Review of Irrigation Development in Kenya

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INTRODUCTION

Background

The land area of Kenya is 582,646 km^2, 17 percent of which is classified as medium to high potential land with more than 700 mm of rainfall per year, which is suitable for rain-fed agriculture. The remaining land is classified as arid and semiarid lands (ASALs) and cannot reliably support rain-fed agriculture unless other technologies, such as irrigation and water harvesting, are used to augment water for crop production.

The government recognizes the important role that the agriculture sector plays as the backbone of Kenya's economy. The sector (including the agro-based industries), contributes approximately 55 percent of the Gross Domestic Product (GDP), provides about 80 percent of employment, accounts for 60 percent of exports and generates about 45 percent of government revenue (Ragwa et al. 1998).

Supporting the rapidly increasing population and ensuring the economic growth in the dwindling landholdings of high- to medium-potential lands will require the use of technologies, which will ensure the intensification of production in such potential lands and the opening of new lands in the ASAL areas. This is possible only with the use of irrigation technologies.

Food security is the major output of irrigation development activities. However, this cannot be achieved without sustainable water resources management. The new thinking currently gaining ground is the integration of irrigation water management within the broader context of integrated water resources management. This is understandable because irrigation is a major user of water. In Kenya, irrigation uses over 69 percent of the limited developed water resources (Torori et al. 1995) and despite this high water use, the performance of irrigation projects has not been impressive.

Food shortages are a recurrent problem, which cannot be solved through rain-fed agricultural production alone, without irrigation development. In Kenya, food insecurity continues to loom, not to mention the existing water crisis. As demand for food increases, more and more water will continue to be used in an attempt to alleviate persistent food shortages. Available water resources are diminishing, leading to conflicts over water uses and among water users. The increasing demand for water for the domestic and industrial sectors is expected to continue. This means that the water use by the agriculture sector must be decreased to 33 percent by the year 2025 (Seckler et al. 1998). This calls for more efficient use of water in

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irrigation. The irrigation efficiency, which was estimated at 27 percent in 1990, should increase to 54 percent to reduce the water withdrawals in irrigation by the year 2025 (Seckler et al. 1998).

The situation is even gloomier in the ASALs, where water scarcity is the main constraint to agricultural development. The problems posed by inadequate water supply are aggravated by population growth, environmental degradation, competition over the use of limited natural resources and increasing water demand. There is a need to develop immediate, practical and sustainable solutions to address the twin problems of inadequate water and food insecurity (Ngigi 1999). The government has realized this need and a number of government and donor interventions have been undertaken, especially in the vast drylands, though with limited success.

Role of Irrigation

For the last two decades, agricultural production has not been able to keep pace with the increasing population. To address this challenge, Kenya must seek ways to improve and stabilize agricultural production to cater to the needs of its increasing population. The biggest potential for increasing agricultural production lies in the development of the ASALs, especially through the development of irrigation and water-harvesting technologies. For instance, if 50 percent of the irrigation potential—of which only less than 10 percent is now exploited—is exploited, Kenya would not only be self-sufficient in food but also be a producer and exporter of agricultural products.

Contribution of Irrigation to the National Economy

Irrigation and rain-fed agriculture are complementary and not mutually exclusive. Irrigation can assist in agricultural diversification, enhance food self-sufficiency, increase rural incomes, generate foreign exchange and provide employment opportunities when and where water is a constraint. The major contributions of irrigation to the national economy are food security, employment creation, settlements and foreign exchange.

Food Security

In the ASALs, smallholder irrigation schemes have been used to supplement fodder. However, contributions to food security are more pronounced in group-based irrigation and National Irrigation Board (NIB) schemes, where rice is the main crop, accounting for 90 percent of rice produced in the country (Kimani and Otieno 1992).

Employment Creation

Irrigation is labor-intensive and is able to generate 730 person-days of labor per irrigated hectare. Hence, irrigation makes a substantial contribution to job creation.

Settlements

Irrigation's contribution to settlements is largely associated with NIB schemes (Mwea, Hola and Perkerra), which have settled unemployed and landless people.

Foreign Exchange

Irrigation has provided opportunities for growing crops that earn foreign exchange or are substitutes for imports. Of significant importance is the growth of the horticultural industry in the private commercial sector.

Categorization of Irrigation Development in Kenya

Public Irrigation Schemes

This category includes the settlement schemes managed by the NIB and the Bura irrigation scheme run by the Ministry of Agriculture. These schemes are based on a tenant-farmer system where each tenant is generally allocated 0.4–1.0 hectare. The other schemes in this category are managed by regional authorities and are operated as commercial estates, e.g., the Yala irrigation scheme under the Lake Basin Development Authority (LBDA), the Sigor irrigation scheme under the Kerio Valley Development Authority (KVDA), and the Kibwezi and Tana deltas, under the Tana and Athi River Development Authority (TARDA).

Smallholder Irrigation Schemes

These schemes can be further grouped into two types.

