Summaries of Papers Presented at the IRMU Seminar Series

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Preface

THE IRRIGATION RESEARCH Management Unit (IRMU) was established in mid-1992 in the Irrigation Department, Sri Lanka. The main objective of it is to identify research needs, conduct and coordinate research and disseminate research results to improve efficiency, productivity and profitability of irrigated agriculture.

As part of its technology transfer program, the IRMU initiated a series of monthly seminars. In 1995, thirteen such seminars were held. These covered the following program areas of IRMU and their distribution was as follows: Assessing and Improving Performance of Irrigation Systems-6, Local Management of Irrigation Systems- 5, Operational Management of Water Delivery and Disposal -1, and Crop Diversification - 1.

Professionals and researchers from national and international agencies as well as freelance consultants dealing with irrigated agriculture and irrigation management participated as resource persons. Speakers came from the Irrigation Department, International Irrigation Management Institute (IIMI), University of Moratuwa and from the Major Irrigation Infrastructure Rehabilitation Project, Alberta, Canada. IIMI was involved in 5 presentations (IRMU --1), the Irrigation Department in 2 presentations, the NIRP consultants in 2 presentations, the Faculty Member from the University of Moratuwa in one presentation, the project manager from the Province of Alberta, Canada in one presentation and 2 freelance consultants in one presentation each. In addition to serving as a strong component of the technology transfer program, these seminars also provided essential inputs in strengthening IRMU's research program. In general, these seminars were well received, with wide participation of different institutions and agencies.

This publication contains summaries of thirteen seminars presented during the year 1995.

Socioeconomic and Institutional Factors Affecting the Agricultural Production System of Tank Cascades in the Dry Zone of Sri Lanka

M. Samad[1]

MINOR IRRIGATION SYSTEMS are an integral part of the agricultural economy of Sri Lanka. Yet, they have often looked upon as social entities, as institutional phenomena or public administration issues, and in more recent years as environmental concerns, but rarely as production or economic opportunities. Most of the earlier research studies were case studies of academic interest and involved detailed investigations carried out in a single tank system, often colored with a streak of romanticism in the description of village life and its environment. Problems were viewed with reference to a nostalgic past, and were largely attributed to the deviation from the "ideal" situation which is said to have existed historically, especially in relation to the pressing problem of water management. The revival of traditional practices and customs has been proposed as a solution to contemporary problems. This uncritical approach is too simplistic. The present conditions in the villages are markedly different from the historical setting. Differences exist in production technology, demography and labor relations, and in the physical, social and economic environments. Moreover, the village community is no longer (if it ever was) the egalitarian, insular society as described in the past. Today, it is a community subjected to various kinds of external influences and internal stresses with clear evidence of growing social and economic differentiation within the village community.

The more recent investigations have been largely focused on the impact of various state intervention programs aimed either at the physical rehabilitation of minor tank systems or to effect institutional changes by appointing *vel vidanes/yaya niyojithas,* setting up farmer organizations and so on to foster improved water management. Several shortcomings have been identified. First, technical failures have been seen to be the cause of a number of problems. Second, the system of resource management, especially water, does not match the requirements of the current cropping patterns. Nor have institutions been formulated and implemented with the participation of the farming community.

While past studies have undoubtedly provided us with vital information about various difficulties in minor tank systems, they amount to a piecemeal perception of the problem which in turn provides for ad hoc remedial measures. A major drawback of most previous efforts was that, with a few exceptions, they were focused on a single tank system treating it as a unique, autonomous entity and limiting the analysis solely to its internal dynamics. The systems were not considered in either the context of the cascade in which they are located nor in relation to the broader socioeconomic and institutional environments in which they operate. These studies fail to examine whether interactions that take place between the tank systems, and between tanks and their external environment, had merit. The broader systems line of inquiry will counter the narrow case study approach which fails to throw light on the impact of external, social, economic, environmental and political changes on the critical factors internal to the system. By ignoring more general systems problems, the remedial measures proposed may deal with narrow, partial symptoms rather than the causes which may be outside the boundaries of the irrigation system.

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[1]Dr. M. Samad, Research Associate, Local Management Program, IIMI.

The problem as identified in the preceding section of is that the performances of minor tank systems in the dry zone are below expectation and are in danger of sinking under their resource management while economic and environmental problems further create poverty pockets. Yet, these systems command a vast area of land where rice is grown and are the main source of livelihood of a substantial proportion of the population in the traditional villages of the dry zone. Attempts by the government to resolve the apparent problems by physical rehabilitation of the irrigation infrastructure and through various interventions have shown to be inadequate. A review of past research suggests significant gaps in the existing knowledge base. There is a clear need for new field research to promote a greater understanding of minor tank irrigation systems, lest well-intentioned development efforts fail to improve or even destroy the very systems who apparent "true" value has only been relatively and recently appreciated.

