INCEPTION REPORT

on the

Phase II

Technical Assistance Study

T.A. 1480 SRI

IRRIGATION MANAGEMENT AND CROP DIVERSIFICATION
(Sri Lanka)

July 1991

International Irrigation Management Institute
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CHAPTER I

INTRODUCTION

1.1. CONTEXT FOR THE STUDY

This study of Irrigation Management and Crop Diversification is being carried out under a Technical Assistance Agreement (T.A. No. 1480 SRI) dated 3 July 1990, between the Government of the Democratic Socialist Republic of Sri Lanka (GSL), the International Irrigation Management Institute (IIMI), and the Asian Development Bank (ADB). This action-oriented collaborative field study is being implemented in the Kirindi Oya and Uda Walawe projects. It addresses through field level research, priority issues of importance and relevance to the two projects to strengthen the long-term performance and viability of the irrigation systems through management innovations in the processes of rehabilitation, system management, institutional strengthening, and operation and maintenance with particular attention given to requirements for crop diversification. The present study is a follow-on to the recently completed Technical Assistance activity "Irrigation Management for Crop Diversification" (T.A. No. 846 SRI). The original terms of reference for that activity envisioned a second phase for assisting the implementation of recommendations coming out of Phase I. Phase II will assist in implementing the Phase I recommendations through action research.

The specific objectives of the study are to:

a) test and assist with implementation of organizational and management innovations which would improve the performance and sustainability of irrigation systems;

b) strengthen the irrigation management institutions including the farmers' organizations so they can effectively participate in system management;

c) assist in implementing design and rehabilitation innovations and alternative system management practices;

d) assist in testing and implementing appropriate on-farm water management practices for rice and diversified crop cultivation and farm income maximization.

1.2. IRRIGATION MANAGEMENT AND CROP DIVERSIFICATION IN SRI LANKA

Irrigation development in Sri Lanka, until recently, has been concentrated on the construction of major new irrigation schemes, both within and outside of the Mahaweli

Development Program. With the slowing down of the Mahaweli Program, the Government has been placing increasing emphasis on improving the productivity of existing irrigation systems through system rehabilitation, improved water management and greater farmer responsibility in system operation and maintenance through self- and joint-management of irrigation systems.

This new policy of the Government would direct most irrigation development investments away from construction of new schemes toward more cost-effective rehabilitation and improvement programs. The area under irrigation would, therefore, not be significantly expanded, but cropping intensities would increase.

The average cropping intensity of the country's irrigation systems is estimated at 130 percent with only a few exceeding 160 percent. The major constraint is limited water availability during the dry season. However, low water use efficiencies significantly account for the low cropping intensities. The low efficiencies are due to various factors including system flaws, lack of proper control structures, improper water management, inadequate funds, inefficient use of funds, and the absence of adequate institutional arrangements for system O&M. In recognition of these deficiencies, the Ministry of Lands, Irrigation and Mahaweli Development, through its Irrigation Management Division (IMD), the Mahaweli Authority, and the Irrigation Department, have increasingly emphasized trying to improve water management and overall irrigation system management.

Increased rice production, mainly as a result of increased irrigated areas and higher yields obtained by farmers through higher input use, had brought Sri Lanka close to self-sufficiency in rice by the mid-1980s. Concerns about over-use of water for rice production, inefficient use of water in areas with soils not suited to rice production, and the low income of farmers have led the Government to embark upon a policy of diversification into other food crops production in irrigation systems. The efficient management of irrigation systems for crop diversification is thus a high priority in the agricultural development strategy of the Government.

Upto the early 1980s investment in Sri Lanka was directed primarily at creating irrigation infrastructure in order to produce more rice. Since then, the emphasis has shifted to institutional and policy reform. The Irrigation Management Policy Support Activity (IMPSA), a major policy reform project in irrigated agriculture, has come out with a vision outlining a broad policy framework for the year 2000 and beyond. It is envisioned that the irrigated agricultural sector will become dynamic, diversified, efficient, equitable, productive, sustainable and participatory in order to achieve high productivity, profitability and environmental stability. To realize the benefits of these innovations, the Government of Sri Lanka intends to put more effort into research and development, policy reform, and institutional strengthening (IMPSA 1991a).

1.3. KIRINDI OYA AND WALAWE IRRIGATION SYSTEMS

As the Phase II study is a follow-up of the earlier study, it will be conducted in the command areas of two bank-financed irrigation projects located in Hambantota district viz. the Walawe Irrigation Improvement Project (WIIP) and the Kirindi Oya Irrigation and Settlement Project (KOISP). The components of the two projects provide opportunities to implement the recommendations of the Phase I study.

The Walawe and the Kirindi Oya irrigation systems are the only two large scale irrigation systems in southern Sri Lanka (Figure 1), and are thus vital to the regional economy of the Southern Province, and Hambantota district in particular.

The Walawe Project, a settlement scheme situated in the transition between the wet and dry zones of southern Sri Lanka, is being rehabilitated to provide irrigation to an area of approximately 17,600 ha through rectification of structural defects in the main system, improvement of canals and structures from main to on-farm levels, rehabilitation of roads, provision of domestic water supply, training, and improvement of water management in the system including crop diversification (Figure 2).

The WIIP, approved by the Bank in 1984, has as its major component the rehabilitation of 12,000 ha of an existing irrigation system earlier financed by the Bank. The executing agency for the WIIP is the Mahaweli Authority of Sri Lanka (MASL) through the Mahaweli Economic Agency (MEA).

The KOISP was approved in 1977 but reformulated for implementation in two phases in 1982. The reformulated Phase I of the project, completed in 1989, included the construction of a dam and downstream facilities for 4200 ha of new lands and rehabilitation of 4600 ha under the command of existing tank systems. The ongoing Phase II Project, approved in 1986, includes the construction of irrigation facilities for the remaining 4100 ha of new lands. Due to severe water shortage, Phase II development was limited to only 1200 ha of new lands. The Irrigation Department (ID) together with Irrigation Management Division (IMD) of the MLI&MD are the principal executing agencies; the Land Commissioner's Department (LCD) and the Department of Agriculture (DOA) are the other two executing agencies for KOISP (Figure 3).