- Schemes where the irrigation infrastructure and water distribution systems are operated and maintained by a water undertaker. Examples of this type are the Yatta Furrow and Njoro Kubwa Furrow where the Ministry-in-charge of water resources is the water undertaker. Another scheme is the Southwest Kano irrigation scheme where an NGO called Smallholder Irrigation Scheme Organization (SISO) is the water undertaker.

- Schemes where the Water User Association (WUA) has full responsibility for operating and maintaining the irrigation infrastructure and for distributing the water to all its members. Most of the schemes supported by the Irrigation and Drainage Branch of the Ministry of Agriculture fall into this subcategory, for example, Mitunguu, Kibirigwi, Eldume, Ishiara, Kwa Kyai and Ngaare Ndare.

Private Commercial Farms

These are commercial farms or estates that produce high-value crops, such as floricultural and horticultural crops, mainly for the export market. Often, these farms are highly specialized in their production of technologies, such as drip, sprinkler and even center pivots. Most of these farms are found in the Athi river area, Naivasha, parts of Central province, around Nanyuki and in the peri-urban areas of Nairobi. Currently, horticultural production is spreading rapidly in the Central province, Rift valley (mainly Nakuru districts and districts neighboring the Eldoret airport) and the Mt. Kenya region.

EVOLUTION OF IRRIGATION DEVELOPMENT

Historical Development of Irrigation

Irrigation is an age-old technology involving the artificial application of water to supplement rainfall for the purpose of crop production. In Kenya, there is evidence that local communities, especially Marakwet, the Ilchamus (Jemp Maasais), the Turkana and the Pokomo, may have practiced some form of irrigation for the last 500 years (Njokah 1992). Formal irrigation started between 1901 and 1905 during the construction of the Kenya-Uganda railway around Kibwezi and Makindu. Large-scale irrigation commenced in the mid-1950s with the development of Mwea-Tebere, Hola and Perkerra irrigation schemes.

The evolution of irrigation development can be categorized by the way they were initiated and/or the period when they were constructed, as follows:

- *Indigenous irrigation schemes* found in Marakwet, West Pokot, Tana river and Baringo districts.

- *Slave-labor irrigation schemes,* which were started in the middle of the nineteenth century, along the river valleys in the Coast province around Kipini, Malindi, Shimon and Vanga, mainly using Arab-owned slave labor. The present Vanga cluster of irrigation schemes is an example of this type of irrigation development. These and other similar schemes collapsed after the abolition of slavery towards the end of the nineteenth century.

- *Uganda railway irrigation schemes,* which were established during the construction of the Uganda railway between 1901 and 1905. Some irrigation schemes were established around Makindu and Kibwezi to produce vegetables for the Asian workers. The Indians who had some experience started these clusters each up to 30 hectares along the railway line. Some have continued specializing in Asian vegetables to date (see paper by Freeman and Silim).

- *Irrigation schemes,* which were established during the Second World War (1939–1945). The need to feed the British troops in East Africa during this war was another event that triggered irrigation development. This period marked the establishment of irrigation in the Kano plains, Taita Taveta, Rumuruti and Karatina.

Irrigation Development during Pre-Independence

Planned irrigation development started after the Second World War, around 1946, when the African Land Development Unit (ALDEV) embarked on a broad agricultural rehabilitation program in "native reserves" whose basic aim was to contain African agitation for land occupied by the European settlers (Ragwa et al.1998). This program included irrigation development, among other approaches. The onset of the Mau Mau uprising and agitation for independence gave an added impetus to this program. ALDEV, the implementing agency, initiated a number of irrigation schemes using the pre-independence Mau Mau detainees as free labor. Between

1950 and 1960, detainee labor was used to construct irrigation infrastructure in Mwea, Hola and Perkerra irrigation schemes.

Irrigation Development during Post-Independence

The efforts of the Government of Kenya in irrigation development after independence focused mainly on establishing large-scale tenant-based irrigation schemes. The Ministry of Agriculture took over the management of the three initial schemes namely Mwea, Hola and Perkerra. In July 1966, the NIB was enacted with the mandate to develop, improve and manage national irrigation schemes in Kenya. By the mid-1970s, another three schemes were constructed: Ahero, Bunyala and West Kano irrigation schemes. This brought the number of schemes under NIB to six. The Bura irrigation scheme was constructed between 1978 and 1983. This scheme, which is also under the central management but under the Ministry of Agriculture, is no longer functional.

Apart from the centrally managed schemes, in the late sixties a number of small-scale irrigation schemes were developed using UNDP/FAO funds in arid zones, especially in Turkana, Isiolo and Garissa districts. Examples of these schemes include Katilu, Merti and Galfasa. These schemes were developed with the objective of settling nomadic people affected by occasional droughts, thus providing them with an alternative livelihood. Irrigated agriculture was expected to augment food security and thus reduce the burden on relief food supplies. In the early 1970s, irrigation activities in Taveta and Lower Tana were also started either by the government or by the NGOs, also with the aim of supplementing food supplies in these areas.

Research findings demonstrated that, in the mid-sixties, coffee irrigation was profitable and hence a number of coffee estates in the Central province were initiated with sprinkler irrigation systems. Similar commercial irrigation activities were later started with the view to expanding horticultural production around Thika (for pineapples) and in Naivasha (for vegetables).