Against this background, the objective of the study is examine ways to improve the performance of minor tank irrigation systems in the dry zone. The study will be based on the fundamental premise that the analysis of the internal dynamics of a single tank irrigation system is a necessary but not a sufficient condition for identifying the factors contributing to the poor performance of that tank alone and therefore the overall irrigation system. They can be better understood when viewed in the context of cross-system interactions and interrelationships between the system and the "external" environment in which it operates. The key question addressed is whether the poor performances of the systems are symptomatic of a defective agrarian structure and conflicts in the institutional environment in which they operate. If this is the case the mechanical solutions such as the rehabilitation of the tanks or forming farming organizations will probably have a limited impact as the evidence seems to suggest.

The presentation will focus on two issues:

1. The impact of the institutional environment on production conditions in small tank systems. It will be argued that, institutional uncertainties/failures have been a major constraint affecting irrigation management and agricultural production in the small tank systems rather than inefficiencies/irrational decision making by farmers.

2. The second issue relates to the land tenure pattern. The question addressed is "Is there a case for land consolidation in small tanks systems?"

Feasibility-Tested Automatic Head and Flow Control Systems

H.M. Jayatilake[2]

THIS STUDY INITIATED under the Major Irrigation Rehabilitation Project (MIRP) in the Rajangana Scheme in the yala season of 1992 was transferred to the Irrigation Research Management Unit (IRMU) in July 1992, after MIRP was completed. The preliminary findings of this research study were presented at the IRMU monthly seminar held on February 28.

The operation of a canal irrigation system under gravity involves head control and flow control under variable flow conditions. Flow control is required to meet crop water requirement under different crop and climatic conditions; to minimize operational losses and for safety of the conveyance system. Head control is required to maintain the command, for flow control at offtake, for protection against failure of banks due to sudden drawdown and to prevent erosion of exposed banks. The primary objective the study was to compare the performance of conventional systems with a system consisting of Neyrtec Automatic Head Control Gates, Baffle Distributors and Long Crested Weirs installed on a pilot basis in the Rajangana Scheme. From the analysis done so far, the following conclusions can be drawn:

* The water level the in the main canal fluctuates with the change of discharge in the main canal due to limited regulation. The new technology is insensitive within the practical limits to such variations.

* The degree of equity attained in water distribution in the pilot area is high.

* Regulatory devices provided in the pilot area are acceptable to users and perform as expected.

* A double-deflector-type baffle distributor which has a wider permissible level range is more suitable than the single-deflector-type baffle now installed. Incorporating better regulatory devices such as long crested weirs in the main canal itself should be investigated.

* During installation of automatic devices a higher level of supervision is needed.

* Local fabrication of a baffle distributor to suit the standards and to the level of precision required is feasible at a cost considerably less than the imported ones.

[2]Mr. H.M. Jayatilake, Deputy Director, ITI, Galgamuwa.

Rice-chili Intercropping Successful—Water Productivity Increased

K.A. Haq[3]

RICE IS THE staple food of the people of Sri Lanka and consequently its cultivation has taken prominence over all other food crops from ancient times. Promotion of rice cultivation toward self-sufficiency in rice has been the declared policy of the successive governments since the island gained independence in 1948 and many projects have been launched and policies formulated to attain this objective. As a result, rice production has increased significantly and currently the country is nearing self-sufficiency in rice. It is important to state that local rice production had shown a steady and appreciable growth up to 1985, but has nearly stagnated since then.

The overuse of water for rice production, inefficient use of water in areas with soils not suited to rice cultivation, low returns from rice and achievement of near self-sufficiency in rice have led the government to launch a strong crop diversification program in irrigation systems designed for rice cultivation.

The principal objective of the study was to develop a crop diversification technology which will accommodate both farmers' concern for food and market security and the government's concern for crop diversification.

It is difficult to draw firm conclusions from the 1992/93 maha season results, mainly because late cultivation and substandard land preparation have affected the outcome. The results in 1993 yala showed that rice-chili intercropping can be done successfully in the yala season. The technology adopted, i.e., "raised bed/border" is technically feasible in the yala season and water productivity was almost fourfold compared to rice cultivation under continuous flooding.

This experiment could be extended to evaluate the potential of using intermediate and poorly drained soils for diversified cropping in rice-based irrigation systems.
This technology could be useful for those who want to grow OFCs under agro-wells.

If both rice and chili are established in time, the chili crop will be in the field for nearly two months after the rice is harvested. There is a possibility of growing a short-term legume like green gram or cowpea with the chili.

It may be necessary to change the physical layout of the plots. During both maha and yala seasons, all the replicates of a treatment were located in the same block. It is necessary to redesign the physical layout so that each block will have all the treatments.

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[3]Dr. K.A.Haq, Technical Advisor, IRMU-IIMI.

Participatory Approach: A Successful Mode of Natural Resources Management—Lessons from SCOR

C.M. Wijayaratna[4]

THE SHARED CONTROL of Natural Resources (SCOR) Project believes that a package of measures (types of vegetation, water saving and conservation practices, novel land and water management practices and related user rights) should be selected jointly with the users and both production and protection should be incorporated into the package. The package should provide adequate incentives such as profits, desired cash flow and desired non-monetary benefits to the user to motivate him or her to protect natural resources.

