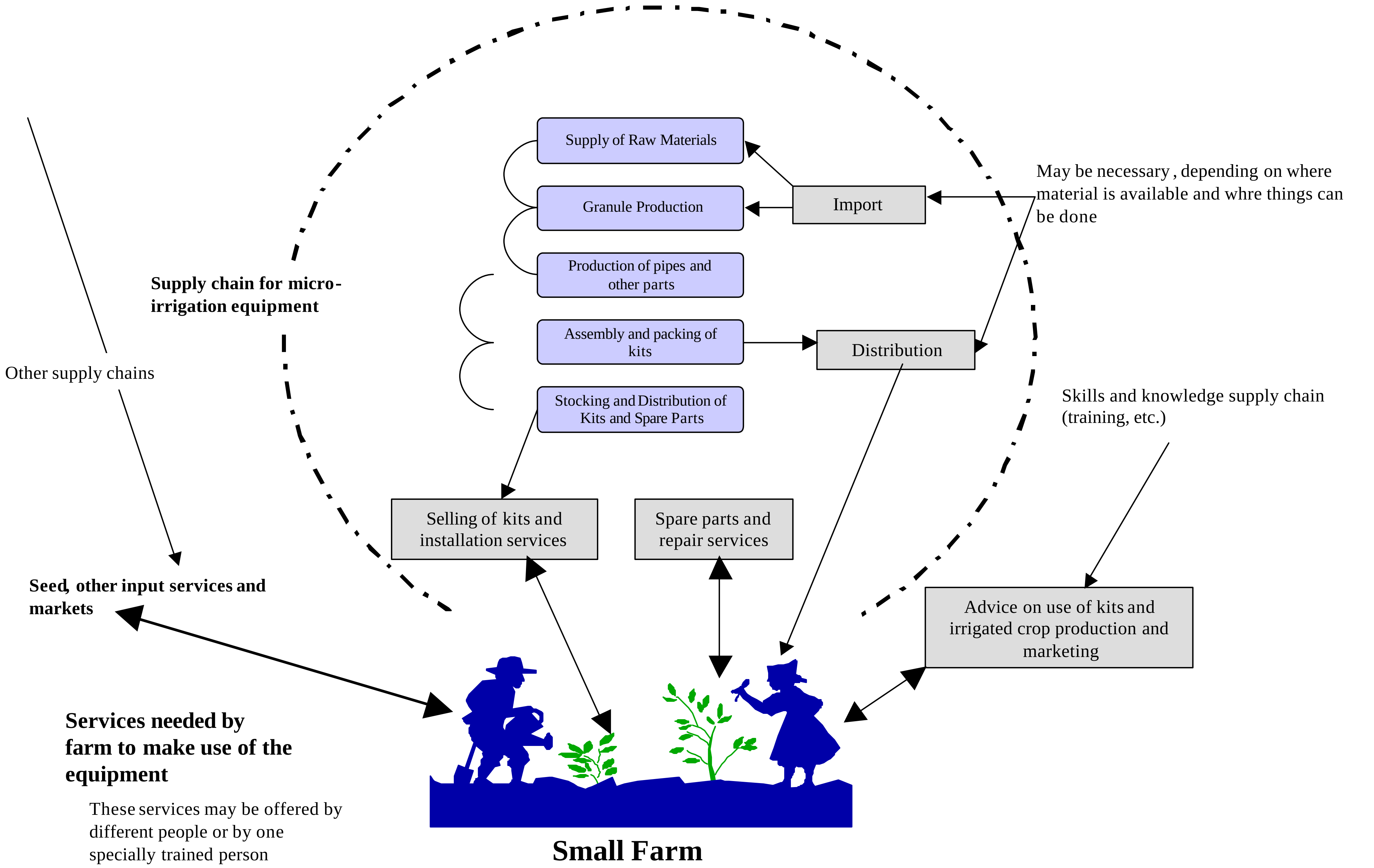
Unfortunately, most previous irrigation projects used a “one size fits all” type technological solution. Typically, all participants received the same expensive European motor pump, irregardless of the size or condition of their farm, received the same chemical inputs, etc. Unfortunately, though, each farmer’s situation is different, and the approach should be tailored to his/her circumstances. Even neighbors’ farms can be vastly different, requiring different approaches and inputs. The ultimate result was that many farmers were coerced into borrowing money to pay for expensive, inappropriate solutions, and when they didn’t benefit after the technology failed, they felt little obligation to repay the loans.

Several factors combine to determine what technology is most appropriate for a given farmer, requiring a customized solution for each farmer, depending on various factors such as:

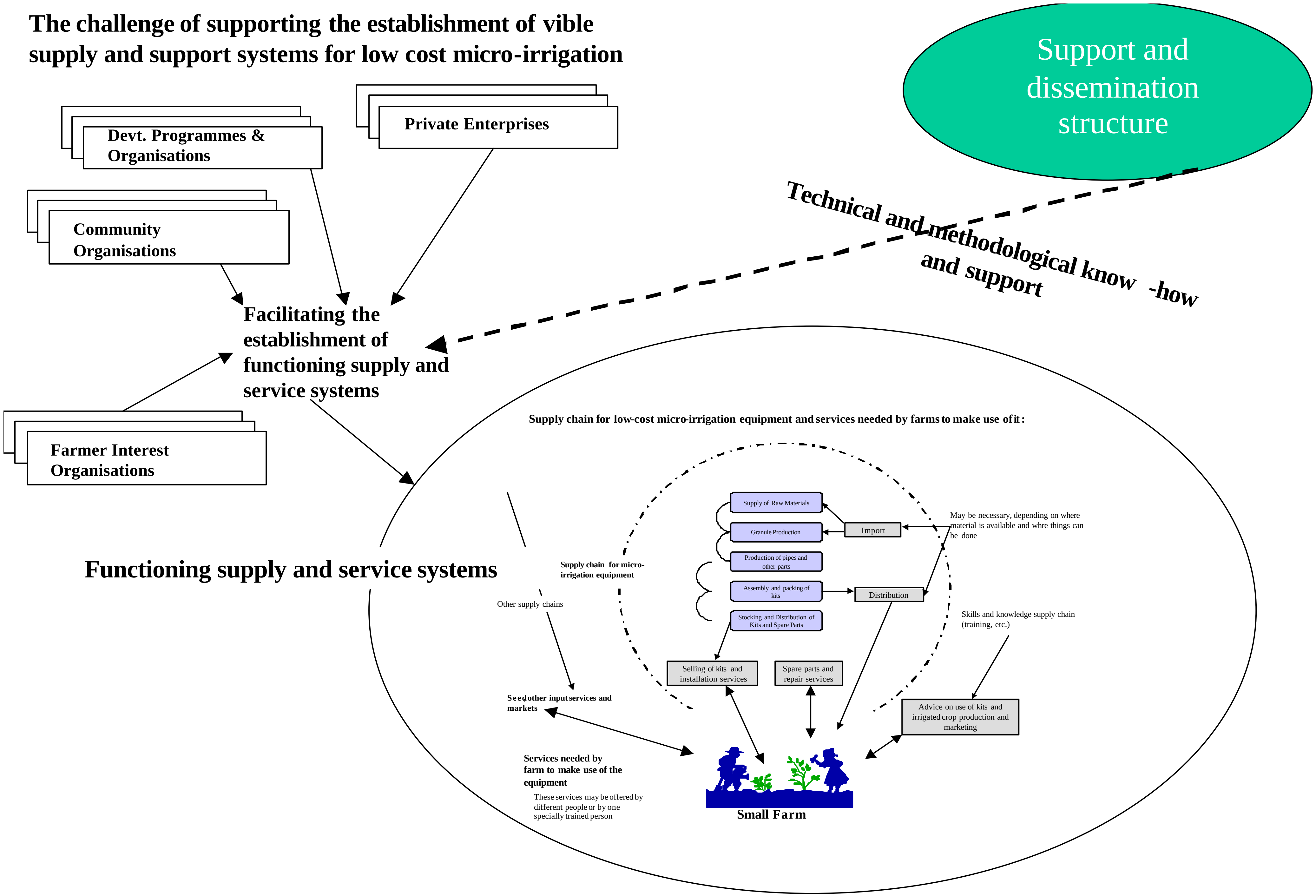
- The capital and operating costs of the equipment
- The value and availability of water, land, labour and cash
- Field topography, layout and soil type
- Crop type
- The nature of the water supply at the field edge
    - Hand carried

[36] World Bank, et al. pp. 11-12.