Institutional Development

In January 1977, the Small-Scale Irrigation Development Project (SSIDP) was established under an agreement for technical cooperation between the Governments of Kenya and the Netherlands. The main objective of the SSIDP was twofold: to promote and develop a participatory model of small-scale irrigation and to establish a national institutional framework for the planning and implementation of smallholder irrigation and drainage programs within the Ministry of Agriculture.

Through the SSIDP, the Small-Scale Irrigation Unit (SSIU) was created in the Ministry of Agriculture and was renamed the Irrigation and Drainage Branch (IDB) in 1978. The IDB established Provincial Irrigation Units (PIUs), which in the mid-1980s were decentralized to District Irrigation Units (DIUs) conforming to the government's policy of the District Focus for Rural Development.

Shift in Irrigation Policy

The centrally managed schemes with a top-down management approach have proven unsustainable, one reason for which is the reliance on government subsidies. The farmers have not been comfortable with this approach due to overexploitation and lack of control over the marketing of their produce. The intended benefit of improving the living standards, to say the least, has not been realized—the tenants continued to live in "ambient" poverty—until they could withstand it no longer. The recent scenario in Mwea (details presented in the paper by Mutero and Kabutha) tells a lot about the deteriorating relationship between the government and the farmers. This case clearly indicates that there is a need to change the approach of managing large-scale NIB irrigation schemes if sustainability is to be forthcoming.

Nevertheless, there has been a shift of policy in the development in the last 20 years (details in paper by Huggins). The emphasis has been to facilitate the development of smallholder irrigation projects, especially in the ASALs, through the IDB. In this approach, community participation in planning, implementation and O&M has been emphasized. However, this approach also seems to have some problems, especially with regard to scheme management. This could be attributed to some degree of overdependence on government subsidies although such schemes were expected to be sustainable because they are owned, operated and maintained by the farmers. Overreliance on the government has led to the abandonment of a number of schemes, especially after the El Niño rains, which damaged many irrigation structures. While the government is now reconsidering its policy towards smallholder irrigation, farmers are now realizing that they must assume management responsibility for their irrigation schemes.

Commercialization of Irrigation

The government has realized that group-based irrigation investment is costly and that its limited resources have been overstretched. In recent irrigation development in Kenya, there has been a deliberate effort by the government to promote greater beneficiary participation through cost sharing, cost recovery and gradual liberalization and privatization in an effort to commercialize the agriculture sector. The emphasis now and in the future is to have less government intervention and pursue a balanced policy that incorporates both public and private sectors and beneficiary participation to build self-sustaining systems. In this structure, the government will concentrate on performing the core or strategic functions such as policy formulation and coordination of development efforts. This philosophy is further articulated in the proposed Agricultural Sector Investment Programme (ASIP) that recognizes a) the private, nongovernmental and governmental sectors as partners in development and b) the need to adopt an integrated approach to agricultural development.

The guidelines presented in the appendix were revised in 1993 to incorporate an item on farmers' contributions as a prerequisite for sustainable irrigation development (Ragwa et al. 1998). Due to the dwindling availability of funds for investment in irrigation development from both the government and the donor community, and the need to impart a sense of ownership of the schemes by the beneficiaries, the guidelines also explored various avenues for mobilization of financial resources for irrigation development. This led to the concept of cost sharing, cost recovery, revolving funds for infrastructure-development loans and allocation of grants for specific issues. The paper by Freeman and Silim presents details on economic and social impacts of commercialization.

Cost Sharing

Cost sharing is recommended for rice schemes, which are expected to have moderate gross margins. The farmers are expected to cofinance the development of infrastructures of rice schemes with the government, donors and NGOs. Farmers' contributions take various forms, e.g., contribution in cash, provision of unskilled casual labor and provision of land for drains and access roads. Once the projects are implemented, the O&M functions are entirely the responsibility of the beneficiaries—the farmers.

Cost Recovery

In 1993, the cost-sharing policy was taken a step further to full cost recovery for horticultural schemes. Farmers can fetch high returns from these schemes, which are commercially oriented. Under this policy, development agencies are expected to provide investment capital in the form of credit, which is recoverable once the scheme is in production. The beneficiaries are expected to take up the O&M functions and ensure that the credit is paid back to the lending agency.

Revolving Funds for Irrigation Infrastructure Loans

The guidelines recommend that investment capital for smallholder irrigation development should be provided through a revolving fund to facilitate reuse of the funds after repayment to finance other projects.

Grants for Food-Based Irrigation Schemes

Food-based irrigation schemes are located in marginal areas (ASALs), which are food-deficit areas. These schemes cannot be justified if economic viability criteria alone are applied. However, to ensure food security in these areas, projects have been initiated where the development of irrigation infrastructure has been financed through grants by the government, NGOs or donors. These schemes also require subsidization of O&M costs for over a long period of time before they are able to become self-sustaining.