Organizing users into groups and facilitating a process of linking users with institutions such as markets, credits and information or extension services and providing users or user groups with appropriate legal rights will provide an effective mechanism for overcoming difficulties in "user and market-oriented conservation." SCOR assumes that the "sense of ownership" is a necessary but not a sufficient condition for motivation to undertake sustainable practices. Therefore, the sense of ownership should be backed up by technology organization and resources. The project activities promote an appropriate mixture of all the three.

This requires active participation of not only the users but also the relevant government officials at various levels, the organized private sector and nongovernmental organizations. The integration of vertical levels in a collaborative mode is essential.

The SCOR approach is to increase the share of control of natural resources of the watershed by the users and to support them as they attempt to intensify, expand or move into new economic activities. To achieve economies of scale, and to utilize group solidarity to promote responsible behavior the project is based upon group action as the primary vehicle for project implementation.

The project's participatory mode starts with the design process in which officials, resource user group representatives and others from the national, provincial, district and divisional levels play important roles. The project strategy is designed to be user-oriented and participatory. The emphasis and activities of the project will be at the field level in the selected watersheds.

In the selected sub-watersheds, participatory appraisal of the characteristics of resource uses and users as well as mapping of current resources uses were done by groups comprising of users/farmers, local-level government officials and IIMI catalysts and other professionals. Next, a participatory resource management mini-project was formulated for the pilot sub-watershed. Such mini-projects aim at profitable technologies/techniques, novel shared control arrangements and organization and resource augmentation. Participatory implementation of such mini-projects is in progress in several sub-watersheds.

The leaders emerging from the community with leaders of groups, organizations and companies aiming at production and protection and volunteer catalysts representing different production/protection zones or activities are considered to be a successful outcome of the participatory approach. In this way, the development process could avoid party politics too.

A continuous flow of information is required to enrich the SCOR's participatory process facilitating interaction, debate, resolution and for replication elsewhere. For this, SCOR has

[4]Dr. C.M. Wijayaratna, Head, IIMI/SLNP.

launched the Management Information Systems Project through the participatory process involving user groups, the government and other project participants.

Eventually, this will lead to better results from every aspect, such as improved cropping intensity, conservation farming in chena/scrub land, conservation farming in home gardens, soil and water conservation in the wet zone tea plantations, energy conservation in the wet zone tea plantations, establishing new agro-based enterprises, and integrated water management.

Planning and Design for Rehabilitation: Experiences from NIRP

N.D.S. Ginige and A. Nadarajah[5]

THIS ARTICLE PRESENTS the results of a study done at four schemes (the Ketawala Scheme, the Kanda Ela Scheme, the Ambewela Scheme, and the Devahuwa Scheme) under the National Irrigation Rehabilitation Project. The purpose of the study was to understand planning and design-related problems of these schemes prior to their rehabilitation.

Rehabilitation is the restoration of a scheme to its original design parameters. The Ketawela Scheme has not deteriorated, but some major changes are required as proper planning and design have not been carried out. In the Kande Ela Scheme considerable changes have taken place; the command area has increased by about 60 percent resulting in a severe shortage of water. A planning study and efficient system of operation would ease the problem. In the Ambewela Scheme, while there have been no improvements, the problem of water distribution is caused by some mistakes in the original constructions. The original conditions of the Devahuwa Scheme have changed as some additional areas are now dependent on the available water resources. To ease the problem, new water resources are being utilized now and a system operation plan designed to utilize the water more effectively and efficiently is being adopted.

The methods used in identifying problems prior to rehabilitation were discussion, reconnaissance field visit, study of availability reports, and other secondary data sources, etc. The problems identified were:

* excessive flooding upstream of the Galwana Diversion Structure
* excessive seepage along the main canal
* water shortage for tail-end command areas (the Ketawela Scheme)
* shortage of irrigation water especially for tail-end areas of canals during the months of March, April and May (the Kande Ela Scheme)
* field channels have steep bed gradients constructed on topographic ridges for irrigating lands on the two banks (the Ambewela Scheme).

When planning an irrigation scheme, a question that one should ask is which method should be adopted to make the maximum use of the project; the normal "Maximization of Benefits" method used by most of the entrepreneurs or the "Benefit Cost Ratio" and the "Internal Rate of Return" methods used by irrigation designers.

Most hydropower projects designs are based on the Maximization of Benefits method and irrigation schemes use the other methods.

The Maximization of Benefits method increases the dam height above the optimum level (e.g., Victoria and Randenigala) and the other method scales down the dam height below the

[5]Messrs. Ginige and A. Nadarajah, Consultants, NIRP.

optimum level causing flood problems and inconveniences to the farmers. The Namal Oya case study is a very good example to illustrate the drawbacks of the Benefit Cost Ratio method when used in irrigation schemes.