Supply chain for low-cost micro-irrigation equipment and services needed by farms to make use of it:



The challenge of supporting the establishment of vible supply and support systems for low cost micro-irrigation



- ➢ Gravity flow in a stream or other open channel
- ➢ Piped supply from a pump or other source

- The technical skill of the farmer and his/her previous experience with irrigated farming
- The farmer's access to equipment and spares
- The availability of a market for irrigated produce
- The quality of advice and technical support from government or private sector extension services.

With so many factors determining what is appropriate irrigation equipment for a smallholder, it is impossible to identify one technology as the best one for everyone. Undoubtedly drip and sprinkler irrigation are the least expensive, entry-level technologies that have potential for adoption by resource-poor farmers, followed by treadle pumps. However, the exclusion of techniques such as buried porous pots or clay pipes, low head and pressurised bubbler systems, or lay-flat pipe in place of open field channels does not imply that these technologies are not appropriate in some farming systems or that low cost drip is a universal "solution."[37]

7.1.5 Inadequate M.I.S.

Lastly, project designers frequently forget or overlook the importance of a high-performance management information system (M.I.S.) within any kind of credit programme. History shows that when the number of loans goes beyond a few hundred, control of disbursements and loan repayments tend to deteriorate rapidly, with the result that the programme goes out of control and usually fails if there is not a good M.I.S.. The lender absolutely must have daily, weekly and monthly listings of loans coming due and those overdue, so that loan officers and other staff can quickly follow up. When these reports are ***not*** available, lending programmes quickly get out of control, defaults rise dramatically, and lending and production targets are accordingly not attained. Therefore, project designers should make sure to build in both sufficient numbers of computers and banking software licences for the foreseen volume of credit, branches, cashiers and back office personnel needing access to loan portfolio information. Fortunately, we have within FAO itself access to state-of-the-art banking software. FAO developed the DOS version of its Microbanker software over a decade ago, and it is being successfully used in well over 1,500 financial institutions in every region of the world. This very capable software is already available in English, French and Spanish, as well as certain other European and Asian languages. Project designers should also not underestimate the effort it will take to train lending institution staff in how to effectively use and exploit the software. At a minimum, one should foresee an initial intensive training of key users for not less than two weeks, followed by a refresher course of a week to ten days six months later. Those having some experience with the DOS version of Microbanker know that it has a rather steep learning curve, and that it frankly is not the most user-friendly software in the world. Fortunately, a new, much more user-friendly Windows version is currently being tested in a variety of sites. MBWin is currently available only in English, but its new architecture facilitates its rapid translation into any language that Windows can use, and can, in addition, be simultaneously bilingual in two languages. French and Spanish versions will also soon be available, and conversions to other languages are not overly complicated. For budgetary purposes, project design officers desirous of using MBWin may wish to include its cost, as shown in the following table:

	Prices of Microbanker for Windows	
1.	**SRTE Stand-Alone Version**	Price
	- Base Module (General ledger, customer maintenance, configurator, and take-on) and one application module	$1,000
	- Additional application modules (Savings accounts, current accounts, time deposits, share accounts, and loan accounts)	$250 each
2.	**SRTE LAN Version (for Windows NT Server or Novell Netware)**	
	- Base Module (General ledger, customer maintenance, configurator, and take-on) and one application module	$1,500
	- Additional application modules (Savings accounts, current accounts, time deposits, share accounts, and loan accounts)	$400 each
3.	**Site Licences**	
	- First 10 sites	$800/site
	- Next 40 sites	$600/site
	- After 50 sites	$400/site
4.	**The EXTE version** (user-customisable code), with unlimited number of site licenses,	$75,000

[37] Cornish & HR Wallingford, Page 3.

Prices of Microbanker for Windows		
	is also available, but most users will not need this.	

Technical and pricing questions about MBWin should be directed to Mr. Ake Oloffson, AGSM, Rome (Ake.Oloffson@fao.org).

7.2 DIFFICULTIES LINKED TO THE BENEFICIARIES THEMSELVES

The greatest constraint in this category is farmers' frequent ***pre-existing indebtedness*** to formal and informal lenders. Ideally, new irrigation loans should not be granted to those already over-indebted, but in the absence of credit bureaus in most African countries, it is frequently difficult to determine this before granting a loan, particularly if the lender is not located in the same community as the borrower (there is yet another reason to try to use DFSs as much as possible—they know the local population much better). A related problem is the frequent inability of the proposed recipient of an irrigation loan to raise the necessary counterpart funds, typically from 10% to 25% of the total cost, as well as pay the increased farm operating costs after the installation of the new irrigation equipment.

In general, farmer-borrower farms' almost systematic ***under capitalisation*** renders them very vulnerable to the slightest unexpected event. In the case of the seemingly excellent farmer associations on the Senegal River, for example, using seven high-capacity motor pumps, borrowers had always been up to date in their payments to the lender. At least until they started to exceed the capacity of the pumps, whereupon they all broke down. Since they had already spent all their available funds on operating costs, however, they could not repair the pumps, and the crops ultimately failed.

African farmers seem unable (some would say they ***refuse***) to understand the mechanism of ***depreciation*** of fixed assets frequently. Because the borrowers do not set aside funds for replacing the equipment at the end of their useful life, they end up at that point as dependent as ever on external capital. A phenomenon particularly widespread, but not limited to French-speaking West Africa, is that the cost of donated equipment is not factored into the price of whatever production results from that equipment, so that when it needs to be replaced, there are no funds to replace it. This phenomenon probably originates in the "hand-out mentality" that has developed, and farmers become convinced that, after all, they can get some donor to finance the next pump when the current one wears out.

Illiteracy, on the one hand, and lack of institutional ***organisation***, on the other, most often prevent farmer-borrower groups from maintaining adequate accounting records or even from properly filling out the loan application. As a result, these tasks are confided to third parties (teachers or children, typically) not having a personal stake in seeing that it's done right.

Lastly, the high rate of ***post-harvest losses*** (typically 20% or more for rice, 30% or more for tomatoes) before marketing the produce reduces the borrowers' income greatly, as well as their ability to repay their loans. The lesson here is for project development officers to give serious thought to creating viable warehousing facilities, in addition to irrigation equipment to increase production and yields.

7.3 DIFFICULTIES CAUSED BY THE LENDING INSTITUTION

Although the distance from the lending institution or branch office to the borrower's village is not a great obstacle to disbursing the loan, it is often a major obstacle when payments come due, particularly in terms of the cost of transport and lost time, and the inability of a far-away lender to appreciate the borrower's problems. The farmer association reflects the ***average*** member, and not the condition of its most vulnerable members, who risk being marginalized, even forced to rent out their land (case of Fouta-Djalon in Guinea in 1995).[38]

Most decentralized financial systems are chronically short of long-term lending funds which would permit them to invest significant amounts in medium and long-term investments such as irrigation equipment. Project design officers, frequently under pressure to complete their project papers, often forget to verify the lenders' funds availability, and when it eventually comes time to disburse the irrigation loans which had been promised to farmers, one discovers that the lenders do not have sufficient lending capital. Worse, after disbursing the equipment loans, one discovers shortly thereafter that there are insufficient funds to pay for operating cost loans.

[38] LeBrun, p. 6.

Project development officers should please take note. The chronic shortages of lending capital is just another reason to prefer micro-irrigation equipment to more expensive, imported power pumps.

Finally, there is an increasing cacophony of competing RFIs promoting their products. Because some competitors may have subsidized lines of credit, those borrowing from unsubsidised sources may object when they learn how little the competing institution charges. At worst, the borrower defaults, and at best he takes all his future business to the less-costly competitor, thus missing the potential benefits to both borrower and lender of a long-term relationship.