TRENDS IN IRRIGATION DEVELOPMENT

Irrigation Potential

There are two basic reasons why the irrigation potential of any country should be estimated. First, it provides a base for the formulation of strategies for irrigation development and, second, it gives a benchmark for monitoring progress within the irrigation sector. Several factors need to be considered when estimating the irrigation potential that include, inter alia, water resources, availability of suitable land, cropping patterns and the irrigation technologies to be used.

The following studies have been carried out to assess the irrigation potential in Kenya: MoWD 1980; World Bank 1987; IDB 1990; Kiragu, 1992 and JICA 1992. The estimated irrigation potential and breakdown for the five drainage basins are presented in table 1. The disparity in the estimated potential could be attributed to factors considered and the assumptions made in each of the studies.

Table 1. Estimated irrigation potential (ha) in Kenya.

Drainage Basin	MoWD (1980)	World Bank (1987)	IDB (1990)	JICA (1992)
Tana	205,500	90,000	100,000	
Athi	40,000	49,500	40,000	
Lake Victoria	200,000	57,400	145,000	
Kerio Valley	64,000	31,200	85,000	
Ewaso Ng'iro	30,000	15,700	20,000	
Total	539,500	244,700	390,000	471,860

Due to technological developments, which are generally more water-efficient, the potential irrigable area is expected to be increased progressively. It is not surprising that some districts like Nakuru have reported an increase in irrigated area that is double the estimated irrigation potential. On the other hand, high rates of population growth have induced demands for water in the other sectors and is evidence that water scarcity is growing.

It is ironic that we are unable to exploit irrigation potential substantially, mainly due to water scarcity when only 5.4 percent of the potential ($14 * 10^9 m^3$/year) surface-water resources is exploited (Chebwek 2000). The groundwater exploitation is also meager and only 9.4 percent ($57.2 * 10^6 m^3$/year) of available groundwater is exploited.

Irrigation Development

Kenya has a relatively limited irrigation tradition and the majority of existing irrigated areas were developed between 1960 and 1980. Since then, the rate of irrigation development has unfortunately declined as shown in table 2. Despite the irrigation growth since 1975, the area under irrigation is far less than the potential irrigable area estimated between 244,700 and 539,500 hectares (table 1 above) in Kenya. Tables 1 and 2 show that the area under irrigation is between 15.6 and 34.5 percent of the irrigation potential. Nevertheless, irrigation has been making a substantial contribution towards national agricultural goals: food self-sufficiency, raising of rural incomes and generating employment. Currently, there is a notable contribution of irrigation to the horticultural export industry—the third highest foreign exchange earner of the country.

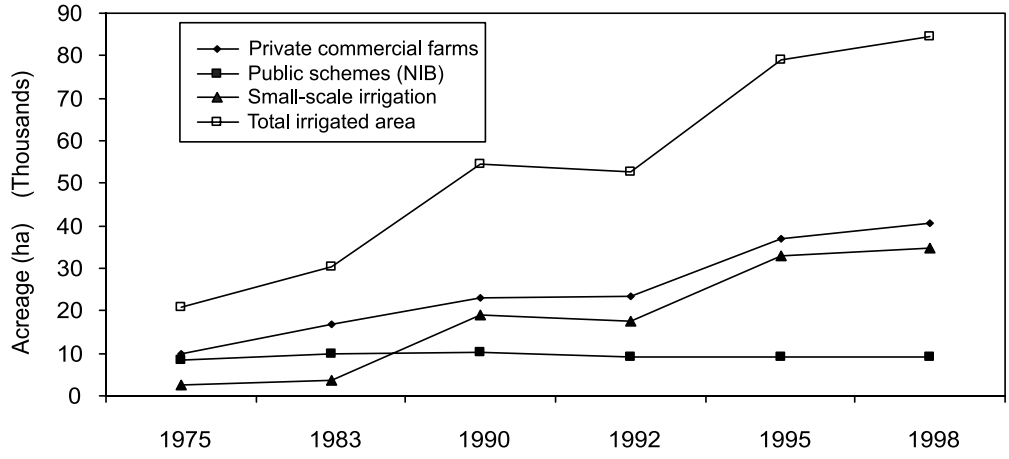
Table 2 shows a tremendous increase in the area under small-scale irrigation in the period 1975–90. This could be attributed to the attention given to this sector by the government and the donors, as smallholders are perceived to spread the benefits more evenly. There has been an immense growth of smallholder and commercial, large-scale irrigation development in Kenya between 1975 and 1990. However, the growth of large government-managed schemes has not been significant. Before 1990, irrigation development, as reflected by the area under irrigation, was on an upward trend. The economy by then was favorable to all sectors. Indeed, between 1983 and 1990, donor support boosted the development and sustenance of smallholder irrigation schemes. The trend in irrigation development in Kenya shown in table 2 can be presented as shown in figure 1.

Table 2. Irrigation development in Kenya (1975–98).