Involvement of Women in Irrigation Maintenance: Need for Unbiased Analysis

K.P. Vimaladharma[6]

THE AGRISWISS MONITORING and Evaluation Project was entrusted with the task of continuous monitoring of the effects of the Major Irrigation Rehabilitation Project in Huruluwewa, Rajangana and Nachchaduwa schemes. The project also initiated several activities such as field canal management field-day, FC-level water measurement, farm surveys with record-keeping farmers, field workshops, training classes and the DCO hand book, all designed to enhance farmers' capacities to monitor and evaluate the irrigation-related activities. For each DCO (Distributary Channel Organization) area, an FO (Farmer Organization) Assistant called *Govisanvidhana-Sahayake* (GS) was recruited jointly by Agriswiss and the DCO from amongst resident educated youths in the area. The GS assisted the DCO and Farmer Representatives (FRs) to organize activities for which they were given systematic and continuing training. They were paid a small out-of-pocket allowances by Agriswiss. Forty percent of the GSs are women.

For field channel maintenance, field-days were conducted starting in maha 1992/93, by the FRs assisted by GSs, and records were kept of those attending and the work performed.

Women attend canal maintenance field days either in their capacity as landowners or as substitutes for husbands or fathers who are the landowners. In the first year, the field-day was introduced, the performance was not much: only 30 percent of all FCs was covered, though there was a high participation. But the situation improved in the next maha 1993/94 when the program covered 51 percent of FCs and there was sustained participation. Participation by women, which was a mere 9 percent of the total in the first session, increased almost twofold in the next season. The percentage of women participants was somewhat more than that of women landowners. Does this mean that women have been burdened with additional unpaid tasks which were earlier performed by men? Does it indicate the rekindling of the sense of moral community?

It shows much more than the fact of successful motivation and organization of women for canal maintenance field-days. Sickness of male family members, or their absence due to paid work were the usual reasons for women to substitute for men. Where the registered owner is a man who is old and not engaged in active work, and the daughters who work the lands would attend field-days whether the land is already subdivided or not. They do so in their own right as actual or potential inheritors. It was also observed that the more affluent households (salaried government officers, businessmen, rich landlords) usually avoided the field-days; neither men nor women substitutes turned up; a few of them paid the "fine" later, while a few who were present did no physical work but provided the expenses for tea and buns/biscuits for the others as part of their contribution to the field-day.

Daughters who have been allocated a part or whole of the allotment by the father, the original allottee, and who work the land with her own family labor or that of hired labor, find in the field-day an occasion to publicly demonstrate and legitimize the new status as landowner, and show that they are the rightful heirs. The official registerer does not list them as de jure owners, but they participated in the field-day as the de facto owners. Hence, a participation rate higher than ownership percentage was recorded by Agriswiss.

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[6]Mr. K.P. Vimaladharma, Managing Director, AGRIDEV Consultant Co.

The survey records have not yet been further analyzed to see whether the women field-day participants were in fact those who are registered or who are potential landowners or whether they merely substituted for their husbands and fathers. The impression one gathers is that the majority of the women turned up on their own right. Another aspect not yet analyzed is whether the recorded participation was higher in the DCO areas where the women GSs worked; our impression is that there is no difference due to the sex of the GS. In the actual work of channel maintenance, there was no sharp distinction between a woman's task and a man's task. Cleaning vegetation, desilting, and plugging holes were done by both men and women while the tasks of cutting earth and filling and strengthening bunds and any masonry work were done exclusively by men.

The major conclusion that could be drawn is that most field surveys ignore the pre-cultivation maintenance activity, make erroneous assumptions on the gender role in irrigation maintenance and lack direct observations, which then tend to produce "expected" results and reproduce insignificant gender prejudices in field studies.

Recent Changes in Irrigation Law and Their Impact on Irrigation Management

I.K. Weerawardena[7]

THE IRRIGATION ORDINANCE was first enacted in Sri Lanka (then Ceylon) in 1856 by the British colonial rulers and was titled as an Ordinance to facilitate the revival and enforcement of ancient customs regarding irrigation and cultivation of paddy lands. The British rulers found that irrigation management from time immemorial was based on *sirith* (custom).

The objective of this ordinance was to codify the prevailing irrigation customs and, therefore, activities like proprietors' meetings, preparation of rules by the beneficiaries for operation and maintenance of the scheme and the establishment of gamsabhas were included in this ordinance. The ordinance was flexible and was amended a number of times to accommodate changing situations.

Institutions like the Vel Vidane System, District Agricultural Committees, Rural Courts, etc., were included in the later amendments to the ordinance. The Paddy Lands Act which was enacted in 1958 did away with the Vel Vidane System and in its place was established farmer represented cultivation committees. These Cultivation Committees were legal bodies with specific authority to manage agriculture including irrigation before the Irrigation Ordinance was amended in 1968 to align itself to the changes in the Paddy Lands Act. In 1972, the Paddy Lands Act was abrogated and in its place the Agricultural Productivity Committees were enacted.

Meantime, a significant step toward participatory management was taken by the Gal Oya Water Management Project. This successful experiment was quickly followed by a few other experiments with the establishment of the Irrigation Management Division. This concept of participatory management with the farmer organizations was institutionalized in all major and medium schemes in this country. Although this concept was accepted and implemented it had no legal acceptance. Thus there was the need by the 1990s to give legal acceptance to the proposals and the outcome was the Irrigation Amendment Act No. 13 of 1994.