7.4 DIFFICULTIES CAUSED BY GOVERNMENTS

The principal problems frequently encountered in this category include the inability of the local authorities to assure an adequate legal and regulatory framework. Problems also include well meaning but counterproductive usury laws or directives that interest rates on agricultural loans should paradoxically bear lower interest rates than loans to other sectors, despite the higher risk of default. Successful rural DFSs generally cannot survive on such artificially low interest rates, and the end result is that, instead of protecting farmers from "damned usurers", farmers end up not having access to loans at all! Other problems include government directives to "encourage" certain segments of the population, which may or may not make economic sense to the lender. Another major problem in much of Africa is the inability to effectively pursue a delinquent borrower legally.

A common problem is also that government officials try to force lenders to grant loans to individuals that do not qualify for loans according to the lender's established loan policy. Accordingly, try to negotiate a clause stating that government will not interfere in a lender's decisions to grant or refuse loans to borrowers. Make sure that loans will be granted exclusively on the basis of the merits of the borrowers' projects; their repayment capacity and their likelihood of repayment. Try to assure that financial decisions are taken by experienced financial personnel, and ***not*** by politicians. Once politics enters the lending decision process, failure won't be long in coming.

A whole other class of problems derives from deficiencies in the government's development policy itself, particularly when it accords insufficient attention to improving ***marketing*** channels (quality improvement through setting of standards, persisting with ineffective marketing boards, inability to create sufficient feeder roads to isolated areas, etc.). The end result of these kinds of policy deficiencies is to either (1) dissuade producers from even trying to fully exploit technologies like micro-irrigation or (2) create a situation where even if production rises substantially, farmers have no place to market the extra production. Project design officers, too, must identify reliable marketing channels before proposing irrigation projects that may considerably increase production. Increasing production alone is not enough to assure the profitability of irrigation loans, and hence their ultimate repayment.

Another problem clearly attributable to governments is their propensity to incur massive budget deficits that provoke high inflation and interest rates. Because of the low rates of return typically applying to agriculture, these high rates greatly discourage farmers from borrowing and investing in their farms.

7.5 DIFFICULTIES CAUSED BY DONORS

Traditionally, the major development banks faced several obstacles in packaging small-scale irrigation activities into a loan package:

- Minimum loan size to justify the bank's investment in the entire project cycle is often too large for the needs of a national small-scale irrigation initiative. Because their projects had to be large in amount (typically $25 million or more), the World Bank and other major international and bilateral donors focused principally on larger scale systems, particularly the expensive mechanization of large agricultural development perimeters, especially for rice production. Results have almost always been disappointing with this approach, for all the reasons already enumerated: lack of focus on market creation, use of overly complicated, expensive and uneconomical equipment imposed by bilateral donors, etc. Donors thus had a built-in bias against "thinking small."

- Small-scale irrigation is essentially a dispersed, local activity where development bank funding tends to support centralized, large-scale investments or investments targeted at large institutions (e.g., national research and extension systems) capable of absorbing large tranches of funds.

- Traditionally, small-scale irrigation has depended on NGOs, CBOs or private companies to jumpstart the process with training, demonstrations, loans, and mass communication campaigns. Development and commercial banks have traditionally focused on public sector institutions, however.

However, recent innovations in funding and country agreements have reduced significantly these barriers to funding small-scale irrigation initiatives:

- Technological advances, particularly in the area of developing affordable, small-scale water lifting devices and drip irrigation systems;
- Governments, as the borrowing agencies, have been more amenable to passing on responsibilities and funding to NGOs or other local organizations to plan and implement development activities
- Shifts in the policy environment favouring private sector initiatives and increased smallholder participation
- Targeted micro-irrigation projects have been able to provide a package (training, funds, marketing assistance, etc.) to promote small-scale irrigation
- Small-scale irrigation, where feasible, can be part of a larger loan package such as a larger water development or rural development project. Such projects often include investments to support other parts of the small-scale irrigation project business model such as rural roads and marketing infrastructure.
- Heightened environmental concerns—in particular, concern for increasingly severe water shortages and food security
- Increased focus on poverty alleviation, achievable by increasing smallholder productivity through affordable small plot irrigation;
- The emergence of viable market creation approaches for smallholder development and growing acceptance that the market creation approach is better than the failed subsidized approaches of the past, and growing commercial interest by manufacturers and irrigation consulting firms in micro-irrigation product development. Markets for smallholder irrigation technologies are, accordingly, evolving rapidly. For example, large irrigation equipment firms, such as Israël's Netafim, which previously were not interested in the idea, are now seriously developing equipment specifically aimed at smallholders in developing countries.

The Niger Private Irrigation Project, currently in the World Bank project cycle for 2001, represents many of these innovations in practice. The Government has decentralized management of water resources to local communities and encouraged greater private sector participation. The project combines tube wells with manual pumps, thus increasing project size, and includes funds for training, technical assistance and finance. An umbrella NGO will implement the project. Advice will include study tours, workshops, demonstrations, field trials, field days, and techniques to improve crop yield and quality. This work will be contracted out to the Niger Association for Private Irrigation Promotion (ANPIP). The programme will also create savings associations; provide land-titling assistance for project beneficiaries; and assist local irrigation service providers. Total project cost is programmed at $33 million.[39] It will be interesting to see how successful this project is; doing "all the right things" will hopefully produce results.

[39] The preceding discussion was inspired by "Smallholder Irrigation Market Initiative: Creating New Markets via Smallholder Irrigation", World Bank, Winrock International and IDE, 2000, pp. 4-5 and 20.

8.0 ELEMENTS OF REFLEXION / LESSONS LEARNED

8.1 IRRIGATION PROJECT DESIGN CONSIDERATIONS

By this point, the reader will have noted that the author of this document has made a number of pertinent observations on how irrigation projects or project components should be designed. First of all, it should be clear to all that projects should be designed and implemented with the full participation of the farmers most affected by them, and not be hurried by project design officers in the faraway capital city or even foreign countries. The second major observation is that project design officers should not just see their jobs as increasing production or yields. The task at hand is much bigger than that. The "market development" approach presented in the previous chapter, and generally accepted by the donor community, now requires projects to take this approach. So, yes, do take the time to figure out (with the farmers who will be using it) what is the most appropriate technological package, but in addition, you also now have to figure out who's going to manufacture the micro-irrigation equipment (importing them is not a sustainable solution), how it's going to be distributed, how other inputs (seeds, seedlings, fertilizers, pesticides, etc.) are going to be delivered on time, where financing will come from and, finally, where the huge increase in production is going to be marketed. In short, you now have to take a systems approach to the design of irrigation projects and components.

Secondly, project design officers should make sure they've identified the real problem to be solved. Is it really low production or yields, or is it the large proportion of post-harvest losses and/or the farmers' inability to hold onto the harvest long enough for prices to rise? You may be able to increase local food production by 30% or more simply by creating storage capacity. Certainly farmers' incomes could be greatly enhanced if they can manage to delay the sale of their produce until later in the year when prices are higher. Accordingly, projects based on reducing post-harvest losses or warehousing of crops may be a more appropriate solution than an irrigation project or component. At a minimum, a PHL reduction component in your irrigation project would certainly complement and enhance whatever production and yield results obtained.

Hopefully, the benefits of low-cost micro-irrigation technology (drip systems, low-pressure sprinklers, treadle pumps, rope pumps, etc.) are clear and obvious to all readers. They offer greater productivity and incomes for the masses, not just a few working on a single large perimeter. Still, one has to recognize that these low-tech micro-irrigation technologies do not work in all circumstances. If surface water is unavailable or if pumping heads are more than 10 meters, none of the aforementioned technologies will work, and intensification will necessarily require more costly solutions. To the extent that power pumps must be imported, project design officers need to more eloquently argue the case to bilateral donors that their expensive pumps do not represent responsible development, and that if they really want to help Africa develop, then they should accept to finance the purchase of equivalent, but much less costly, power pumps from Asia. No matter where the power pumps come from, however, the project design needs to make sure that there are mechanisms built in to supply sufficient quantities of spare parts and backup pumps to temporarily replace pumps that break down. The project also has to somehow assure that there will be sufficient maintenance and repair capacity available to farmers. The absence of these latter features has doomed a majority of previous irrigation projects.