Category	Area under Irrigation (ha)					
	1975	1983	1990	1992	1995	1998
Commercial private irrigation	10,000	17,000	22,979	23,280	37,000	40,700
Large-scale irrigation (NIB)	8,500	10,000	10,325	9,020	9,000	9,000
Small-scale irrigation	2,400	3,500	18,907	20,490	33,000	34,650
Total	20,900	30,500	51,401	52,790	79,000	84,350

Sources: Heyer 1976; IDB 1990; Ragwa et al. 1998; and Ogombe 2000.
Note: Small-scale irrigation development includes schemes developed by the IDB, NGOs, and individual farmers or groups of farmers. The recent increase under this category could be attributed mainly to individual efforts, i.e., small-scale households.

Figure 1. Trend in irrigation development in Kenya.



It is evident that despite the initial positive trends, the rate of development of government-supported large- and small-scale irrigation schemes has been declining. Poor water management and ensuing environmental problems, such as waterlogging and salinization have led to a decline in agricultural productivity of some irrigation schemes. Consequently, the outputs from irrigation development have not been commensurate with the massive government efforts and donor support in this sector. It is also notable, on the other hand, that private individual and NGO-supported small-scale irrigation development activities have progressively increased.

Despite the decline in the rate of irrigation development, there are a number of promising small-scale irrigation technologies with high water-use efficiency being promoted in Kenya. They include, but are not limited to, low-head drip-irrigation systems, ApproTEC treadle/pedal "super money-maker" pumps, Jua Kali low-head sprinklers, small basins, etc. (Ngigi 1999). A number of these technologies seem to be gaining more attention and popularity in Kenya. Increases in the acreage resulting from these technologies may not be captured in the national statistics. Details on new irrigation technologies in Kenya are presented in the paper by Sijali and Okuma.

Factors Affecting Irrigation Development

High Cost of Irrigation Development

Irrigation investment requires a relatively high capital investment for infrastructural development when compared to rain-fed agriculture. This capital is not within the reach of many smallholder farmers. The costs are further escalated, if horticultural production is considered, which is highly capital-, labor- and input-intensive. The costs of pump-fed irrigation schemes are, depending on the technologies used, higher than those of gravity-fed schemes. The average cost of smallholder irrigation development (Ragwa et al. 1998) is summarized in table 3.

Table 3. Average cost of smallholder irrigation development.

Type of the System	Average Cost (Ksh) per ha
Gravity-fed open canal conveyance and distribution	80,000
Pump-fed open canal conveyance and distribution	150,000
Gravity-fed open canal conveyance, piped distribution	150,000
Gravity-fed piped conveyance and distribution	200,000
Pump-fed piped conveyance and distribution	250,000

Farmers' Access to Credit Facilities

The majority of farmers, especially those in the smallholder category, lack financial resources to invest in irrigation activities. To access credit, farmers are required to provide collateral by commercial financial institutions. Because of this, coupled with the fact that the financial institutions find it risky, expensive and cumbersome to administer such credit, many smallholder farmers are precluded from obtaining such credit facilities. Inadequate access to credit has, to a great deal, slowed down the development of smallholder irrigation development in Kenya.

Lack of Clear Policy on Irrigation Development

Irrigation development in Kenya has been constrained by the lack of a national policy that would create an enabling and conducive environment for all actors.

Coordination of Various Stakeholders in Irrigation Development

There are various stakeholders who are directly engaged in irrigation development in Kenya. Although these players could contribute significantly to the development of irrigation, implementing the institutional framework to effectively coordinate and rationalize the use of the limited resources is a daunting task. This has resulted in duplication and overlap of activities, misappropriation of limited resources, inefficiencies and conflict of interests.

Water Availability and Utilization Efficiency

The spatial and temporal distribution of water resources in Kenya is skewed so that it is expensive to undertake irrigation development in some areas due to the long distance that water has to be conveyed. This, coupled with the use of inefficient technologies and poor on-farm water management, implies that the pressure on scarce, easily exploitable water resources will continue to deter development, especially in the arid and semiarid areas.

Support Services for Irrigation Development

In many areas with high potential for irrigation development there is inadequate infrastructure such as access roads, marketing outlets, electricity, extension services, etc. These factors have contributed to the declining pace of irrigation development in some areas in Kenya.

Land Tenure System

Title deeds of lands are a prerequisite to the development of irrigation as they provide security for obtaining loans for investment in irrigation development. In many areas where there is potential for irrigation development, especially in the ASALs, land adjudication to facilitate issuance of land title deeds has either not been done or is incomplete. This has been a serious setback to irrigation development in some areas because farmers cannot access credit and have no incentive to invest due to insecurity of land tenure.

Landownership continues to affect water management, especially in the ASALs where land rights are governed as trust lands. Lack of inadequate land tenure has drastically affected irrigation development in these areas. Torori et al. (1995) argued that any efforts arrived at improving water resources management must be based on the prevailing land-tenure system, as this provides the context and defines rights to water.

Marketing of Fresh Horticultural Produce

Marketing of fresh horticultural produce has been a persistent problem for smallholder farmers. This could be attributed to reasons such as the inaccessibility of some schemes due to bad roads, coupled with flooding the market with produce due to lack of diversification and uncontrolled production. Middlemen are also accused of manipulating the market and exploiting the poor farmers. The lack of an organized marketing system, seasonal fluctuation in demand, quality concerns and perishability of produce aggravate this situation.