The impact of this amendment which is an important benchmark in the annals of irrigation management of this country is as follows:

The power once wielded by Cultivation Committees which were set up under the Paddy Lands Act of 1958 and subsequently disbanded was transferred to the Farmer Organizations that were set up under the Agrarian Services Act.

This meant that the FOs that were established in all major/medium schemes received powers to make rules relating to O&M of irrigation schemes, attend to irrigation management activities, take action to prevent damage to structures and to appoint irrigation agents.

It also provided legal protection for FOs in the discharge of their duties. Second, this amendment institutionalized the Project Management Committees. Until then, the PMCs had no legal status. Under this amendment the Farmer Representatives were given greater weightage over officials in the PMCs and the PMC itself was given legal authority.

The existing procedure for cultivation meetings was done away with and in its place a special meeting of the Project Management Committee, presided over by the District Secretary, had been given authority. Third, the farmers in FOs that had taken over the management of

[7]Mr. I.K. Weerawardena, Consultant, NIRP.

distributary canals were exempted from the payment of the irrigation rate and the FOs were empowered to collect a levy for this purpose, if necessary. Fourth, the post of Project Manager and the PMC came to be legally recognized.

Water Management Infrastructure Rehabilitation, Operation and Maintenance Experience in the Province of Alberta, Canada: Current and Future Issues

Upali Hippola[8]

THE PROVINCE OF Alberta in Western Canada has just completed a major irrigation infrastructure rehabilitation program. This program is part of a $1.3 billion investment on an integrated water management master plan in southern Alberta, initiated by the Provincial Government in 1980.

The main objective of this program was to rehabilitate and upgrade the existing irrigation headworks systems and improve the delivery of water to all the 13 irrigation districts in southern Alberta to meet the current and expanding demands for irrigation. The headworks systems constitutes a complex water management infrastructure that supplies water not only for irrigated agriculture but also for domestic, industrial, municipal, recreation, wildlife enhancement purposes and hydropower generation and for other uses.

After continuous operation for 60-70 years, without any maintenance, the existing canals and structures of most of the headworks systems were badly deteriorated, outdated and in disrepair. Therefore, a major rehabilitation program was necessary to ensure the sustainability of a vital industry in the province.

This multi-year multi-project program was initiated in 1975 and intensified in 1980 after the formal announcement by the Government. Under the program altogether of 500 kilometers of irrigation main canals were rehabilitated with capacities ranging from 25 cm to 90 cm. Major emphasis was placed on curtailing seepage from the canals to minimize salinity damage to arable land, to conserve water and to improve the overall delivery efficiency. Approximately 150 kilometers (30% of the total length) were provided with seepage control measures. The various types of seepage control measures used were (a) full membrane (20 mil PVC) lining with granular cover, (b) partial membrane lining, (c) downslope cut-off (d) deep interceptor tile drains (e) multiple shallow interceptors, and (f) clay lining.

The program also included the implementation of four internal storage reservoirs within the irrigation districts with a total live storage capacity of 295,000 dam^3. Seven major flow conveyance structures, including one of the largest cast-in-situ concrete syphons in Canada, were also reconstructed.

The 15-year program was completed in March 1995 at a total cost of $558 million. The implementation of this infrastructure rehabilitation program has helped improve significantly the efficiency of water deliveries to the irrigation districts. The districts have been able to increase the cultivated area from 900,000 acres in 1975 to 1.3 million acres in 1994, an increase of approximately 45 percent.

Apart from direct benefits to irrigated agriculture, the program has given substantial spinoff benefits to the province. For a period of about 15 years it generated extensive engineering and construction activity in the province. Alberta Engineers and Contractors, working in this program, gained valuable engineering experience and leading edge technology in large irrigation canal construction under cold weather conditions.

The program implementation was managed by a program coordinator through a team of project managers. Construction was mainly carried out through public tenders. Engineering

[8]Dr. Upali Hippola, Manager, Major Irrigation Infrastructure Rehabilitation Project, Alberta, Canada.

for the various projects was handled by Alberta engineers and contractors in-house staff and private consultants.

Now that the rehabilitation program is essentially complete, operators of this massive infrastructure face challenging times ahead due to the current fiscal situation in the province. Funds are hard to come by for rehabilitating the two remaining important projects, which are in disrepair and are a liability to the province. There is also a serious gap in the provincial funding for operation and maintenance of the headworks infrastructure.

As we are approaching the twenty-first century water resources managers in Alberta, like many other jurisdictions in the West, are also facing some new challenges and issues. From a government's perspective, Alberta has seen some changes in the provinces' approach to water resources management. Briefly, some of these issues are: (a) water management legislation, (b) integration of water management into ecosystem management, (c) public participation, (d) trans-boundary issues, (e) maintenance of the existing water management infrastructure, and (f) changing sources of water pollution.