Hopefully, most readers will also have been convinced by this point that credit is not always the solution. In fact, if one accepts the premise that preference should be given to micro-irrigation technology over expensive power pump solutions, it follows that most African farmers probably don't ***need*** credit to purchase $25 or $50 micro-irrigation equipment. They can just buy them for cash. The problem is to create the manufacturing and distribution systems that make them available to the masses.

At this point in time, leasing is not a technology that can be definitely recommended as a sound approach. Ongoing experience with this approach in Mali and elsewhere, though, should be closely monitored, so that if successful approaches to leasing do appear, they can be replicated.

8.2 CREDIT SUPPLY AND DEMAND

The first recommendation in this area to project design officers is that they try to assure the objective of ***near proximity*** through the creation or support of one or more existing local DFSs, such as a credit union, village bank or rural bank, through sensitisation of the population, capacity building and institutional development. The DFS thus created or strengthened has the considerable advantages of knowing the borrowers and are more able to monitor the loans closely than development project staff ever will. Of course, the project will have to abide by the DFS's overall credit policies and interest rate structure. If the local DFS is a member of a federation, then you may be able to negotiate considerable outreach to widespread sites where DFSs belonging to that network have been implanted. If you're lucky, the federation may, as is increasingly the case, have a central liquidity, or rediscount, facility, that will be able to provide and manage the additional liquidity that your irrigation project may require. The federation may well assist you to negotiate, if necessary, with commercial or development banks lines of credit that the rediscount facility can redistribute to its member DFSs. It is, in fact, becoming more and more common for DFSs that successfully mobilise large amounts of savings to lend their excess liquidity to other DFS networks (e.g., the case of FUCEC-TOGO). If there just aren't any DFSs in the region you want to implant irrigation technology in, you're basically out of luck, and have but two choices: (1) take a long-term perspective, and create the required DFSs yourself, probably in collaboration with one or more existing networks interested in expanding into your zone or (2) chose a more propitious region already served by one or more networks of DFSs. Of course, you can try to work with commercial banks, but for reasons already cited, the experiences with that approach have in general been considerably less than satisfactory. Don't forget that detailed agreements will have to be negotiated with each federation, rediscount facility, bank or DFS. This is a time-consuming process that should not be minimized in the project document; if you do, you'll almost certainly find yourself behind schedule very early on in the implementation of the project. Fortunately, you can probably obtain samples of previous agreements of this type which you can use for inspiration.

A second recommendation is to make absolutely sure in your project design, and this applies to whatever lender(s) you choose to manage the loans, that there is a definite and adequate source of funds for financing a considerable amount of medium-term irrigation loans. Most DFS networks will not have enough long-term funds, so you'll have to figure out where you're going to get them from: capital grants through the project, although these are less and less attractive to donors; lines of credit from commercial or development banks, governments/central banks or even donors; or other sources (NGOs, etc.). Most African countries' banking systems have excess liquidity that can, in principal, be brought to bear, if properly negotiated, but that takes considerable time that busy project development officers are short of. But they have to find the time, because they need to negotiate all these ***during project design***; if you wait until implementation, any significant snags will put your project way behind schedule, or cause it to fail outright.

Another increasingly relied-on source of long-term lending funds is, oddly enough to some, ***client savings***. The war between those who claimed "it's obvious that the poor cannot save" and those, like credit union leaders, who claimed that "the poor can and do save", has been won by the latter, and most microfinance specialists now acknowledge that the poor are able to and do, in fact, save considerable sums. Although there are many (especially proponents of the Grameen Bank approach) who still preach that it's "obvious" that poor people can't save, and that it's necessary to "prime the pump", evidence now clearly shows quite the opposite, and most donors no longer are interested in hearing the tired old "poor people can't save" refrain. The question is therefore no longer, "do they save?", but rather how can we capture these savings and use them to finance development? The work of many microfinance practitioners, especially the World Council of Credit Unions, shows that significant sums of savings can be mobilized from the poor. To attract a stable and rapidly growing pool of savings from such a population, you must pay positive real interest rates (i.e., greater than the rate of inflation, rates on such deposits being based preferably on "CPI-Plus" formulae). It is also frequently necessary to clean up the DFS's balance sheet, and write off defaulted loans and other accumulated "junk assets", as well as improve the services and image through the introduction of modern methods and techniques, especially computerisation, modern loan monitoring systems, and strict loan write-off procedures. Sometimes a new coat of paint is really all that's needed. The combination of these measures frequently provokes a veritable explosion in savings growth, and the problem then become one of managing the DFS under the stress (e.g., the need to double your staff every year) of constant rapid growth.

Another important recommendation is to make sure the ***term*** of irrigation loans is within the expected useful life of the assets ***in the local environment***, not that prevailing in the country where it is manufactured. Past (and painful) experience has shown that many irrigation credit scheme's loan terms were too long, so that farmers continued owing money to the lender well after the equipment was already exhausted and retired. Experience shows that poor African farmers tend to over-use their expensive equipment in the hopes of maximizing its output, but in doing so, greatly decrease their useful life. Accordingly, diesel and gasoline-powered pumps' repayment terms should in no case exceed 4 years, 5 at the outside limit. Electric pumps, where usable, tend to hold up better, and their terms can be stretched out to 7 or 8 years at the most.

Another recommendation is that wherever possible, build in a post-harvest loss-reduction component (probably involving warehousing). If your irrigation project succeeds beyond your wildest dreams and doubles or triples the production of rice or other crops, you have not necessarily improved the farms' profitability if the bumper crop results in a collapse of produce prices. A complementary warehousing scheme, in addition to letting the farmer store his produce until prices improve, also permits him/her to significantly reduce the typical 30% losses due to pests and humidity that occur in the absence of sound storage facilities. To make this work, the lender will have to be able to provide additional working capital loans during the period the production is stored; otherwise, farmers will be forced to sell at least part of their harvest to just survive, and thus lose much of the benefit of increased production. The Nyesigiso DFS network in Mali, for one, has done this effectively by integrating the initial investment loan and extended working capital loans into a single package.[40] Beyond just warehousing cereals or other produce, give serious thought and specify exactly how the increased production will be marketed at a profit. It does no good to increase production if it isn't sold and rots at the farm.

Another recommendation is to continue the tendency to rely less and less on formal guarantees. This does not mean complete elimination of hypothecation or reducing the lender's legal rights. Rather, because African legal and cultural systems frequently do not permit rapid resolution of conflict through the judicial system, lenders will probably be better protected from loss if they rely more on "joint and several" loan repayment responsibility by borrower group members, through the creation of effective group solidarity and social pressure.

8.3 INSTITUTIONAL DEVELOPMENT

Good (or bad) organisation is usually a determining factor in the profitability (or lack thereof) of an irrigation project. If inputs are provided and applied on a timely basis, if borrower counterpart funds are collected on time, if the credit process is well thought-out, if there are replacement parts and backup machines available, if there's a technically sound water management system in place, and reliable marketing channels for increased production have been identified, most likely the project will succeed in increasing production and profits. When any of these elements are defective, the entire programme can suffer greatly. Accordingly, to succeed, project design officers will be wise if they formally incorporate into their projects such institutional development activities as training, information services, assistance in improving the management of DFSs and their federations and refinancing bodies, and generally improving the degree of organisation.