1.4. CHANGES SINCE PHASE I RESEARCH AT KIRINDI OYA AND WALAWE PROJECTS

Since the establishment of its headquarters in Sri Lanka in 1985, the International Irrigation Management Institute (IIMI) has carried out substantial field work to diagnose constraints to improved irrigation system performance in Sri Lanka, and to recommend management innovations for overcoming these constraints. A major component of this work

has been done in the Kirindi Oya and Walawe systems from 1987-1990, with bank support. The Phase I study has led to improvements in both projects and has provided a basis for testing a number of management innovations that are likely to have a significant impact not only on these systems, but others are well.

IIMI submitted its recommendations for improving system management under its Phase I study in June 1990. Since then, there have been considerable organizational, institutional and procedural changes in institution building and in planning and operating the irrigation systems to improve their performance. Some of the visible changes that had taken place during the last two seasons (maha 1990/1991 and yala 1991) are:

a) The continued commitment and serious efforts by the concerned staff of the various line agencies towards crop diversification in Kirindi Oya has become stronger and more effective. The facts that 750 ha of other (non-rice) field crops (OFCs) was cultivated on the 'paddy' allotments in tracts 6 and 7 of the right bank main canal during the last maha and that farmers themselves have now displayed a keen interest in OFCs are a clear manifestation that the commitment and efforts are paying off. For the 1991 yala season, it is expected that OFCs will be cultivated on more than 1000 ha. The last two seasons have demonstrated that OFCs can be introduced into the cropping pattern and sustained provided certain constraints such as inadequate seed supply, marketing problems and insufficient credit facilities can be overcome.

b) With regard to water allocation, a breakthrough occurred in the relationship between the farmers of the old Ellegala and Badagiriya systems on the one hand, and the new settlers on the other hand. The establishment of a single Project Management Committee (PMC) for the entire project area has helped to achieve a compromise for allocation of reservoir water. In course of time, the PMC should be able to develop its own principles and procedures for seasonal allocation of the reservoir water among different sub-systems based on a critical analysis of the historical flow to the reservoir, rainfall and proposed cropping pattern, etc.

   The Irrigation Department (ID) with the help of IIMI, is carrying out a systematic water measurement and water balance study in the old Ellegala system to verify claims of the old system farmers on the reservoir water. The data being systematically collected and analyzed will lead to better decision making and more efficient use of scarce water resources.

c) Recently, the Department of Agriculture has merged its research, extension, training and education divisions into one technology transfer division and has expanded its staff positions. This would help accelerate introduction of diversified crops on a more sustained basis.

d) In the Uda Walawe project, significant changes have been taking place since last year under the present Resident Project Manager (RPM). Farmers were organized on a pilot project basis using a non-governmental organization (NGO). The rehabilitation process was restructured so as to involve the farmers in the rehabilitation process and to entrust the project staff with more responsibilities.

The Phase II research is designed to build on the already initiated changes and practices to improve the performance of the system through systematic introduction of innovations and organizational and managerial changes, and proposes to assist the operating agencies to internalize the changes and practices.

1.5. THE PHASE II RESEARCH IN THE KIRINDI OYA AND WALAWE IRRIGATION SYSTEMS

The Phase II research is action-oriented, intended to refine and assist in implementation of selected recommendations of the Phase I research study in connection with the Kirindi Oya Irrigation and Settlement Project (KOISP) and the Walawe Irrigation Improvement Project (WIIP) and to evaluate their effectiveness. This study will not only contribute to improved performance of the two systems; it will also provide management innovations for improving irrigation system performance for other major irrigation systems in the country. The study will be carried out in close collaboration with the Ministry of Lands, Irrigation and Mahaweli Development, Irrigation Department, Irrigation Management Division and the Department of Agriculture at Kirindi Oya for KOISP, and the Mahaweli Economic Agency of the Mahaweli Authority of Sri Lanka for WIIP. It is a joint collaborative activity in which IIMI will provide technical inputs and training, monitor the progress of implementation, document the processes, analyze findings and prepare reports in collaboration with the implementing team, disseminate the study results, and develop necessary training modules.

The broad areas of action and study to be undertaken both at Kirindi Oya and the Uda Walawe Project sites under Phase II include:

1.5.1. Water Resources and Main System Management

The water resources and main system management research will concentrate on developing and implementing a water allocation policy through a participatory approach. It will also build on present management practices to develop improved workable seasonal and in-seasonal allocation plans and to test and implement main system management procedures to regulate and control the flow for effective and equitable distribution.

1.5.2. Secondary and Tertiary System Management

Under this research component, the farmers and agencies will be motivated, organized and assisted to coordinate the various activities related to secondary and tertiary systems to effect better management of water and other agricultural inputs within a framework of a participatory management system. This will be pilot tested on a sample distributary and will be modified through a learning process for adoption in other distributaries.

1.5.3. Maintenance Management

The maintenance management research will develop a methodology for identifying required maintenance work, establish and test a workable maintenance procedure and methodology to achieve optimum maintenance with the limited resources available, and establish and validate a simple but effective monitoring, evaluating and feedback mechanism.

For each of the above components, the study will attempt to develop and test methodologies for improved planning, implementation and performance monitoring with a strong emphasis on institutional strengthening, which could be adopted more widely.

1.5.4. Improving the System Rehabilitation Strategy in the Walawe Project

Methodologies and strategies for using the process of rehabilitation and modernization as a vehicle for institution building for long-term sustainability of the system and, for facilitating joint management through a participatory approach, will be tested and validated.

1.5.5. Maximizing Farmers' Incomes Through Diversified Cropping

Under the crop diversification research, a total management package under limited water conditions will be evolved for promoting profitable crop diversification under a distributary turnout area in Kirindi Oya.

1.6. THE TECHNICAL ASSISTANCE AGREEMENT

IIMI submitted a proposal to the Asian Development Bank in May 1990 and requested a Technical Assistance (TA) grant for the Phase II action study on Irrigation Management and Crop Diversification in the Kirindi Oya and Walawe projects. This

proposal had been thoroughly discussed by the project-level management staff as well as the Study Advisory Committee. A Bank fact-finding and technical assistance preparation mission visited Sri Lanka between 2-3 July 1990 to finalize preparation of the proposed TA. The mission held discussions with the concerned Government agencies and IIMI. A Memorandum of Understanding was signed on 3 July 1990 by representatives of the Government of Sri Lanka, the Bank and IIMI (Appendix 1); it summarizes the understanding reached among them on the main issues of the TA.

