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FINAL REPORT

on the
Technical Assistant Study
(TA 846 SRI)



IRRIGATION MANAGEMENT AND CROP DIVERSIFICATION

(Sri Lanka)

Volume II

Kirindi Oya Project

June 1990

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TABLE OF CONTENTS

FIGURES	ii
TABLES	iv
PREFACE	viii
I INTRODUCTION	1
II PLANNING AND MACRO-LEVEL ISSUES IN KIRINDI OYA PROJECT	11
111 IRRIGATION INSTITUTIONS IN KIRINDI OYA	35
IV DESIGN-MANAGEMENT INTERACTIONS	73
V IRRIGATION SYSTEM PERFORMANCE	107
VI RICE AND NON-RICE CROP PRODUCTION IN KIRINDI OYA: A STUDY OF SYSTEM PERFORMANCE AND CROP DIVERSIFICATION	156
VII DEVELOPMENTS DURING MAHA 1989/1990	215
REFERENCES	255

FIGURES

1.01	Location map of research sites (Sri Lanka)	6
1.02	Kirindi Oya Irrigation & Settlement Project	7
1.03	schematic layout of RB branch <i>canal</i> No. 2, tract 5, KOISP	8
1.04	schematic layout of DC 2, tract 5, KOISP	9
1.05	Blocking-out plan for DC 2 branch No. 2 of Kirindi Oya right bank	10
2.01	Variation of annual rainfall, Kirindi Oya basin (1935 - 1986)	34
3.01	The proposed organizational structure for O&M organization in Kirindi Oya	72
4.01	Half hourly flow variations at the heads of DC 2 and FC 9, 10 and 15 in DC 2 under BC 2.	103
4.02	Half hourly flow variations at the heads of FC 11, 12 and 13 in DC 2 under BC 2	104
5.01	Schematic representation of the factors affecting the water delivery performance of an irrigation system	141
5.02	Rainfall and evapotranspiration, RB tracts, maha 1987/1988	142
5.03	Rainfall and evapotranspiration, RB tract 5, yala 1989	142
5.04	Land preparation progress, RB tract 5, yala 1989	143
5.05	Target and actual discharge, RB tract 5, maha 1987/1988	144
5.06	Target and actual discharge, RB tract 5, maha 1987/1988	145
5.07	Target and actual discharge, RB tract 5, yala 1989	146
5.08	Target and actual discharge, RB tract 5, yala 1989	147
5.09	Target and actual discharge, RB tract 5, yala 1989	148
5.10	Water table fluctuation, RB tract 5, FC 12 - tail end allotment, maha 1987/1988	149
5.11	Conveyance losses in DC 2, RB tract 5, maha 1987/1988	149
5.12	Half hourly fluctuation, RB tract 5, maha 1987/1988	150
5.13	Relative Water Supply (RWS), yala 1989	151

5.14	Relative Water Supply (RWS), yala 1987/1988	152
5.15	Mean relative water supply along BC 2 and along DC 2 , in maha 1987/1988 and yala 1989	153
5.16	Cumulative relative water supply (CRWS) yala 1989	154
5.17	Cumulative relative water supply (CRWS) mid maha 1987/1988	155
6.01	Crop calendar for rice and non-rice crops in 189 yala , Kirindi Oya	213
6.02	Weekly labor requirement per hectare for rice and non-rice crops in 1989 yala , Kirindi Oya	214
7.01	Land preparation progress RB Tract 05	244
7.02	Rainfall & Evapotranspiration RB Tract 1	245
7.03	Land preparation Progress DC 5 Tract 01	245
7.04	Land preparation progress RB Tract 01	246
7.05	Target and actual discharge RB Tract 01	247
7.06	Target and actual discharge RB Tract 01	248
7.07	Relative water supply (RWS) RB Tract 01	249
7.08	Relative water supply (RWS) RB Tract 01	250
7.09	Mean relative water supply, RB Tract 01 , Maha 1989/90	251
7.09	(Continued) Cumulative relative water supply, RB Tract 01	252