Placing the overall responsibility for the management of perimeter rehabilitation projects directly in the hands of those concerned is a relatively new, but rapidly growing approach, and is perhaps best illustrated by the Asprodeb/PDPI project in Senegal. In that case, the farmer borrower associations themselves designed their projects and, with the assistance of their federation, their local lender obtained credit (and sometimes subsidies) accordingly through the CNCAS. This type of approach, based on true, meaningful participation of beneficiaries in the design of their projects, is much more likely to succeed than "one size fits all" projects designed by hurried project design officers and technicians "on farmers' behalf" in faraway capital cities. It permits the flexibility to custom tailor a loan to a particular farmer's (or farmer group's) circumstances and needs. If it fails, the farmer can no longer blame the project or the lender, claiming that they made him or her do something he/she didn't really believe in.[41]

In the same vein, the introduction of the concept of "twinning" of borrower groups that have already successfully borrowed monies for irrigation purposes and those who are just starting the process is becoming an increasingly popular and effective measure that goes a long way toward assuring the proper application of project resources. This approach was successfully used in the ACODEP (PNUD/BIT) project in Mali, particularly in the transition from monoculture to more intensive cultivation and poly-culture. Using this technique, those having already benefited from the first interventions train those just starting, thus creating a spread effect ("tâche d'huile" in French). Twinning activities may be either solidarity-based or paid by the receiving parties, and has the

[40] LeBrun, p. 8
[41] LeBrun, p. 8.

additional advantage of creating a peer-to-peer self-help group that can help each other when difficulties arise. Known types of problems can then be quickly resolved, instead of waiting for far-away project or technical officers to come resolve the problem.

While this paper strongly urges project design officers to make greater use of local DFSs, it is also important to warn them to make sure that financial activities are strictly separated from non-financial activities. For example, a village may have a strong village association that is well organized and is significantly improving life in the village. They're doing many worthwhile activities, but up to this point, have not been involved in lending. The appendage of a financial "window" to such an association is usually a formula for disaster. Management and accounting organisation are almost never adequate to know which activities are profitable and which aren't, funds get commingled and are often embezzled. Accordingly, make sure that any village financial schemes' funds and accounts are completely separate from non-financial village operations. It is quite possible, and even very common for the officers of a village association to also be the officers of the local DFS, but they have to be able to separate their functions in their mind, as well as keep the funds quite distinct from one another, and be able, in effect, to "change hats" at will.

8.4 POLICY CONSIDERATIONS

In a market economy, the role of the State is focused on regulation, creation of infrastructure, promoting and creating incentives. Three aspects of its contribution seem imperfectly mastered at this time in most African countries, as has become clear from a series of FAO (AGSM) workshops in recent years:

- First of all, governments are still too prone to offer subsidies to "encourage" a certain activity; the distortion caused by subsidies will, in fact, frequently have an effect quite the opposite of that intended. The fact that most African development banks, with their heavily subsidized interest rates, have now disappeared is eloquent testimony to the bankruptcy of that approach, as are the perverse effects of central banks' attempts to make financial institutions charge lower interest rates on farm loans than on those to much less risky sectors.
- Secondly, as previously indicated, governments may sometimes overstep the bounds of their legitimate interests in safeguarding depositors' interests and in assuring an adequate food supply to the country's population throughout the year. To forestall harmful interventions of this type, project design officers would do well to negotiate clauses with governments requiring that they not interfere in lenders' loan-granting decisions, not declare loan repayment moratoriums or take any other actions inimical to the success of the lending programme. The ability of lenders to operate without political interference is of fundamental importance to project success; if loans are granted because of political pressure, both the project and the lending institution will be in jeopardy.
- Thirdly, while many countries, especially those that are members of the UEMOA, have made important strides in improving regulations, most still have a long way to go to assure effective prudential control. All countries need to intensify efforts in this area, particularly by clarifying currently grey areas, and not with the aim of gaining control of DFSs, but rather to assure the public that their funds deposited there are reasonably safe.
- Fourthly, largely as a result of the microfinance "movement" these past few years, many innovative financial institutions and financial service products have appeared. However, many other lenders still rely heavily on traditional practices and products more appropriate for the commercial banking sector than development finance, and all governments need to gently push those involved in development finance to adopt more appropriate institutional forms and financial service products. The IDA of the World Bank Group has developed useful training sessions for local leaders on mastering this type of negotiations.

Finally, this writer would like to recommend that the State use its powers of persuasion to sensitise borrower groups and their lenders of the need to progressively create an increased self-financing capacity over time, so that the subsidisation of irrigation equipment can be phased out. This is particularly important for the irrigation sector, given the frequent high cost of the initial investment, and most governments' declining ability to support this type of subsidy. As we all know, subsidisation also attracts influential opportunists who frequently benefit from such programmes more than those originally targeted. If we let the market rule, such influential people will not be so attracted like flies to sugar.

8.5 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

In most African countries, there is sufficient liquidity within the banking and DFS sectors to finance all foreseeable irrigation needs. The problem is not one of lack of financial resources, but rather identifying a sound way of accessing and using them such that they inspire the confidence of those responsible for their management. This paper has attempted to provide some guidance on how to create that confidence through the conception of sounder irrigation projects. If you retain nothing else from this presentation, please try to abide by as many of the following "Ten Commandments" of irrigation finance as possible:

1. Right at the project identification stage, make sure that you have correctly identified the farmers' real principal problems before attempting to design the most appropriate solution. While this sounds obvious, in reality, a great many problem statements are incorrect or inappropriate, in great part because the participative process has been short-circuited. Make a concerted effort to determine whether the main problem is one of "low production and/or yields", or whether it is rather the huge post-harvest losses (PHL). If PHL is large, consider an initial project or phase that specifically addresses PHL. This will so dramatically improve farm profitability that there's a good chance farmers will be able to self-finance most, if not all, of the second phase (micro-irrigation) of the project or of follow-on projects. This would be particularly true if your project design is based on ***leasing*** (straight or lease-purchase) irrigation equipment, as opposed to outright purchase. For more information on proven solutions for PHL, please check out the FAO publications "Warehousing and Inventory Credit" and the "Manual on the Establishment, Operation and Management of Cereal Banks." These books are downloadable for free from the FAO and are available in booklet form for a nominal fee. Corollary No. 1 is that project design officers should not short-circuit the participative process; those most affected by the design must be intimately involved in it from the outset. Corollary No. 2 is to always abide by the K.I.S.S. (Keep It Simple, Stupid!) principal during project design, and adopt the ***least*** complex (and probably least expensive) technical solution consistent with accomplishing project objectives.
2. Recognize that credit is not always, or even in a majority of cases, the most appropriate solution. If a number of inexpensive, locally-manufactured treadle pumps will do the same job as an expensive European motor pump, selling them outright for cash is definitely better and will save all concerned many heartaches resulting later on from credit programmes, particularly from the high defaults typically experienced when using expensive European irrigation equipment. Similarly, during project design, give serious consideration and allocate time to identifying possible local manufacturers and/or retailers of required irrigation equipment. Maybe the "poorest of the poor" will not benefit directly from your project, but production and profitability will almost certainly improve considerably, and the very poor will still probably at least benefit from the need for additional labour to run the more mechanized and/or larger farms.
3. If, after the foregoing precautions, you still opt for a credit programme or component, make sure that a sufficient quantity of long-term funds is available to finance the projected volume of irrigation lending**.** Don't cavalierly leave the details of this component as something whose details "will be worked out by project staff during implementation." This is an essential component, and you absolutely must be reasonably sure that the funds will be available; because their eventual non-availability would jeopardize your entire project. Corollary 1 is that experience so far with loan guarantees has tended to encourage poor performance by lenders, since the latter will recover their capital whether they perform well or not, and hence you should avoid loan guarantee schemes, if at all possible. Corollary 2 is that there is currently insufficient information to support leasing of irrigation equipment as a valid approach, although efforts in this direction in Mali and elsewhere need to be closely monitored to identify sound new approaches.
4. If, despite the advice given in points 1 through 3 above, you still decide to propose the use of complex, expensive irrigation equipment installations, then use a more rational approach to procurement than has often been the case in the past. First, do yourself a big favour and make absolutely sure that there will be sufficient spare (backup) machines, spare parts, and competent, readily-available repairmen when pumps, as they certainly will, break down. Secondly, make sure you use the most appropriate and cost-effective equipment available to carry out project activities, and not necessarily those preferred by donors, especially in bilateral programmes. Oftentimes, it will be better to introduce an inexpensive technology that is only slightly different from previous practices. Experience shows that radical changes (e.g., from the hoe to tractors or animal traction, and from hand sprinkling to motor pumps) very frequently fail. Let's all do a better job of convincing bilateral donors that if we're really serious about development, purchasing unnecessarily expensive irrigation equipment in the donor's own country is ***not*** a sustainable approach. Where surface water and local water tables permit, always opt for micro-irrigation technology, since it potentially can positively affect millions of farmers, not just a few on a big development perimeter.
5. If, after all the above warnings and precautions, you still decide to include irrigation credit in your proposed project, try to rely more heavily on the increasingly ubiquitous networks of Decentralized Financial