There was an unexpectedly long delay in receiving Bank approval of the TA, which was approved only in May 1991. Although IIMI was able to retain most of its field level staff at the project sites during this intervening period of ten months with expenses met from its own funding, in order to maintain continuity and not lose the momentum generated during the Phase I research, the delay in approval of the TA has caused some implementation problems. The timing of the TA sanction in May 1991 was too late to plan and start the field research during yala 1991. Therefore, this first season of the Phase II research will be utilized to prepare a detailed plan and the inception report; effective research will be carried out for only three subsequent seasons, starting from maha 1991/1992. Further, as a result of the ten month delay and a high rate of inflation in the country, the budget provided is extremely tight in relation to the study objectives.

The TA agreement signed with the Bank is given in Appendix 2.

1.7. IMPLEMENTATION ARRANGEMENTS

1.7.1. Overall Strategy

IIMI is currently working with the Government of Sri Lanka under an Irrigation Management Policy Support Activity (IMPSA) to review existing policies and institutional arrangements for the irrigation sector and to make recommendations that will guide the management of the nation's irrigation systems in the coming decade. One of the important policies accepted by the Government is to turn over smaller systems to farmers' organizations for self-management and to promote joint-management by agency officials and farmers in the larger irrigation systems. It is proposed to use the Phase II research in Kirindi Oya and Walawe projects to test some of the ideas elaborated under the IMPSA participatory management activities. In addition, other management innovations have been proposed and to some degree tested under the ADB-supported Institutional Strengthening Project and the USAID-supported Irrigation Systems Management (ISM) Project; where appropriate the present study will also build on or test lessons emerging from these projects.

IIMI carries out both generic research, and collaborative field- and action-research. Together they form an integrated coherent program approach aimed at establishing a body of knowledge from which conclusions can be drawn of direct and practical relevance to irrigation management. IIMI's field research programs aim at producing a set of generalizable results that will improve management of irrigation systems and increase their performance. IIMI has several different modes of operation in carrying out field research: sometimes it carries out its work through collaborative agreements with national research organizations; and often it carries out research directly, in cooperation with managing agencies but retaining full responsibility and control, and then presents the results to the concerned government, agencies, and donors. The Phase I work -- essentially a diagnostic phase -- was carried out in this manner. This mode may be appropriate for diagnosis, but is not effective for action-research.

Phase II is planned as an action-oriented study. It requires the active participation of the officials of the concerned agencies for success. Therefore, IIMI proposes to work in close partnership with the management agencies and farmers' organizations in Kirindi Oya and Walawe in the implementation of this research. Much of the work will be carried out by the agency officials and farmer leaders as a part of, or integrated into, their normal duties, with the assistance and support of IIMI staff. The management innovations and practices to be tested will build on and improve upon present practices, and will be well within the present capabilities of the departments; we do not propose to introduce radical changes that may look good in theory but are impossible to implement and sustain. IIMI and the staff of the concerned agencies have agreed on this mode of implementation, with the full support of management at the higher echelons. Through the various project management committees and distributary farmers' organizations, farmers are also being kept informed and involved in the study.

This collaborative mode of operation will have several important advantages:

a) it will ensure the full support and interest of the project staff and farmer representatives, since they must be convinced in their own minds that the proposed innovations are useful and practical;

b) it will contribute to developing the skills and capacity of project staff and farmers to continue testing and improving new innovations even after IIMI's involvement ends;

c) it will produce important results in terms of tested management innovations that can be used to improve the performance of these and other irrigation systems;

d) it will contribute directly to the development of the proposed research management unit in the Irrigation Department by providing staff with experience in doing applied interdisciplinary research;

e) it will lead to the refinement and validation of a methodology for action research that can also be used for building institutional capacity and innovativeness within the participating agencies and in others as well; and

f) it will be a cost-effective way of achieving important results since the resources of both IIMI and the government agencies and farmers will be combined.

1.7.2. Implementing Agency

The study will be carried out under the technical assistance agreement by IIMI in close collaboration with the implementing line agencies. The research implementation will be highly participatory, with line agencies taking the lead role through project level sub-committees, assisted by the IIMI research team. The various sub-committees formed for implementing the relevant research components are given in Appendix 4.

The relevant government agencies which will collaborate with IIMI are those involved in the implementation of the WIIP and KOISP. For the WIIP, the principal agency will be the Mahaweli Economic Agency of the Mahaweli Authority of Sri Lanka. For the KOISP, the major cooperating agencies will be the Irrigation Department, the Irrigation Management Division and Department of Agriculture. In the KOISP, there are project managers for irrigation, land settlement and irrigation management, from the Irrigation Department, Land Commissioner's Department and the Irrigation Management Division respectively. Agricultural development of the KOISP is the responsibility of the Assistant Director (Extension), Department of Agriculture, for Hambantota district.

IIMI's internationally recruited staff will devote 30 man-months of time to this research study. This will include about 13.5 man-months of social-sciences input, 11 man-months of irrigation engineering and 5.5 man-months of agriculture economics input. Full-time local professional staff (research associate - 27 man-months and research officers - 351 man-months) will be recruited by IIMI and located at the site. Specialized consultancy input totalling about 4 man-months will also be provided by IIMI as required.

A list of IIMI staff participating in the project is given in Appendix 5.

1.7.3. Coordination

At the national level, coordination among the concerned agencies, the Ministry of Lands, Irrigation and Mahaweli Development, and the Ministry of Agricultural Development and Research, will be through the existing national Sri Lanka - IIMI Consultative Committee on which senior officials of these agencies are represented. A

reconstituted Study Advisory Committee (SAC) previously formed for the Phase I Study will provide overall guidance; it will include a representative of the Bank. At the field level, the study activities will be coordinated through two Study Coordinating Committees (SCC), one each for the Walawe and Kirindi Oya systems. Members of the two committees will comprise, besides the Study Coordinators of IIMI, the heads of line agencies responsible for project management and O&M activities and chairmen of various sub-committees constituted for implementation of the research components. A list of members of the SAC and two SCCs is given in Appendix 6.