Water Allocation for Future Irrigation

In view of continuing water scarcity and competition among users and uses, there is a need to seek measures that will foster sustainable increases in the productivity of water used in agriculture through better management of irrigation and water-basin systems. Being the biggest water user, irrigation requires special attention. If Kenya is to realize its industrialization goals by 2020, then more water is required for industrial development, not to mention the ever-increasing domestic water demands. Hence, there is a need to evaluate irrigation development with the aim of achieving sustainable water-resources management. The preliminary evaluation identified issues and opportunities for better management of water for irrigation and improved food production.

However, the answer to the question "how to reduce irrigation water use from the current 70 percent to 33 percent, as recommended by Seckler et al. (1998)," still remains elusive. Conflicts over water resources are real in Kenya. The current drought has brought to the fore the water-crisis time bomb. For instance, in the North Ewaso Ng'iro river basin, the government was forced to ban all irrigation activities to ensure that there was water for downstream users (details in paper by Gichuki). To enforce the ban, the Administration Police has been called in, especially where downstream users have decided to march upstream and destroy all irrigation intake structures. In response to the 1999–2000 drought, the Ministry of Natural Resources and Environment (Department of Water Development) convened a national meeting of all the major water users—mainly large-scale commercial farmers—to seek ways of addressing the increasing water scarcity. Unfortunately, despite the high irrigation demand, other uses are accorded more priority under the law (Water Act, chap. 372).

EVALUATION OF IRRIGATION DEVELOPMENT

Need for Evaluation

Past efforts, such as the development of large- and small-scale irrigation projects through the NIB and the IDB, had initially shown a positive trend in alleviating poverty and improving food security. Irrigation projects, which had been initially successful, have, in many cases, declined in productivity and, in some cases, they have been abandoned. There is a need to evaluate past and current irrigation development in Kenya to map out sustainable future strategies. Participation by farmers in such a process will be crucial, as farmers have developed and are continuing to develop sustainable coping mechanisms for food security and water scarcity, which if understood and improved could be the long-awaited solution.

There are a number of innovative approaches being developed and adopted by farmers to enhance food security in Kenya. These approaches are, unlike the conventional irrigation systems, inexpensive and easily manageable and, in spite of some negative past experiences, some technologies are showing promising results and increasing adoption rates by small-scale farmers. These include low-head drip irrigation technologies, such as the bucket and drum-drip irrigation system, developed by Chapin Watermatics, among others, which are being promoted by the Kenya Agricultural Research Institute (KARI) and other stakeholders in Kenya (for more details see paper by Sijali and Okumu). Other recent technologies that may require further evaluation are low-head "Jua Kali" sprinklers, small basins and ApproTEC's treadle/pedal "super money-maker" pumps, to mention a few.

These new technologies have not been evaluated to ascertain their technical and socioeconomic performance under the local conditions. The possibilities of adapting other high-level technologies, such as greenhouse farming systems to small-scale users, for example, need to be explored. The promise of new technologies needs to be evaluated to identify constraints and opportunities for future strategies to address water scarcity and the ensuing food insecurity.

There are various reasons for the irrigation potential to have been unrealized despite the persistent food shortage. Some of these issues need to be critically addressed in light of declining irrigation development. There is a clear indication that something must have gone wrong along the way in the development of irrigation projects in Kenya (Ngigi 1999). This calls for a need to evaluate the genesis of the current situation with a view to identifying successes, failures, challenges, opportunities and constraints. The evaluation needs to point out what went wrong and formulate possible remedies and future strategies. In addition, the evaluation process also needs to be geared towards collecting data necessary to enhance the development and management of water resources.

Concept of Evaluation

The objectives of an evaluation should be to understand the factors affecting the viability of small-scale irrigation development in Kenya with the aim to:

- evaluate the trend of irrigation development in Kenya,
- identify and analyze underlying socioeconomic factors,
- identify challenges and opportunities for improving small-scale irrigation schemes,
- review gender roles in irrigation development,
- review health and environmental issues related to irrigation evolution,
- determine governance issues such as water rights, access to and use of water, water abstraction permits,
- identify promising technologies, especially water-efficient irrigation technologies, to be promoted, and
- contribute to the technical, economic and social evolution of irrigation development in Kenya.