In meeting these challenges and resolving some of the issues the tendency would be a shift in focus from:

* water resources management as an isolated exercise to water resources management as an element of ecosystem management

* building new projects to maintaining existing infrastructure

* provincial government management to co-management with community representatives

* water pollution control to water pollution prevention

Participatory Rural Appraisal

K. Jinapala[9]

PRESENTING THE SEMINAR on Participatory Rural Appraisal Mr. Jinapala addressed three main issues; general principles of PRA, practical issues and methodological errors. Mr. Jinapala pointed out at the very outset that he will be focusing on participatory rural appraisal (PRA) rather than on rapid rural appraisal (RRA). Explaining the importance of PRA he identified the following as its strengths:

* makes use of the available local expertise/human resources
* involves the beneficiaries as active participants in the planning as well as in the monitoring of local development projects
* helps reduce cost (cost effective)
* makes the process more realistic: people who are living in the area can provide the real information about the things that are around them
* helps harmonize the development process

To derive the maximum benefit out of PRA, there are some issues that need particular attention while conducting PRA sessions. For example, one should make sure that the diverse physical characteristics of the project are presented, the diverse community characters are well represented, the dominating nature of some characters are taken care of and non-motivated groups of participants are also given their due place. If the characteristics of the physical systems are of varying degrees, different sessions can be arranged to deal with these variations. Similarly, different sessions can be organized to get the views of different community characters. The entire success of the PRA process, according to Mr. Jinapala, depends on the facilitator's ability in running the session. While s/he should be (a) open-minded, (b) prepared to learn, and (c) prepared to listen s/he should not be a specialist.

In his concluding remarks Mr. Jinapala mentioned that PRA must be conducted in the beginning as a monitoring and evaluation exercise, if better results are to be obtained. However, one major weakness of PRA as a tool of development planning and development research is embedded in the vagueness of findings, analysis, etc. Therefore, it is necessary to validate the findings and analyses of PRA through a questionnaire survey especially for socioeconomic aspects. Similarly, technical issues may be treated in-depth, undertaking specific experiments by subject-matter specialists.

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[9]Mr. K. Jinapala, Research Associate, IIMI/SLNP.

Objective-Oriented Project Planning

D.C.H. Senerath[10]

THE AUTHOR QUOTED the West European saying *Tell me, I may remember it, Teach me, I may learn it, Involve me, I may do it* and indicated that a common feature of many projects launched in this country as in many other developing countries is that they are planned by high officials and donor agencies with little or no inputs from those at the grassroots level and those immediately involved with implementation and utilization. But for successful implementation of projects, the cooperation and participation of the actual users of the project such as farmers and others closely associated with the users such as extension officers are vital. The situation is often complicated by the fact that the explicit or implicit objectives of the planners at higher levels and the users at the lower levels are not identical if not conflicting. This leads to the failure of projects. Ironically, the planners are not in the scene when failure is realized.

To improve this situation, a new method has been developed which seeks to integrate the views, interests and judgements of a wide spectrum of persons involved in formulating a project. Since there is exposure and open discussion in a systematic manner, of all views, the method brings about more objectivity and therefore tends to increase the chance of success of the project. This technique is called objective-oriented project planning. In the case of an irrigation project, project planning is carried out in six steps by a team consisting of representatives from all parties connected with the project such as ministry officials, officers from irrigation and other relevant departments and farmers, etc.

Step 1. Description of Situation

In this step, the facts of the case (not the problem) are recorded with contribution from the participants. The required information such as the name of the project, the commencement of the project, the command area, the location of the project and the cropping seasons, etc., has to be recorded on cards, charts, maps and displayed in front of participants.

Step 2. Problem of Analysis

In this step, all problems related to the project are presented by the participants in writing, one problem in one card. Each problem should be a negative statement such as; farmers at the tail end of the distributary canal do not get sufficient water. All problems must be considered irrespective of whether they are independent of connected problems or whether the problems can be solved or not. Problems have to be categorized under several headings, for example, technical issues, financial issues, administrative issues, cultural issues, etc.

Step 3. System Analysis

In the system analysis step the problems are arranged in a problem tree where the "cause" is arranged at the bottom of its "effect." The problem tree identifies causes and effects in the

[10]Dr. Senerath, Department of Civil Engineering, University of Moratuwa.

identified list of problems. There can be one cause giving rise to several effects or one effect due to several causes.

Step 4. Participation Analysis

In the participation analysis, the connected parties and their general characteristics must be identified, i.e., interests (+) and fears (-), strengths (+) and weaknesses (-). A technical project should not be considered in the narrow sense of technology; other aspects such as human psychological needs, cultural interests, etc., must be considered.

Step 5. Alternatives Analysis

In this step, alternative approaches are identified from a dominant and dependent matrix which is based on a scoring system.

Step 6. Project Planning

The success of the project planning depends on the assessment of the priority of components based on the selected criteria such as degree of acceptability by farmers, sustainability, degree of contribution to rice production, cost/benefit ratio, operational costs, technical capability, environmental impact, etc.

The above method of project planning is presented as an improved alternative to the methods that are usually adopted. However, this method must be coupled with common sense and past experience at all stages of its application. Even if this method is not used in its totality, the concepts included in this method may be beneficial for any form of project planning.

Participatory Management: Empowering or Marginalizing Women?