1.7.4. Implementation Schedule

This study will be carried out in four stages over a period of 27 months starting 10 May 1991. Stage 1 consisting of the first one and a half months, involves interacting with agency officials, establishing subcommittees for planning and implementing various research components, formulating detailed workplans through discussions, identifying the subsystem sites for specific study activities, firming up cooperation agreements with the agencies, and finalizing the Inception Report with a broad workplan in a workshop conducted jointly for both the Kirindi Oya and Walawe systems. During stage 2 of the study, covering three months, we will develop detailed work plans, carry out seasonal and in-seasonal planning of water allocation, plan for main and tertiary system management, and for implementing rehabilitation construction. Trial runs of measurements to be taken, training of research staff, and calibration of discharge measuring sites will be carried out during this period. Stage 3 of the study will cover the entire three seasons (maha 1991/1992, yala 1992 and maha 1992/1993) during which the study's field activities will be implemented and data will be collected and analyzed. Stage 4 of the study, consisting of two and half months, will be used to evaluate the results of field activities in order to formulate further recommendations for operational improvements and prepare training modules.

1.7.5. Reporting Plan

An Inception Report -- i.e., the present document -- is being presented by IIMI to the Government and the Bank within two months after the start of the Technical Assistance study (before 10 July, 1991). This report contains an overall workplan for the study period. Six weeks after the end of each cropping season, a short Progress Report consisting of a brief overview of the previous season's activities and accomplishments and the plans for the next season will be presented to the Government and the Bank. A Draft Final Report will be prepared at the end of Stage 3 analyzing the results of the first two seasons and providing a preliminary assessment of the work during the third season. The Final Report, to be submitted two and a half months after the last season, will present an analysis of the study results as well as further recommendations for improvements and adoption. It will also include an assessment of the effectiveness, advantages, disadvantages, and lessons learned from the experience in carrying out collaborative action research with implementing agency staff.

In addition to these formal reports, IIMI plans to develop a number of training modules which the agencies could use for implementing the research results throughout the two systems and on other systems.

1.8. DISCUSSION OF DRAFT INCEPTION REPORT

A two-day workshop was held at Hambantota on 10th and 11th June to discuss and refine the draft Inception Report prepared by the research collaborators. About 60 participants drawn from the policy making bodies, including the State Secretary for Irrigation, the implementing and supporting agencies, Asian Development Bank, and IIMI attended the workshop. The draft inception report was presented by the implementing agency officials and discussed in three small groups as well as in a plenary session. A number of implementable suggestions and a few corrections put forward by the participants were incorporated in the revised inception report.

The participants appreciated the innovative way of preparing the inception report and approved the various activities proposed for improving the performance of both the Kirindi Oya and Walawe projects; however, they expressed some doubts and concern about too much being proposed for the study given the limited resources.

Subsequent to this workshop, the quantum of implementable research activities was discussed among the implementing agencies and IIMI researchers. It was decided that instead of cutting down some of the proposed activities or sub-activities, they will all be retained in the inception report; however, emphasis will not be given at the same level to all the proposed activities; instead, it would be possible after two seasons of research to indicate the relative levels of work for each proposed activity or sub-activity; this will overcome the impression that might be gained that all activities would be carried out with the same degree of intensity.

This Inception Report is therefore a joint product of IIMI and the agencies collaborating in the study, especially the Mahaweli Economic Agency, the Irrigation Department, the Irrigation Management Division, and the Department of Agriculture. The important contributions of the project officials to this report are gratefully acknowledged.

CHAPTER II

IMPROVING MAIN SYSTEM MANAGEMENT - KIRINDI OYA

2.1. INTRODUCTION

Recent analyses of the available water resources for Kirindi Oya system by the Irrigation Department (Dharmasena 1988) and IIMI (1990) show that the actual availability is between 25 to 60 percent less than estimated at the time of planning and design; Kirindi Oya is thus structurally a water-short system.

IIMI's previous research indicated that water use efficiency is low and there is great potential for improving performance if proper policies are adopted for water allocation between the old and the new systems and if improved operation, maintenance and management inputs are made at the main and tertiary systems. The research findings emphasized the need to focus attention on effective use of rainfall and drainage water, skillful planning of scheduling and introduction of effective monitoring and feedback mechanisms.

IIMI submitted its recommendations on the ADB-funded Phase I study in June 1990. Since then there have been considerable organizational and procedural changes in planning, operating and implementing the water allocation and distribution practices to improve the efficiency of the Kirindi Oya system. The Phase II study will build on the already initiated changes and practices to improve the performance of the system through a systematic introduction of organizational and managerial innovations, and will assist in internalizing these changes and practices within the operating agency of the system, i.e., the Irrigation Department.

In addition, overall national policy towards turnover of operation and maintenance activities at distributary canal level to farmer organizations has become clearer. If this policy is to be successful, it is essential that the main system be operated and maintained in such a way as to foster the handover of responsibilities, and create the conditions where farmers can utilize their own managerial capacities to their full extent.

The research objectives therefore address not only certain site-specific issues inherent in a water short system such as Kirindi Oya but also look at aspects of main system management that will be required if effective joint management of larger systems in Sri Lanka is to be achieved.

2.2. OBJECTIVES

There are three primary research objectives at the main canal level in this Phase II study:

a) **development and implementation of a seasonal water allocation plan** that permits effective matching of available supplies to potential demand while still maintaining overall objectives of equity and efficiency, and which can be readily transformed into an operational plan for the main canal system;

b) **improvement of main canal operations, including testing of alternative options for flow regulation and water control** that will result in water delivery schedules that are technically and managerially feasible to implement, which achieve the overall allocation objectives at system level, and which accommodate as far as possible the desires of water user groups;

c) **development of maintenance strategies at main canal level** that will result in more reliable and predictable water deliveries at the point of handover of responsibility from the irrigation agency to water user groups.

One theme common to all of these research activities is that the resulting recommendations be tested not only in terms of water use efficiency but also in terms of economic and institutional efficiency.

Ultimately the adoption of management innovations will be because they are more efficient than existing procedures: the research in Phase II will look at ways in which the **economic costs and benefits of alternative management strategies** can be quantified and assessed to ensure that innovations are not recommended merely because they are new or different.