Systems, as opposed to the formal banking sector (since, however, a number of commercial banks are beginning to be interested in rural finance, at least on a wholesale basis, to proven micro-lenders, don't automatically assume any more that banks are not interested in micro-credit) or development banks, in those few countries where the latter still exist. DFSs are likely located in much closer proximity to your targeted farmers, and are better able to tailor loans to fit their needs, as well as to monitor the loan effectively. Focus more on the DFSs' institutional development (what we have called in this paper, "accompanying measures") and less on the provision of lines of credit. Project designers do a big disservice to partner DFSs if they overwhelm them with large sums of external "cold" funds relative to their own, locally-mobilised "hot" capital (i.e., savings). Also, don't let the irrigation loan portfolio overly dominate the DFSs' other loan portfolio segments. To do so would create too much covariant risk. If, despite all the advice provided in this document, you opt for an expensive, imported, power pump-based intensive agriculture, it would be better to work with a bank than to drown local DFSs in foreign money. Too much easy money has already been the ruin of thousands of RFIs around the world.

6. If, in the end, it is definitely determined credit is essential to your project, don't spoil local financial markets by building a cheap credit "window" into the project organisation itself using subsidized (less than market) interest rates. Instead, let professionals in successful local RFIs, DFSs and banks manage the entire lending process according to their own policies and procedures, which have stood the test of time. Never try to "force" the lender to grant loans that the applicant is not qualified for according to the lender's established criteria. If you decide to "do it yourself" within the project, recognize the high probability of failure and, development-wise, a ***100% certainty*** that you will fail to leave an institution to carry on when your project ends.
7. Farmers must be called upon to self-fund increasing proportions of their irrigation projects, i.e., they must learn to properly ***depreciate*** their fixed assets and provide for their eventual replacement, instead of seeking a new loan to finance a replacement pump every four or five years. Remember that a development project may help farmers finance their ***first*** pump, but it's up to the borrower to finance its replacement when the first one must be retired. A corollary here is that the term of the loan (or lease) should correspond to the expected useful life ***in Africa***, not in the equipment's country of origin.
8. Lenders must do a better job of learning from each other and continue to adapt their products to the specific needs of farmers involved in irrigation. Encourage SFDs you work with to participate fully in the MFI networks that now exist in nearly all African countries. Build in study tours abroad for key personnel to successful irrigation finance programmes. At the client level, try to integrate twinning programmes whereby experienced micro-irrigation clients are associated with those just joining the programme; this has been proven an effective way to spread micro-irrigation technology and techniques.
9. Don't just focus on using irrigation technology to increase production. Re-orient your whole approach to irrigation development to one of ***market creation*** and ***institutional development***. That is, recognize and build in the upstream manufacturing and distribution of your micro-irrigation equipment, the inputs (seeds, seedlings, fertilizers, pesticides, small tools, etc.) supply chain, the necessary mass marketing required to make the product a household name, as well as the forward linkages (processing, storage and market outlets). It doesn't suffice to double or triple production; for farmers to truly benefit, remember that the product has to be sold without glutting the market. The latter must be addressed ***during project design***. If you leave it for implementation and markets are ***not*** found, then time, effort and money will have been wasted.
10. A good M.I.S. is ***essential*** to any credit programme. Accordingly, project designers should build into the budget sufficient numbers of licenses for a capable M.I.S. such as Microbanker for Windows (MBWin), sufficient computer equipment, and sufficient training for the expected number of users. If, despite all the accumulated evidence and the advice presented in these ten commandments, you still decide to go it alone and have project staff, instead of DFSs, manage an irrigation credit programme, the MIS commandment is doubly true. In fact, having a good M.I.S. will likely be your ***only*** slight hope of success.

A number of current projects are researching these issues in search of effective solutions. Let us continue to learn from these and share from each other's experiences through networking.

9.0 ILLUSTRATIVE IRRIGATION LOAN PRODUCT DESCRIPTIONS

This paper has made the argument that future FAO efforts in the area of irrigation finance in Africa should focus on using a market creation approach to make the new, low-cost irrigation technology available to a maximum number of African farmers. If this is done, it should be possible within a few years to have affordable drip kits, sprinklers, treadle pumps, rope pumps and other innovative equipment being produced locally and costing $100 or less, hopefully less than half that amount. It has also been suggested that to the extent possible, FAO avoid encouraging farmers to borrow to obtain this technology. It should be inexpensive enough for all but the very poorest to obtain on cash terms, so this author recommends the avoidance of credit except for these poorest farmers. Since its payback is generally one agricultural season or at most one year, it is probably the most profitable investment farmers can make, and experience elsewhere (Asia) would indicate that poor people ***will*** buy it after seeing demonstrations.

That said, all of these inexpensive irrigation technologies require that there be a nearby stream of water or groundwater near the surface. If that condition does not apply, then the micro-irrigation equipment described in this paper will simply not work. In such cases, the only alternative to rain-fed agriculture will be the use of expensive power pumps, which will require credit in most cases. As already stated, there will be cases, too, where some farmers are too poor even to up-front the costs of a $20 bucket drip kit. These cases, too, will require credit. Where credit is required, the project design officer should first try to follow all the “Ten Commandments” delineated in Chapter 8.0, and, in addition, design loan products that closely fit the needs of the borrowers, but this has to be done within the framework of the lending institutions’ pre-existing loan policy (we did agree that FAO development projects will not themselves be involved in the granting and recovery of loans, right?). Because different geographic zones, climates and crops require different loan product features, it is difficult to provide a universal recipe for irrigation loan products. Nonetheless, project design officers might take inspiration from the following table, which defines loan features for three typical irrigation loan products, a $25 drip kit or sprinkler system, a $50 treadle pump, or a $2,500 Asian power pump (Hopefully, the era of bilateral donors imposing their $5,000+ power pumps is over.). Your projects’ loans may differ substantially from these, but at a minimum you should think about each feature and make a judgment about the configuration of each feature. This is not an exact science; trial and error and a good monitoring system will provide the feedback to permit one to fine-tune the loan products chosen.

Typical Irrigation Loan Product Definitions

Product Feature:	**$25 Drip Kit Loan**	**$50 Treadle Pump Loan**	**$2,500 Asian Power Pump Loan**	**Seasonal Operating Cost Loans (May Be Granted In Addition to One of the Other 3 Types of Loans)**
Targeted Farmers				
Sex	Women & Horticulturalists	Women & Horticulturalists	Men	Men and Women
Farm Size	Min. 500 Sq. Meters/Kit	1 Hectare	5 Hectares	NA
Term:				
Minimum	3 Months	3 Months	24 Months	Crop Season
Maximum	12 Months	12 Months	48 Months	Crop Season
Number of Units (Maximum Amount):				
Minimum	1	1	1	1 (Customized)
Maximum	Up to Lender's ceiling	Up to Lender's ceiling	1	1 (Customized)
Repayment Periodicity:				
Number of Principal Repayments	1	1	Variable according to crop intensity	1
Frequency:				
o Interest	Fortnightly to maintain contact	Fortnightly to maintain contact	Monthly to maintain contact	Fortnightly
o Principal	At Harvest	At Harvest	At Each Harvest	At Harvest
Interest & Fees:				
Loan Processing Fee	Lender's Policy	Lender's Policy	Lender's Policy	Lender's Policy
Nominal & Effective Interest Rate on Loans	Lender's Policy	Lender's Policy	Lender's Policy	Lender's Policy
When Interest Paid (In Adv./At Repmt.)	Lender's Policy	Lender's Policy	Lender's Policy	Lender's Policy
Delinquency Penalty	Lender's Policy	Lender's Policy	Lender's Policy	Lender's Policy
No. Days in Year for Int. Calc. Purposes	Lender's Policy	Lender's Policy	Lender's Policy	Lender's Policy
Individual or Group Loans:	Solidarity Groups Preferred	Solidarity Groups Preferred	Individual or Group	Solidarity Groups Preferred
Commitment:				
Collateral Accepted	Equipment or Other Personal Assets (Not Req'd for Groups)	Equipment or Other Personal Assets (Not Req'd for Groups)	Equipment or Other Personal Assets (Not Req'd for Groups)	Equipment or Other Personal Assets (Not Req'd for Groups)
Savings/Compensating Balance Reqt.	Lender's Policy/>=15%	Lender's Policy/>=15%	Lender's Policy/>=15%	Lender's Policy/>=15%
Cash or In-Kind:				
Irrigation Equipment	In-Kind	In-Kind	In-Kind	In-Kind
Seeds/Seedlings	NA	NA	NA	In-Kind
Fertilizer	NA	NA	NA	In-Kind
Land Preparation Labour	NA	NA	NA	Cash
Harvest/Processing/Warehousing Labour	NA	NA	NA	Cash
Transport	NA	NA	NA	Cash