K. Athukorale[11]

SOME OF THE preliminary findings of a study carried out in the Gampola Raja Ela, Rajangana and Kalankuttiya irrigation systems are presented here. The main objective of the study was to document and analyze gender roles in irrigated agriculture and irrigation management.

In these three irrigation systems there is limited participation of women in FOs. Factors that could be attributed as constraints to female participation in FOs are that the legal recognition of irrigator status is reserved for men except in those cases where women are heads of households. Since farming and irrigation are conceived as all-male affairs it has been automatically assumed that the farmers who are to form FOs are men. Training and awareness programs are directed usually to male farmers. Another reason for low female involvement in FOs may be that organizations like FOs are projected as public sector organizations which are associated with male roles than with female roles.

As for the main users of irrigation systems, especially in the dry zone, women are involved in many tasks in irrigated agriculture. In a number of households headed by women (20% or more) they are solely responsible for all household and agricultural activities. In households headed by men, at the household level, women assume a larger share of farming responsibilities which include not only working in the fields but also mobilizing labor sharing, group supervising hired laborers, managing agriculture-related family enterprises and by organizing finance for agricultural purposes from various sources. Financial management of the household and the farming activities are often handled by women and their daughters.

Many women ask their husbands, neighbors or relatives about what happened at FO meetings. That is why they usually do not feel the need to actually attend FO meetings themselves. Although many of them are not directly involved in FO meetings women appear to be influencing FO decisions through discussions with men at the household level. These women actively urge and support their husbands to assume FO responsibilities, and help them with their administrative or organizational work. However, in cases where the benefits of FO involvement are not directly apparent, wives perceive their husbands' FO involvement as an impediment to the economic advancement of the family.

In summing up, it can be said that irrigation, irrigated agriculture and irrigation management are identified as all-male businesses. This is an inaccurate perception of the reality in irrigation systems. Because of the increasing involvement of women in field activities as well as in decision making they are increasingly emerging as an interest group in irrigation.

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Irrigation Design Standards in Indonesia

K.S.R. de Silva[12]

INDONESIAN IRRIGATION SCHEMES generally classified into three categories: simple, semi-technical and technical. Simple schemes command areas of less than 500 ha and are characterized by temporary structures at the head works, no structures to measure or regulate discharge and undeveloped tertiary systems. There is no agency involvement in these schemes. Semi-technical schemes have permanent or semipermanent structures and low tertiary structure density with little provision for water measurement, a 40-50 percent overall efficiency and a command area of up to 2,000 ha. The technical schemes are, on the other hand, characterized by permanent headwork structures and adequate structures to regulate and measure discharge, fully developed tertiary systems and a high overall efficiency. Unlike in the simple and semi-technical schemes the irrigation and drainage systems are completely separated in technical schemes. There is no limit on the command area of the technical schemes.

Irrigation systems are generally demarcated into tertiary, secondary and main units. A tertiary unit is the basic planning unit of the irrigation layout. The average size of the units is between 50 and 100 ha. The unit receives water via a tertiary canal and within the unit, water distribution and operation and maintenance are the responsibilities of farmers with assistance from the government agency for irrigation. A secondary unit consists of several tertiary units, all served by one secondary canal. A secondary unit normally receives water from a division structure located on a primary canal or another secondary canal. Boundaries of secondary units are defined by distinct topographic features such as natural drainage lines. The main unit consists of several secondary units and is served by one primary canal.

The design of the irrigation systems usually follows the steps laid out in the text books which include, desk study, identification study, reconnaissances study, feasibility study preliminary design and detailed design. In the desk study the initial decision is made to bring a certain area under irrigation either through observing the physical opportunity in the field or through an analysis of available data; at this stage, a conceptual plan is prepared. In the identification study, the results of the desk study are examined to verify the feasibility of the project concept. It focuses on the important planning objectives including water requirements and availability, roads and accessibility, flood and inundation, etc. The main objective of the reconnaissance study is to present a broad outline of the multi-sector project development from a technical point of view covering subjects like hydrology and engineering, agronomy and other related subjects. Feasibility of project implementation is then assessed from technical and economic points of view by conducting topographic and land capability surveys and geotechnical investigations. Detailed engineering designs are then carried out by estimating water requirements, water availability and computing water balances.

A simple rainfall-runoff model viz. Mock model (named after the developer) is being widely used to establish water availability when flow records are not available. This model has been widely used in Indonesia with satisfactory results. Flood studies are an important aspect of the design which determines the maximum flood of the river in a pre-determined return period which can be safely evacuated without endangering the safety of the structures. When

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sufficient flow records are available (at least 20 years), standard frequency methods are used to compute the design flood. In the absence of such data, empirical methods developed in Indonesia are used. All the hydraulic structures including canals, regulating and measuring structures, dams, contracts, flumes, aqueducts, etc., are designed using the standard methods. Special attention is given to stress redistribution in the design of gravity dams and low-tensile stresses in concrete are permitted. In the design of canals, sedimentation is minimized by increasing the hydraulic property IR (I is the energy gradient and R is the hydraulic radius) in the downstream direction. This helps the suspended sediment to be carried away without being deposited.