Similarly, it is important to recognize that the utility of innovations is dependent on the **institutional capacities of the different groups involved**. There is little point in recommending an innovation that is beyond the managerial capacity of either the farmers' organizations or government agencies.

2.3. ACTIVITY 1:DEVELOPMENT AND IMPLEMENTATION OF SEASONAL ALLOCATION PLAN

2.3.1. Research Objectives and Activities

A successful seasonal water allocation plan is characterized by three primary components: an effective assessment of likely water supply, an estimation of the probable demand for water during the season, and achievement of the overall system objectives

of productivity, equity and efficiency. It is also likely to be characterized by change because of improved information and knowledge about the system over time through parallel monitoring and feedback activities, and because of changes in expectations, farming practices, and management skills of farmers over time.

A primary objective of this research activity is therefore to identify and utilize those planning procedures that prove effective rather than developing a rigid, technically oriented set of allocation rules that limit the scope for participation of farmers in this process. In other words, the research will give considerable emphasis to the development of an effective planning process, a benefit that will go well beyond the immediate needs of Kirindi Oya.

a) Supply Assessment

The primary objective of supply assessment activities is to generate information useful to planners in determining likely water availability for any given time period. This requires several different levels of data analysis, including:

i) assessment of rainfall variability using current rainfall data, including gauges outside the catchment;

ii) determination of reservoir inflows and development of rainfall-inflow relationships for the catchment: this requires both short duration analysis to include the effect of flash floods and longer term analysis to assess baseflow contribution, both by graphical and statistical methodologies. For items i and ii, the data set developed and used by the Central Engineering Consultancy Bureau (CECB) in the Menik Ganga Appraisal Report (CECB 1991) and approved by an ADB consultant will be used in our analysis;

iii) estimation by water budgeting of weekly and monthly inflow to the tanks in the Ellegala system which have independent catchments (for details refer to Appendix 2).

With this improved data base, it is then possible to develop a set of information that will facilitate improved seasonal planning. Information to be generated will include:

iv) estimation of rainfall probabilities by week and month throughout the year;

v) estimation of probability of reservoir inflows based both on historical records and analysis of antecedent rainfall conditions;

vi) determination of probability of reservoir storage before each season.

Using the probability information it is possible to classify years as above normal, normal or below normal, and thus guide planners as to the likely water conditions that can be expected for each season. This provides a rational basis for allocation of water between different water user groups. The use of time-based probability information allows the plan to be updated during each time period to see whether conditions are as expected, or whether the situation has improved sufficiently to warrant a change in the earlier plans.

b) Establishing Water Rights and Priorities

Because Kirindi Oya is a water-short system where there is unlikely to be sufficient water to allow all farmers to have a free choice in cropping patterns, it is important that the planning process addresses issues of demand very carefully.

The first objective is to carefully define actual water rights of water users in different parts of the system. Water rights in a system such as Kirindi Oya need to be expressed both in terms of whether or not there is an entitlement to receive water in any given season, and then, if water is to be granted, whether it is going to be sufficient for rice cultivation over the entire area concerned.

It is clear, for instance, that farmers in the Ellegala system have first priority for water based on historical precedence, and that these rights are based on the expectation that all farmers are entitled to cultivate at least one rice crop a year. In the newer portions of the system water rights are less clearly expressed, and need to be clarified.

Once the needs of those areas having first priority for water have been catered for, the balance water needs to be allocated between the remaining areas of the system on the basis of a mutually agreed set of priorities that will, in the long run, achieve specific objectives of equity and productivity.

Research objectives for this sub-activity include:

i) defining a system of water rights for each part of the system, so that the available water can be properly allocated between the older and newer portions of the system, between tracts and, ultimately, between distributary farmer organizations within those tracts;

ii) developing a process that determines the different priorities for water in each season or year: tracts that received more water in one season would automatically have a low priority for the next season in an effort to establish some overall equity of access to water;

iii) monitoring to ensure that over a period of several seasons the planning process does achieve long term goals of equity of access to water without jeopardizing production because of poor allocation decisions.

The purpose of these inputs is to ensure that there is an effective and clear process for gross allocation of estimated water supplies to different portions of the system.

c) Planning Seasonal Demand

Only when planners have information on probable water supplies, and have decided on the principles that determine which portions of the system have priority for irrigation water for that season, is it possible to plan seasonal demand effectively.

In rice-based systems such as Kirindi Oya, farmers' cropping choices will be guided by planning decisions, volumes of water delivered, and the timing of water deliveries, and the planning process has to attempt to find the most effective combination of these factors that will result in optimal combinations of rice and non-rice crops.

Where water is in short supply, it is inevitable that the planning decisions will have to be based primarily on available supplies: farmers cannot expect a totally free choice as to how much water they will receive. However, although the planning decisions may make some overall assumptions about the cropping patterns that farmers may adopt under different priority conditions, the primary allocation is of water, not by crop type. If farmers in lower priority areas wish to try to grow smaller areas of rice rather than more extensive areas of non-rice crops, they have every right to do so, but it is at their own risk because they will face constraints in terms of timing and volume of water deliveries.

Research issues include:

i) identification of appropriate methods to determine the area and location of areas to receive high priority water supplies, low priority water supplies, or no water, based on both expected supply availability and water deliveries in previous seasons;

ii) development of guidelines that will help farmer organizations understand the implications of different levels of water availability for cropping pattern decisions;

iii) determination of optimal dates for commencement of land preparation and planting that will maximize anticipated rainfall;

iv) determination of the optimal duration of land preparation, taking into account technical limitations of the conveyance system, and power and other constraints faced by farmers;

v) development of ways to evaluate the effectiveness of these planning changes, and introduce modifications in subsequent seasons.

d) Implementing the Allocation Plan

A further component of this activity is improving the process by which overall seasonal allocations are translated into an operational plan for subsequent implementation. This operational plan is concerned with defining the overall pattern of water deliveries within the main and secondary canal system, including the beginning and end dates for the season, the beginning and end dates for land preparation, the total volume to be delivered in each irrigation period, start and finish times for rotational issues, the location of areas to be irrigated simultaneously, and the determination of daily discharge targets at the main sluice, along the main canal, and at heads of secondary canals to each distributary canal organization.