A T T A C H M E N T S

Attachment 1

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Attachment 2

Sources of Information and Assistance on Micro-Irrigation Systems

Sources of Information and Assistance
on Micro-Irrigation Systems:

<table>
<tr><th colspan="2">List of Micro-Irrigation Equipment Manufacturers, Consultants, Contractors and Sources of Expertise</th></tr>
<tr><td colspan="2">Manufacturers:</td></tr>
<tr><td>Netafim International:
Mr. Arik Aharoni
Netafim Family Drip System (FDS)
Kibutz Yiftah, D.N. Merom Hagalil 13840 Israel
Tel. +974 4 6955506, Fax 6951221,
E-Mail: arika@netafim.Com
Web:
http://www.netafim.com/netafim/doa_iis.dll/Serve/item/English/1.4.4.1.3.html
Note: Specialists in “Family Drip Kits” & Low-Pressure Sprinklers</td><td>Mr. Richard D. Chapin
Executive Director
Chapin Waterworks and Chapin Living Water Foundation
368 North Colorado Avenue
Watertown, NY 13601 USA
Tel.: +1 (315) 786-8120
Web site: http://www.chapindrip.com/Father.htm
Note: This company manufactures drip systems and the foundation has donated thousands of pumps to developing countries.</td></tr>
<tr><td>Ajay Industrial Corporation (Irrigation Division)
E-Mail: Info@ajayindcorp.com
Web Site: http://www.ajayindcorp.com/right.htm
Note: Manufacturers of world-renowned “Mark II” and “Mark III” motor pumps</td><td>Shakti Pumps
Head office
226, Shastri Market, M.G. Road, Indore - 452007, M.P., India.
Telephone : 91 731 535791 / 538165 / 538722
Fax : 91 731 536923 E-mail : spilit@satyam.net.in
Note: Leading manufacturer of motorized water pumps</td></tr>
<tr><td>Mapex Pumps (India) Pvt Ltd.
303, Vikas Building,
11 N.G.N. Vaidya Marg, (Bank Street),
Fort, Mumbai- 400 001., INDIA
Tel.: + 91 - 22 - 266 3070 (4 Lines),
Fax: + 91 - 22 - 266 1349, 264 1336
Email: cottor@bom2.vsnl.net.
Note: Manufacturer of motor pumps</td><td>Kubota Water Pumps
Web site: http://www.kubota-generator.com/kgpkvp.html
Note: Leading source of economical Japanese power pumps</td></tr>
<tr><td colspan="2">Senior Micro-Irrigation Development Consultants, Contractors and Project Managers:</td></tr>
<tr><td>Swiss Senior Experts for the Third World (SE3WE3)
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Emeritus Professor of Irrigation Engineering at Utah State University and Board Member of
International Development Enterprises (IDE)
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E-Mail: ide@ideorg.org
Web site : www.ideorg.org
Note: Treadle Pump Specialist & leading micro-irrigation expert</td></tr>
<tr><td>Enterprise Works
1828 L Street NW
Suite 1000
Washington, DC 20036 USA
E-Mail: info@enterpriseworks.org
Web site: www.enterpriseworks.org
Note : Specialists in Treadle Pumps. Currently manufacturing treadle pumps in Benin, Côte d’Ivoire, Senegal and Niger. TCP projects are using these pumps in Senegal, Guinea-Bissau, Chad, Ghana, & Liberia.
E-mail of Edgar Perry, regional rep in Abidjan:
Perrye@enterpriseworks.org.</td><td>ApproTEC
P.O. Box 64142
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</table>

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Other Micro-Irrigation Consultants:	
Dr. Urs Heierli Swiss Agency for Development and Cooperation Freiburgstrasse 130, 3003 Bern, Switzerland. Berne, Switzerland Tel.: 031 322-4412 Fax: 031 324-1348 E-Mail: info@desa.admin.ch Web site: http://www.sdc.admin.ch Especially his book, "Poverty Alleviation as a Business: The Market Creation Approach to Development" (2000)	François Münger Water and Sanitation Program World Bank 1818 H. Street NW Washington, D.C. 20433 USA Tel. +1 (202) 473-9785 Fax: +1 (202) 522-3313, 522-3228 E-Mail: fmunger@worldbank.org, info@wsp.org Web site: http://www.wsp.org
Community Water and Sanitation Agency (CWSA) Fidelity House Ring Road Central PMB K1A Accra, Ghana Tel. 233 21 779102 Fax: 233 21 245846 E-Mail: cwsd@ghana.com	The Irrigation Association Web Site: http://www.irrigation.org/
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Mr. Raymond Peter, Executive Director The International Network on Participatory Irrigation Management (INPIM) 600 Pennsylvania Avenue SE, Suite 340 Washington, DC 20003 USA Tel: + 1 202-546-7005 Fax: + 1 202-318-0215 rpeter@inpim.org	International Commission on Irrigation and Drainage (ICID) 48 Nyaya Marg, Chanakyapuri New Delhi 110021, India Tel : 91-11-6116837, 91-11-6115679 Fax : 91-11-6115962 E-Mail : icid@icid.org Web : http://www.ciid-ciid.org
International Water Management Institute New Delhi, India	Mr. Hilmi Sally International Water Management Institute (IWMI) Regional Office for Africa, Private Bag X813, Silverton 0127, Pretoria, South Africa. Tel: 27(12) 842 4132 / 4125 / 4128 Fax: 27(12) 804 6397 Email: h.sally@cgiar.org
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Attachment 3

Timbuktu Motor Pump Leasing Agreement

Lease Agreement

BETWEEN:

The below-named renter ("lessee"), part of the first part :

AND:

The below-named Proprietor, party of the second part :

IT HAS BEEN AGREED THAT :

Article 1

The present Contract has as objective the Rental of a power pump with generator (PPG)

Types …………....... + pump ……………………..…....

For the 200__ Agricultural Season.

Article 2 PAYMENT

The amount of the equipment rental is set at : ____________ per ______________.

This amount covers a minumum number of ___ hours of operation.

The lessee agrees to pay this amount in full upon signature.

Article 3: FILLING OUT TECHNICAL LOGS

The lessee agrees to carefully fill out the technical logs provided to him/her. These logs must be available for monitoring purposes during each visit of the Proprietor's Maintenance agent or other person(s) similarly mandated by the Proprietor. Each intervention of the mechanic will be detailed on the logs which will be maintained in dupulicate, one for the Proprietor and one for the Lessee.

During each intervention of the mechanic, the following will be noted by the mechanic :

The date of the intervention

The nature of the intervention

The arrival time and departure time and times the tool case was opened and closed, as well as the length of time worked.

Spare parts and consumables used

Any remarks and recommendations of the mechanic.

After each intervention, this log thus filled out in duplicate will be signed by the Lessee or his representative and the mechanic.

Article 4 OPERATION OF EQUIPMENT

Petrol is at the Lessees expense.
The Lessee agrees to assure that the equipment is operated properly at all times, to verify that there is always sufficient motor oil, to clean the air filter, and carry out all the tasks enumerated in maintenance schedule A.