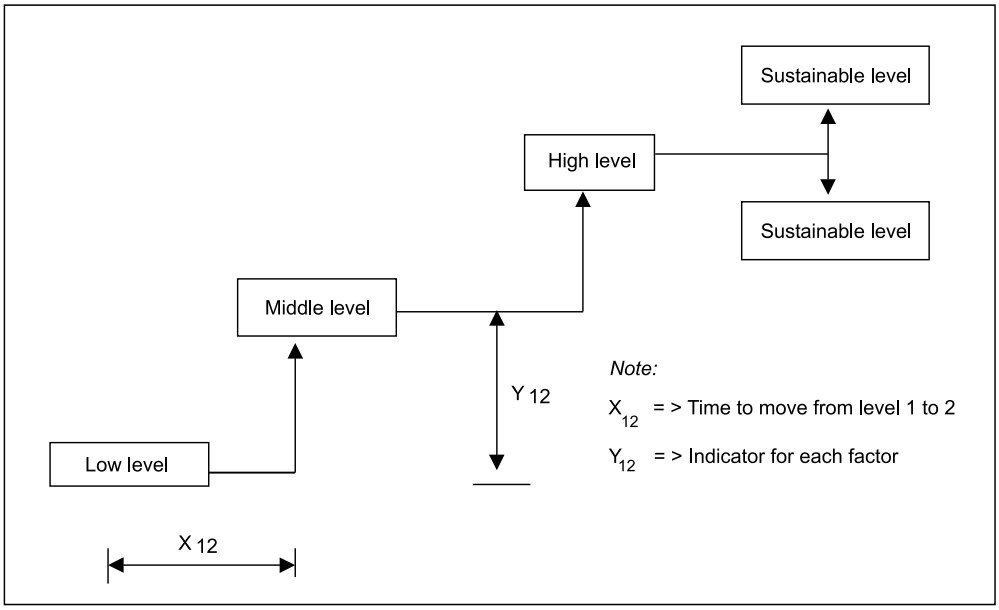
The evaluation outlined is a participatory learning process, which involves all key actors and critical issues that affect irrigation development in Kenya. This process recognizes the fact that the solutions to declining irrigation development could be identified by looking back at where we started, the current situation and where we want to be in the future. Comparative evaluation of various irrigation schemes vis-à-vis different technologies, water management, socioeconomic factors, crop production and marketing systems, institutional arrangements, sociocultural and gender perspectives, etc., will form the basis of a focused evaluation process. Evaluation and monitoring should be a continuous process if sustainable irrigation development is to be realized.

An effective evaluation should focus on the trends of various technologies, social organizations and related training and research activities and their overall impact on small-scale irrigation development in Kenya. Identification and evaluation of the numerous innovative developments in, and application of, small-scale irrigation technologies will provide the basis

for the development of appropriate guidelines for future irrigation development. Identification of successful developments will also provide a strong basis for the development of participatory technology. The evaluation should not focus on a particular technology against its technical specifications but rather on the experiences of users in the application of the techniques (IWMI 1999).

The proposed evaluation concept assumes that irrigation schemes are at various levels of development and we need to understand the factors that have led to those different levels. For simplicity, three levels (low, middle and high) are to be considered. They are evaluated against no irrigation development on the lower level and sustainable irrigation development on the higher level. The sustainable irrigation-development level may vary from one scheme to another and, hence, it could be either higher or lower than the higher level of development. The shift from one level to another has important learning lessons necessary for understanding the genesis of irrigation development. The time taken to pass from one level to another also varies from scheme to scheme, depending on a number of factors that will also be important for the evaluation process. The evaluation process is graphically presented (figure 2) below:

Figure 2. Basic evaluation concept.



In this figure, the y axis represents different development levels of various parameters, factors or indicators, whilst the x axis represents the time taken from one development level to another. The sustainable level represents the targeted or anticipated development level for a scheme. Therefore, a critical evaluation of different irrigation schemes, say three, at different levels of development, say low, middle and high, may reveal the required effort required to move from one level to another or why an irrigation scheme is at a certain level. Such an evaluation will identify the development or advancement paths of different schemes and factors that determine the path. This will be important in planning future strategies, which aim at developing a scheme to a higher level. The evaluation will also identify training needs for farmers, irrigation committees or extension staff based on experiences of the others, with the aim of enhancing the development process. The concept can also be used to evaluate the performance of a cross section of projects over a certain time period.

Database Development

For effective monitoring and evaluation of irrigation development and performance of irrigation projects, a reliable and updated database is a prerequisite. The advent of Geographical Information Systems (GIS) is making database development and updating easier. Although GIS is just starting to be widely utilized in Kenya, the basic data files are becoming more freely available and the technology has advanced so that it is more user friendly (Mati 2000). GIS can now be used with the minimum assistance of specialists. GIS can display data in a very quick and visual manner. Therefore, GIS should be available at the national level to assist in monitoring irrigation development (see paper by Mati).

CONCLUSIONS AND WAY FORWARD

Conclusions

The rapid changes in the political economy of Kenya are having a direct impact on the nature of irrigation and the benefits that accrue from investing in modern irrigation technologies. The rapid pace of these changes means that there is an opportunity to use Kenya as an example of similar changes in a number of countries in eastern and southern Africa (Blank 2000). The three most important changes are the following:

- The capacity of the government to manage large-scale surface systems has rapidly deteriorated. In the Mwea irrigation system, which forms over 60 percent of the large-scale systems operated by the NIB, farmers are in the process of taking over its responsibilities and operate and maintain the systems by themselves, despite the lack of any formal management structure or federated water user organization (see paper by Mutero and Kabutha). In many irrigation areas, rules for water allocation and distribution imposed for many years are now in abeyance and new

rules and operational strategies are needed to help farmers effectively manage water into the future.