To facilitate the selection of a suitable operational plan, a prototype computer-based assessment of operational requirements for each rotational alternative will be applied. The purpose of this model (Canal Operations Management Assessment or COMA) is to quantify management inputs required of gate keepers in terms of gate operations and monitoring and determine whether this is within the manpower and other resources available to the irrigation agency.

The operational plan has as its overriding objective the description of water deliveries that farmer organizations can expect to receive throughout the season. This not only assists them in understanding how much water they will receive, thereby facilitating effective cropping choices, but also provides a schedule of deliveries and water levels that they can use to verify that they have indeed received the water to which they are entitled for that period.

Research issues in this sub-activity include the following:

i) development of effective methods of describing the water conditions to be implemented at points of transfer of administrative responsibility within the main canal system, and between the main system and tertiary sub-systems;

ii) evaluation of alternative rotational schedules based on the prototype COMA model that assesses the managerial requirements for each rotational plan;

iii) determination of how best to express the proposed water allocation and delivery plan so that it is clearly understood by water user group representatives;

iv) determination of the acceptable margins of error that allow for inevitable fluctuations in water deliveries and yet which do not produce unnecessary uncertainties for water users;

v) development of the level and types of changes to this schedule during the season in response to unexpected changes in water conditions, such as higher rainfall, increased inflow into the system, or lower than anticipated storage in the reservoir.

The long term purpose of this activity is to develop methods by which contracts or agreements can be made between the agency responsible for main and secondary canal operations and distributary canal organizations that define the basic level of service to be delivered. Given the relatively short duration of the Phase II activity this may not be achieved in Kirindi Oya, but it is anticipated that preliminary indications can be obtained of suitable ways of drawing up hydraulically-based agreements at points of transfer of responsibility both within the irrigation agency, and between the irrigation agency and water user groups.

e) Institutional Issues for Seasonal Planning

There is a tendency for planning, especially under resource-short conditions, to be top-down and only involve user groups towards the end of the process in obtaining their concurrence with the resulting plan.

The moves towards greater responsibilities for operation and maintenance by farmer groups in larger systems are likely to require changed approaches to planning and decision-making in irrigation systems.

Research issues in this respect include:

i) determination of the potential for involvement of farmer representatives at each stage of the planning process;

ii) demarcation of rights and priorities for water allocation on a seasonal basis;

iii) evaluation of the timing of decision-making to minimize the time between assessment of resource availability and the commencement of land preparation, so as to have the most up-to-date information at hand when decisions are made;

iv) review of existing mechanisms for discussion and approval of plans by government agencies and farmer representatives, and formalization by the District Agricultural Committee; and

v) identification of mechanisms to modify initial decisions in light of unanticipated changes in water resource availability.

2.3.1. Outputs from Activity 1

As a result of these research activities the following outputs will be generated:

a) Improved information concerning water availability at seasonal level to assist in the planning process, and determination of probabilities of rainfall and reservoir inflow for each period within the season.

b) Clear identification of water rights and priorities for each season that achieve overall goals of equity and which result in improved production from the system.

c) Clear determination of the total volume of water available to each portion of the system during each season so that farmers can make appropriate cropping choices with high degrees of certainty.

d) Development of a system-wide water delivery schedule at the beginning of each season that informs farmers of the dates for starting and finishing land preparation, the last date of irrigation deliveries, the rotational schedule to be adopted, water levels to be maintained at the handover points between agency and farmer areas of responsibility, and the mechanisms by which deviations from this plan are to be addressed.

e) Development and implementation of a seasonal allocation plan that reflects the joint participation of agencies and farmers, and provides sufficient flexibility for modification in light of changed information or different agricultural or social priorities in the area.

2.4. ACTIVITY 2: IMPROVEMENT OF MAIN CANAL OPERATIONS

2.4.1. Research Objectives and Activities

Effective main canal operations require that there be a clear plan that defines the water delivery targets, that there be a good system of monitoring and feedback to ensure that the targets are being met, an evaluation process that determines whether the targets were indeed appropriate, and a set of response mechanisms to allow for contingency conditions not included in the original targets.

The Phase II research activities in Kirindi Oya will look at each of these four components of main canal operation in order that water deliveries to farmer organizations are reliable and predictable, and that scarce water resources are used as efficiently as possible to maximize production and equity.

a) Defining Water Delivery Targets

The first task of managers responsible for water deliveries in the main system is to define water delivery targets for each irrigation period based on the overall seasonal allocation plan developed at the end of the planning process. This task requires that discharge-head relationships are known at each point at which water control is to be implemented, and discharges or heads can be effectively measured at each offtake structure, i.e., point of transfer of responsibility.

In Kirindi Oya this activity has been made easier by the parallel work being undertaken under the Kirindi Oya Simulation Modelling project sponsored and funded by the French Government. This activity has already resulted in calibration of many locations in the system so that it is relatively easy to determine exact water level and discharge targets at locations along the right bank main canal. The computer simulation allows different operational targets to be tested in terms of the hydraulic limitations of the conveyance system, and also determines the optimal sequencing of gate operations to stabilize flows rapidly. Further details of this activity are given in Appendix 3. The present study will be closely coordinated with, and build on, the Simulation Modelling Study.

Based on this information, the system engineers have to communicate to all field staff the discharge and water level targets at each structure, the time at which gates should be opened and closed, and the necessary forms for the monitoring of actual water conditions.

Research activities in support of this sub-activity (funded by the parallel French-supported project) will include:

i) computer testing of different operational options for flow regulation that will result in simple operational inputs to achieve the desired water delivery targets;

ii) development, where still required, of head-discharge rating curves for use by gate keepers and other field staff to facilitate accurate implementation of the operational plan;

iii) evaluation and assessment of present methods of communicating revised targets from the Water Management Feedback Center to field staff responsible for operating control structures.

b) Refining Monitoring and Feedback

For each irrigation period in which operational targets have been set it is essential to have a parallel system of monitoring and feedback to determine whether or not operational targets were actually achieved. Given that the primary goal of main canal operation is to deliver water as reliably and predictably as possible to each point in the system where farmers take over operational responsibility, the primary focus of the monitoring activity is to ensure that the predetermined operational targets were indeed met. Only when they have been met is it valid to consider the actual utility of the initial target.