In response to a question from the floor on structure failures (designed on the basis of stress-redistribution), Mr. de Silva indicated that he personally had passed over 200 such designs and there had been no failure. Even the United States Bureau of Reclamation design standards permit this practice. In reply to another question he agreed with the general observation that there is a tendency on the part of the engineers to overdesign the structures to avoid risk of failure. The main problem the engineers in Indonesia (encompassing 13,000 islands) are facing is the lack of sufficient and accurate data, especially on hydrology which forces them to adopt empirical methods very often.

Geographic Information System: Perspectives in improving Irrigation Water Management

Daniel Renault[13]

A GEOGRAPHIC INFORMATION System (GIS) is a computerized means of storing, processing and displaying spatial data (distributed over space) and information. Thus a GIS is nothing but another alternative component in a range of information tools, i.e., spreadsheet, database, statistical tools, model, GIS. A choice between these tools must be site-specific and adapted to the goal and to the resources as well.

Specificities of a GIS compared to other means are:

* *Communication* with the user himself/herself and with other users: a map is often more understandable than a series of tables or words.

* *Spatial data storage:* spatial information is mainly used in irrigation schemes only prior to the main interventions, i.e., settlement or rehabilitation. GIS allows to store, update and access this information for routine management (soil properties, topography, hydrogeology, etc.).

* *Spatial analysis:* GIS is a classic database with additional geographic information, which implies that usual requests can be improved with questions such as: **Where** are the fields suitable for a particular crop? **Where** are the areas with water stress? **What** are the areas dominated by an irrigation structure? etc.

* *Spatial modeling:* Combining a model and a spatial database leads to a distributed model, which in some cases appears more powerful than the lumped model.

Geographic Organization and Structures: Layers of Information in Two Modes

The geographic data of a GIS are stored in layers of information depicting spatial objects within the area, while the non-geographic data are stored in a database (tables). Each layer of geographic information is related to one attribute, say, land use, rivers, canal network. Each spatial object is referred to by an identifier that allows to link this spatial information with nonspatial characteristics. For example, a rice field identified in the land use layer with the id = x, corresponds in the database to one or more values or information related to the rice field (ET, percolation, crop period, etc..), stored under the id = x.

Two very different modes of geographic information are found. The *vector mode* describes the space with polygons composed of arcs, identifying the limits of the geographic feature (object). This mode uses topological properties to link spatial objects. The *raster mode* is made of a grid dividing the whole area into pixels. Every pixel of a layer stores information regarding the attribute of the layer. The raster mode is well adapted to remote sensing images, but is rather memory-consuming.

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Spatial objects depicted in layers of information can be *physical entities* which are discrete spatial entities recognizable in the real world. Rivers, roads, watersheds, command areas along an irrigation network, fields, etc., fall in this category. Objects can also be *social entities,* which are spatial units not recognizable physically (ownership of land, administrative boundaries) (*also called man-imposed objects*).

GIS FOR MANAGEMENT OF IRRIGATION SYSTEMS

Irrigated cropping systems transform natural resources into food and fiber as well as byproducts which affect water and land quality. Management of the inputs and outputs of these complex physical and biological systems depends on spatial information and the understanding of the *transport and transformation of water* and chemicals throughout the area. The main components of management are system operation (daily), water deliveries scheduling (weekly), and land and water allocations (seasonally).

Spatial and Temporal Information

Spatial information is as important as temporal information, and management decisions are to be made at the proper scale. Local flows, from areas served by individual turnouts, can interact and combine to affect regional flows (e.g., local deep percolation and runoff may be intercepted by downstream users and can lead to efficient water use at the basin scale, but not at the local scale, if water quality and quantity are not diminished as water cycles through the system). The time scale is also important because a perturbation upstream may not affect downstream conditions until much later. For example, changes in flow at a turnout affects a subarea of the district and may propagate to the outlet of the watershed after some time (time lag).

GIS for Better Decision

Geographic Information Systems can be useful to better monitor and then understand the flow patterns within the areas of irrigation, drainage and rainfall. This leads to a decision support tool for *water deliveries scheduling* within irrigation systems.

The same approach but at a wider scale can produce water management methodologies *at basin level* including the environmental impact of irrigation with special attention to water quantity and water quality.

GIS are suited for handling the *distribution of performance indicators* among the sub-administrative units (tracts under new areas and command areas under tanks) on a real time basis; hence they can actually facilitate the system manager to formulate better decisions.

GIS can be helpful in allocating resources at the beginning of crop seasons. For example, in rice field areas, GIS can help to improve the planning of land preparation, taking into account soil property distribution within the area, drainage flow, rainfall expectation, etc.

GIS for Better Communication

Information is not only essential for the manager to make better decisions, but also to communicate with other partners of the project. Modern irrigation system management with renewed targets, increasing water use competition and environmental constraints, requires a constant flow of information between water users, operators, data collectors and overall operation policymakers. This information is diverse in nature, and usually the requirements for the maintenance of such a flow of information are extensive in terms of data storage and display.