- Commercialization of smallholder irrigation has enabled some individuals to move away from the irrigation of traditional food grain crops and enter the high-valued vegetable and fruit market (see paper by Freeman and Silim). This has been accomplished, in part, through smallholder contacts with marketing agents and expansion of markets for such crops as tomato, French bean and Asiatic vegetables.

- New technologies are being rapidly introduced and adopted widely by irrigators. These include motorized pumps, manually operated treadle-type pumps, low-head drip-irrigation kits and locally manufactured sprinkler and drip systems. Because some of these technologies enable them to lift water, farmers, many of whom are women, can access water sources previously unavailable to them, and they can use water much more effectively on small plots so that potentially they can expand the area they can cultivate.

These changes are likely to result in improved utilization of the scarce water resources of Kenya and increase the incomes of those who are able to take advantage of the new technologies. However, there are some cautionary lessons that need to be learned from current experiences in Kenya that have a wider regional importance, particularly those that address issues of water rights, environmental degradation, poverty alleviation and equity. According to Blank 2000, the most critical of these cautionary lessons appear to be the following:

- Inadequate capacity of the government to regulate and control access to water resources because much of the new development relies on small pumping and water-lifting devices owned and operated by individuals. This may lead to basin-level problems of access to water, and intensify the adverse impacts of irrigation associated with higher input use such as conflicts over water, equity concerns, groundwater depletion and undesirable environmental effects (see paper by Gichuki).

- Traditional community water rights may be overridden by individual-based irrigation development resulting in a realignment of access to water to a more entrepreneurial class of farmer.

- Reduced access to water by the very poor and disadvantaged members of the community, including women, who cannot afford the initial investments, albeit small in terms of potential benefits, in new irrigation technology.

- An urgent need to facilitate transfer arrangements in systems where the government has traditionally had management responsibility but can no longer provide these services due to the lack of finance and manpower so that tail-end and other less-influential farmers do not lose their existing rights of access to water.

- Rising concerns about environmental issues such as the relationship between irrigation in wetlands (see paper by Chin and Orego).

A review of irrigation development reveals that Kenya is already experiencing all of these issues and is struggling to find ways in which access to, and exploitation of, water resources for irrigation can be undertaken in such a manner as to support increased agricultural production, maintain an acceptable level of equity of access to water, maintain ecologically sensitive land uses and continue to reduce poverty through improved production of food and cash crops.

Way Forward

The importance of evaluation of irrigation development in Kenya cannot be overemphasized. The evaluation will assist in updating the database and identifying opportunities and constraints to improve the productivity of irrigation activities. Therefore, an evaluation of irrigation development is aimed at identifying the following:

- future strategies—which way—for irrigation development
- what has gone wrong—past mistakes—leading to decline in irrigation development
- means to increase the productivity of water
- water-scarce and constrained irrigation schemes and river basins
- conflicts among irrigators and other water users
- what needs to be done to increase food production
- research and training needs to enhance irrigation development
- promising technologies for small-scale irrigation development
- adaptive strategies and farmers' innovations for addressing various constraints
- documenting recent trends in irrigation development recommendations to policy makers, donors and other stakeholders, etc.

Appendix

Guidelines on Smallholder Irrigation Projects in Rural Development

These guidelines were formulated in 1986, mainly to impress upon district planners and agricultural officers on the concept of smallholder irrigation and the important role it can play in rural development within the context of district focus for rural development. The guidelines identified the basic developmental phases of an irrigation project, i.e., scheme identification, investigation, design, implementation and O&M. Monitoring and evaluation were also identified as important activities for measuring achievements against objectives and targets. The guidelines emphasized the importance of farmer participation in all these stages for the success and sustainability of the scheme.

Guidelines on Farmers' Participation

In an effort to mobilize development resources and ensure sustainable irrigation development, the Irrigation and Drainage Branch (IDB) developed guidelines in 1991 to ensure full beneficiary participation in all phases of project development. The IDB recognized that local people have a wealth of knowledge, skills and organizational abilities that have evolved over a period of time for the purpose of managing the local resources and adaptation to the prevailing physical and socioeconomic environment.

Concept of Participatory Development

Participatory development in smallholder irrigation development is encouraged, based on the experience that participation of farmers in the management of irrigation systems results in better performance with respect to water use, production and O&M. This approach entails the involvement of farmers to empower them to take the leading role with respect to decision making in planning operations, and the management of their resources and the scheme. Participation of farmers presents an opportunity to improve their capability and strengthen their organizations and institutions that are prerequisites to sustainable development.

Concept of Sustainability Development

The concept of sustainable development is also introduced in the guidelines. Sustainability concept, when viewed within the context of smallholder irrigation development generally refers to the long-term ability of the beneficiaries to operate and maintain their schemes profitably with little or no external intervention other than the normal extension services.

Therefore, sustainable smallholder irrigation development entails the devising of a technical, social and economic production system, which guarantees that the farmers' goals of increased levels of income, increased levels of food security in the household, employment opportunities and general improvement of their standards of living are sustained through effective management of their irrigation systems.

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