Monitoring of water deliveries by field staff of irrigation agencies by themselves has proved difficult in many countries. There is an inevitable tendency to report that targets were achieved when in reality they were not. To help avoid this type of situation, the farmers organizations can play an important role by being involved in the monitoring of water conditions at the point of handover of operational responsibility.

Only when accurate information on actually achieved conditions in the system is available is it possible for system managers to assess the suitability of the operational plan in terms of ease or difficulty of implementation. If targets are not being met, the manager needs to have a process of determining whether this was because, given existing levels of manpower and other resources, the plan could not be implemented, or whether field staff were not following the instructions that had been given to them. Once the primary causes of deviations between targets and actual conditions are identified, the system manager can take appropriate remedial action.

Research activities to support this sub-activity include:

i) development and testing of methods by which farmer representatives or their designates can assist in the monitoring of water conditions at points of handover of operational responsibility: this will require some training both of farmers and agency staff to ensure that the monitoring is being conducted correctly, and development of simple and effective reporting procedures;

ii) assistance to system managers in determining causes of deviations between operational targets and actual conditions, including a diagnostic set of procedures to identify appropriate remedial actions to ensure targets are more closely met during the next irrigation period;

iii) development of simple methods to track performance during the season, both in terms of target and actual conditions, and of the staff involved in setting targets and operating control structures to achieve them.

c) Evaluation of the Utility of Operational Targets

Only when operational targets have actually been achieved in the field is it possible to conduct an evaluation of the relative utility of those targets. It is inevitable that some operational targets will be based on imprecise information or assumptions, such as conveyance losses, seepage and percolation rates, and crop water requirements.

In a well managed system there will be a system to undertake periodic monitoring of water conditions at field level to determine if the discharge targets were indeed appropriate. Typical parameters that are included in such evaluation activities are observation of conditions in drains, which indicate whether water deliveries are excessive, observation of water status in fields to determine the presence and extent of any water shortages and the relative degree of water distribution equity, and assessment of whether irrigation intervals and stream sizes during each rotational period are satisfactory for effective irrigation by farmers.

With this information, it is then possible to determine whether the allocation plan drawn up at the beginning of the season is satisfactory, and to make within-season adjustments to the overall plan.

Research tasks for this sub-activity include:

i) development of standing orders that allow a coordinated and rapid response to rainfall at tertiary level, in agreement with farmer representatives, both in terms of reductions of discharge and the schedule for re-establishment of deliveries to normal levels following the end of the rain;

ii) determination of alternative, non-routine operational scenarios, based on computer simulations, that can allow for lower than normal discharges to accommodate reduction in demand at tertiary level, and efficient and effective ways of re-establishing normal operational conditions once demand has increased again;

iii) development of mechanisms to track overall water consumption during the season and cross-check with updated estimates of water availability to determine whether operational targets developed before the season can actually be maintained to the end of the season;

iv) in the event of greater than anticipated water supply, procedures that allow for revision of operational targets to include additional land for irrigation during the current season.

2.4.2. Outputs from Activity 2

As a result of these research activities it is expected that the following outputs will be generated:

a) improved understanding of the hydraulic conditions of the system that would permit development of technically suitable operational targets and accompanying instructions for gate operations to field staff;

b) an effective two-way system of communication for passing instructions to field staff, and receiving monitoring and feedback information about actual discharges in the canal system and water conditions at tertiary level;

c) involvement of farmers organizations in monitoring and feedback process, and in evaluation of the utility of different combinations of discharge and timing of deliveries for agricultural production;

d) procedures for assessing both water delivery performance and performance of staff in undertaking operations;

e) development of clear response mechanisms to deal with contingencies such as rainfall or drought that require adjustments to the seasonal operational plan.

2.5. ACTIVITY 3: MAIN SYSTEM MAINTENANCE MANAGEMENT

2.5.1. Research Objectives and Activities

Maintenance is the management response to deterioration of the physical condition of an irrigation system that threatens to make it impossible to achieve operational targets. Maintenance is the process of keeping the irrigation, drainage and other infrastructural facilities in good repair and working order, enabling managers to meet system objectives (Pereira and McCready, 1987). Yocom (1986) states that the intention of maintenance is upkeep of physical facilities with the goals of efficient operations, minimum breakdown and good appearance. Despite these definitions, however, there is frequently no direct relationship between maintenance and operations: sometimes different staff and different budgets are involved, and maintenance inputs are often uncoordinated with operational goals.

In many industrial engineering enterprises maintenance programs have been developed that support operation of the enterprise in a cost-effective manner. There is little evidence, however, that in irrigation systems maintenance programs have been evaluated in terms of their impact on irrigation system performance, or that the cost-effectiveness of the procedures has been evaluated. A recent study of maintenance management on five major Sri Lankan irrigation schemes demonstrates that (a) funding levels are inadequate to achieve technically and socially desirable maintenance levels, and more important (b), the present system for maintenance management does not use existing resources effectively, and is not performance-oriented (TEAMS 1991).

In this study two overall objectives have been identified that help to more closely link maintenance inputs to operational targets:

- identification of the acceptable level of physical conditions of the canal system and control infrastructure that permit implementation of operational plans, and

- improved system performance through more effective water delivery-oriented maintenance procedures.

As a pilot exercise the research work on maintenance in Phase II will focus on Weerawila Tank system in Tissamaharama Division because the canal design and conditions are more typical of those in Sri Lanka than the newer designs incorporated into the right bank main canal.

a) Identification of minimum acceptable level of physical conditions required to permit implementation of operational plans

One of the primary factors that will determine the success or failure of an operational plan is the physical condition of the conveyance infrastructure. Operational targets are based on assumptions about hydraulic conditions such as slope, roughness, and cross-section, all of which affect the velocity of water in the canals and therefore head-discharge relationships. Changes in the physical condition of the canal will eventually make it impossible to achieve operational targets.