Article 5
Transportation, installation and return of the equipment are at the expense of the Lessee.

Article 6:
Only those mecanics and assistants approved by the Proprietor are authorized to carry out repairs, installation and return of the equipment.

Article 7 ENGAGEMENT OF THE PROPRIETOR'S GARAGE
The Proprietor's Garage agrees to regularly carry out at its own expense periodic maintenance and repairs, as necessary of the Equipment.

In case of breakdowns which cannot be effected right away, the Proprietor's Garage will attempt to provide a replacement pump during the period the Equipment is under repair.

Prepared at ________________ on __________________________

SIGNATURES:

FOR THE PROPRIETOR FOR THE LESSEE

Attachment 4

HIPPO List of Alternative Motor Pumps & Specs

Overview of pumpsets and desk-study results

Pumpsystem	drive[*]	price BKO (FF)	life-span (hrs)	Hs = 1 m Q l/sec	Hs = 1 m fuel liters	Qmin	Hs = 2,5 m Q	Hs = 2,5 m fuel	Hs = 4 m Q	Hs = 4 m fuel	Qmax	Hs = 6 m Q	Hs = 6 m fuel	Average fuel cons. l/hr	Spec. Cost/ 100 m3 (FF)	Spec. Cost /ha ($)
60-80 LITER/SECOND SYSTEMS																
ATE-Stork CN150-125/AV-2	direct	27000	7000	80	1,43	63	80	1,79	80	2,15	80	70	2,2	1,70	5,7	**142**
Kirloskar 6-inch low pressure/AV-2	**direct**	**26000**	**7000**	**80**	**1,43**	**63**	**80**	**1,79**	**80**	**2,15**	**80**	**70**	**2,2**	**1,70**	**5,6**	**139**
Kirloskar MF200/AV-2	v-belt	33000	7000	80	0,95	65	80	1,48	80	1,7	95	80	2,2	1,27	5,78	**145**
150HW-5[i]/TS-160	**direct**	**18000**	**6000**	**80**	**1,44**	**65**	**80**	**1,74**	**80**	**2,03**	**83**	**72**	**2,1**	**1,66**	**4,7**	**118**
150HW-5/TS-140	direct	18000	6000	80	1,39	63	80	1,74	78	1,94	78	69	1,95	1,61	4,6	**116**
200HW-5/TS-160	**v-belt**	**24000**	**6000**	**80**	**0,9**	**75**	**80**	**1,43**	**80**	**1,67**	**95**	**72**	**1,67**	**1,23**	**4,84**	**121**
Stork CN150-125/Yanmar TF-160	direct	60000	8000	80	1,43	63	80	1,79	80	2,15	80	70	2,2	1,70	9,3	**231**
Caprari BHR200/Lister-Petter TS-2	v-belt	60000	8000	80	1,1	74	80	1,57	80	1,96	83	61	1,8	1,43	8,86	**221**
Kirloskar MF200/TV-1[ii]	v-belt	30000	7000	80	0,95	80	80	1,47	80	1,91	80	0	N/A	1,32	5,5	**137**
Kirloskar MF200/TV-1[iii]	v-belt	90000	7000	80	0,95	80	80	1,47	80	1,91	80	0	N/A	1,32	5,5	**137**
<60 LITERS/SECOND																
Kirloskar NW9ME/TV-1[iv]	**direct**	**24000**	**7000**	**60**	**1,16**	**45**	**60**	**1,42**	**59**	**1,62**	**59**	**52**	**1,62**	**1,34**	**6,4**	**160**
100HW-8/"L40AE"	**direct**	**9000**	**2000**	**25**	**0,35**	**20**	**25**	**0,45**	**25**	**0,6**	**25**	**21**	**0,6**	**0,44**	**9,0**	**226**
>80 LITERS/SECOND																
Kirloskar MF 17½ -20/TV-2	**direct**	**33000**	**7000**	**107**	**2,03**	**80**	**107**	**2,40**	**107**	**3,00**	**107**	**80**		**2,36**	**5,5**	**138**
Stork CN200-200/Lister-Petter TR3	direct	69000	8000	110	3,00	60	110	3,00	110	3,00	N/A	95		3,00	8,8	**221**
AXIAL-FLOW SYSTEMS[v]																
8YZ Axial-flow Pump (China[vi])	**direct**	**9000**	**2000**	**72**	**1,00**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**1,00**	**4,05**	**101**
8YZ-2A Axial-flow Pump	direct	9000	2000	75	1,60	N/A	50	1,6	N/A	N/A	N/A	N/A	N/A	1,60	7,23	**181**
DA-IRRI[vii] single-stage	direct	9000	2000	80	1,30	55	50	1,9	N/A	N/A	N/A	N/A	N/A	1,60	7,23	**181**
DA-IRRI two-stage	direct	9000	2000	80	1,35	75	80	2,16	80	2,81	80	50	N/A	1,92	4,99	**125**
PREVIOUSLY INTRODUCED SYSTEMS[viii]																
Cooper CVR, CUB or SVC?? (india)[ix]	direct	5000	5000	15	1	10	15	1	15	1	15	15	1	1,00	11,5	**287**
Deutz (2-cilinder 14.4 hp)	direct	60000	8000	55	2	40	80	2,25	55	2,5	55	55	2,5	2,19	10,0	**249**
Caprari BHR200/Lister-Petter HR-3[x]	direct	100000	8000	134	3,9	120	134	4	134	4,2	134	120	4,2	4,00	10,2	**255**
Stork CN160-200/Lister-Petter HR-2[xi]	direct	69000	8000	80	2,8	60	80	3	80	3,2	90	75	3,4	2,95	12,1	**302**

In bold type the 7 pumpsets that seem to be most suited for a low-lift irrigation pump pilot project. The ones typed in italic are introduced "from the blue" (see sub-section 4.1). Some of the assumptions in above calculations are: 5-10% efficiency loss in v-belt transmissions. The pumpsets are equipped as set out in the table of subsection 3.2. Fuel consumption is corrected for engine load. Specific cost includes: fuel cost, interest cost (10%), repair and maintenance cost (10% of initial system cost) and depreciation.

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[i] Wuxi Pump Works, Wuxi City, Jiangsu, P.R. China. It seems that the HW-series of mixed-flow pumps (orifice internal diameters ranging from 100-650 mm) is widely manufactured in China.
[ii] Normally equipped MF200/TV-1 (v-belt arrangement: 800 rpm $_{\text{pomp}}$:1200 rpm $_{\text{engine}}$).
[iii] System alternative on pump station, i.e. without discharge hose etc.
[iv] The Kirloskar TV1/NW9ME pumpset was purchased by 2 private persons in the Netherlands (J. Boverée and S. van 't Hof) and will be shipped to Bamako, Mali, in the course of 1998. It will be the first pumpset of Asian origin to be used and tested by Hari Goumo in Timbuktu.

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[*] The direction of rotation of pumps and engines can be a bit tricky: only when pumps and engines rotate in the same direction can they be coupled directly. Where possible direct drives are preferred over belt-drive arrangements. Typically, Indian engines rotate in the opposite direction of European and Japanese engines. The same holds true for the smaller pumps. Interestingly, many Indian engines have reverse-rotation as an option.

[v] The axial-flow systems cannot be directly compared to mixed-flow systems. Therefore no attempt is made to complete the table.
[vi] Foshan Diesel Engines Factory, Foshan, Guangdong, P.R. China
[vii] See: Aban, M.M., 1985, and PCARRD, 1986.
[viii] Only observed values are presented. Unfortunately, recent information on the Hatz pumpsets introduced under the current MaliNord Programme of GTZ were not available at the time of preparation of the article.
[ix] The small Cooper pumpsets of Indian origin were introduced in the area in late 1970's as part of a wheat promotion programme in Diré. The author doesn't know the type indication of the pumpsets.
[x] This is the main UNICEF pumpset introduced during1988-1992.
[xi] This is one of the FENU pumpset used in appr. 50 village irrigation schemes during 1986-1992

ISBN 92-9090-494-1

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