A critical test of the effectiveness of a maintenance program is therefore whether or not the canal system is capable of meeting operational targets. There must be a set of measurements of physical parameters that determine whether the operational plan is feasible, and a program of maintenance that ensures operational targets will continue to be met into the future. This involves monitoring both the conveyance capacity of canals, which deteriorate continuously over time, and the functionality of control infrastructure where maintenance is oriented towards prevention of catastrophic failure of gates and regulators.

To support these objectives, the following research activities will be undertaken:

i) development of methods to assess whether existing physical conditions are indeed compatible with expected operational targets for main and distributary canals, based both on physical observations of water conditions and, if possible, on computer simulation;

ii) development of standards for canal maintenance, including such aspects as depth of sediment, density of weed growth, cross-section, and other physical conditions that permit operational targets to be fulfilled;

iii) initiate procedures for estimating the rate of change of physical conditions of canals and control infrastructure that will assist in determining the probable costs, manpower and equipment required over time to keep conveyance capacity and operational control within acceptable limits;

iv) compare these estimates with existing resources for maintenance to determine whether or not the physical system is likely to be sustainable;

v) assess whether current procedures for maintenance require modification in order to maintain or improve the level of performance of the canal system, and where required, make recommendations as to alternative maintenance procedures that will be more cost-effective within the likely availability of resources.

b) Improving System Performance through Effective Maintenance

Once the physical system is stabilized to a point where maintenance procedures are cost effective, then there is an opportunity to address more carefully the overall efficiency of system performance.

Maintenance is important to the achievement of operational targets because it helps determine the level of conveyance losses of water through the system. If, as is likely to be the case, operational targets are defined at the points of transfer from agency to farmers, then efficiency will result in smaller releases into the system from the reservoir, and thus result in overall savings of water that can be productively used at a later stage.

For this to be effective there has to be a good system of monitoring, evaluation and feedback on key parameters of system performance that identifies when and where maintenance inputs are required. Typical parameters are likely to include conveyance losses, time taken to re-establish correct water levels following closure, flow velocity, and design discharge capacity.

To support this program, the following research activities will be undertaken:

i) development of a set of parameters that are useful for system managers to identify the impacts of maintenance of system performance, including such aspects as determination of conveyance losses, measurement of flow velocity and actual discharge at sample locations, and evaluation of cross-sectional changes;

ii) establishment of a long term but simple monitoring program that periodically measures the values of the selected parameters and which will then be used to schedule maintenance inputs in relation to priority concerns;

iii) development of a long term program for maintenance that is based not on annual financial resource availability, but is also needs-based in relation to the performance of the conveyance system.

2.5.2. Outputs from Activity 3

The following outputs will be generated by these research activities:

a) establishment of closer relationships between maintenance inputs and the operational objectives of the main system in terms of efficient and effective water conveyance;

b) development of a set of maintenance standards that need to be met during maintenance activities and which will be used as the criteria in determining when to undertake specific maintenance tasks;

c) evaluation of the effectiveness of current maintenance practices and budgets and monitoring and evaluation of maintenance to sustain canal performance, and development of alternative procedures where appropriate.

2.6. IMPLEMENTATION PLAN

As discussed in the above sections this research deals with three main activities, development and implementation of a seasonal allocation plan, improvement of main canal operations, and main system maintenance. In the process of implementation these research activities undergo stages of planning, execution, and monitoring, evaluation and feedback. Description of the tasks, agency responsibility and supporting agency etc. are tabulated below under each activity.

Task	Agency/Unit responsible	Supporting Agency
Activity 1: Development and Implementation of Seasonal Allocation Plan		
a) Supply Assessment		
:Analysis of hydrological data	ID/WMFC & SCC	IIMI
:Estimation of reservoir inflows	ID/WMFC & SCC	IIMI
:Water balancing EIS	ID/IE(T), SCC	IIMI
b) Establishing Water Rights		
:Allocation of water to sub systems etc.	PMC/ID,SCC,WMFC	IIMI
:Selection of crops	DA/ID/LCD(SCC,WMFC)	
c) Planning Seasonal Demand		
:Method to determine the area and location	ID/IMD(SCC,WMFC)	IIMI
:Guidelines for water availability related to different cropping pattern	ID/DA(SCC)	IIMI
:Determination of dates for start of seasons, land preparation	ID/DA/IMD(SCC)	IIMI
d) Implementing the Allocation Plan		
:Operating condition in Main system	ID/RE(RB),SCC	IIMI
:Assessment of managerial requirements (use of COMA)	IIMI	ID/RE(RB)
:Determination of method of expressing allocations to users	ID/IMD(SCC)	IIMI
:Determination of acceptable tolerances level & types of changes required for more stable main system conditions	ID/WMPC	IIMI

	Task	Agency/Unit responsible	Supporting Agency
e)	Institutional Issues for Seasonal Planning		
	:Involving farmers in planning of water allocations	ID/IMD,SCC	IIMI
	:Updating the information for decision making	ID/DA(WMFC)	IIMI
	:Review of cultivation plans	PMC(ID,IMD,DA)	IIMI
Activity 2: Improvement of Main Canal Operation			
a)	Defining Water Delivery Targets		
	:Simulation model field testing	WMFC/IIMI	ID
	:Development of H vs Q curves	ID/WMFC	IIMI
	:Evaluation of communication links with the field staff	IIMI	WMFC&RE (RB)
b)	Refining Monitoring and Feedback		
	:Involving farmers&agency staff in M&E	ID/IMD(SCC)	IIMI
	:Diagnosing the causes for operational target deviations and identify remedial measures	IIMI(SCC)	ID
	:Developing methods for verifying actual vs targets	IIMI/ID(SCC)	IIMI
c)	Evaluation of the Utility of Operational Targets		
	:Joint assessments and reporting of utility of water delivery targets	ID/IMD/SCC	IIMI
	:Revision of operational targets	WMFC(SCC)	IIMI
	:Development of reporting procedures for actions on operations	WMFC(SCC)	IIMI
d)	Response Mechanisms to Contingencies		
	:Standing orders for climatic changes	WMFC(SCC)	IIMI
	:Use of simulation model to accommodate lower discharges & to bring back to normal	WMFC(SCC)	IIMI
	:Verification of targets against the water availability	WMFC(SCC)	IIMI
	:Revision of operational targets to accommodate additional lands	WMFC(SCC)	IIMI

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