TABLES

2.01	A comparison of recent discharge measurement with original series	16
2.02	Actual sluice water duty in three seasons - Kirindi Oya Project	23
2.03	Parameters used for system irrigation scheduling	26
4.01	Comparison of monthly reference crop ET values at Mahalluppallana, Hambantota and Weerawila	77
4.02	Land soaking and land preparation periods and irrigation water requirements in Kirindi Oya	79
4.03	Comparison of effective rainfall suggested by design guide lines and O&M Manual	81
4.04	Comparison of efficiency parameters in new area of Kirindi Oya	82
4.05	Daily peak irrigation water requirements as per O&M manual	82
4.06	Daily peak irrigation water requirements as per design guidelines	83
4.07	Comparison of the design capacities (existing) with the required capacities of distributaries (DCs) in Kirindi Oya	85
4.08	Standard field and distributary canal sectors	88
4.09	Variability of flow in DC 2 of BC 2 of right Bank tract 5, Kirindi Oya Project	98
5.01	Rainfall distribution in right bank tract 5 at Weerawila	114
5.02	A comparison of computed evapotranspiration (ET) based on pan evaporation measurements at Weerawila with evaporation values adopted for the design based on climatic variables at Angunokolapelessa	114
5.03	Adjustment rules for rainfall in yala	115
5.04	Measured seepage and percolation values, DC 2 , tract 5	117
5.05	Progress in land preparation during yala 1989	118
5.06	Summary of findings from daily hydrographs, maha 1987/1988 season	120

5.07	Comparison of actual delivery with targets in maha 1987/1988 season	121
5.08	Summary of water table fluctuations	125
5.09	Relative water supply (RWS) and water delivery performance (WDP) for right bank tract 5 , BC 2 sub-system	130
5.10	Water delivery ratio in BC 2 sub-system, tract 5	132
5.11	Total water use in BC 2 sub-system in right bank tract 5	134
6.01	Population and sample allotments in distributary canals under study in Tract 5 of Kirindi Oya, by location along distributary <i>canal</i> and by soil type	184
6.02	Output, Inputs, and factor payments per hectare, farm income per hectare and per farm, and prices in irrigation rice production in selected regions in Sri Lanka study area	185
6.03	Output, Inputs, and factor payments per hectare, farm income per hectare and per farm, and prices in irrigation rice production in selected regions in Sri Lanka study area	187
6.04	Average rice yield per hectare in the three seasons under study, by location and by soil type, Kirindi Oya, based on crop-cut survey	189
6.05	Average rice yields (kg/ha) in the BC 2 allotments in the 1987/1988 maha season , Kirindi Oya, by location along the distributary and by soil type, based on the 100% crop-cut survey	190
6.06	Rice yield per water supplied at different locations of the sub-system under study, Kirindi Oya, 1989 yala	191
6.07	Yields and inputs per hectare in rice production for sample allotments in Tract 5 , 1987/1988 maha , by distributary canal, by location along distributary canal and by soil type	192
6.08	Labor use per hectare in rice production for sample allotments in Tract 5 , 1987/1988 maha , by distributary canal, by location along distributary <i>canal</i> and by soil type	193
6.09	Factors affecting input uses per hectare, 1987/1988 maha : Summary of regression analyses	194

6.10	Factors affecting rice yield per hectare, 1987/1988 maha: Summary of regression analyses	195
6.11	Sources of credit for and amount borrowed by sample farmers by distributary canal, 1987/1988 maha	196
6.12	Gross revenue, factor payments and gross value added per hectare, farm income per hectare and labor productivity in rice production, 1987/1988 maha and average for three seasons studied, Kirindi Oya	197
6.13	Market prices used for analysis	198
6.14	Yields, labor requirements and costs and returns of selected non-rice crops grown under irrigated conditions in the dry zone of Sri Lanka in 1985 yala	199
6.15	Yields, labor requirements and costs and returns of selected non-rice crops grown under irrigated conditions in the dry wne of Sri Lanka in 1986 yala	200
6.16	Yields, labor requirements and costs and returns of selected non-rice crops grown under irrigated conditions in the dry wne of Sri Lanka in 1987 yala	201
6.17	Yields, labor requirements and costs and returns of selected non-rice crops grown under rained conditions during the maha season in the dry zone of Sri Lanka	202
6.18	Area planted with non-rice crops of selected demonstration farms, by crop and by farm, Kirindi Oya, 1989 yala	203
6.19	Yields, labor requirements, and costs and return of selected non-rice crops under irrigated condition in Kirindi Oya in 1989 yala	204
6.20	Comparison between rice and selected non-rice crops: profitability, and requirements for irrigation, labor and capital	205
6.21	Labor use per hectare for selected crops by type of labor, Kirindi Oya , 1989 yala	206
6.22	Labor use per hectare (days/ha) in non-rice crop production, Kirindi Oya, on-farm demonstration, 1989 yala	207
6.23	Current and alternative cropping patterns in Kirindi Oya	208
6.24	Assumptions for assessing returns from different cropping patterns and cropping intensity, Kirindi Oya	209

6.25	Changes in the total agricultural income generated in the Kirindi Oya System by alternative cropping patterns and intensity at 1989 prices	211
6.26	Changes in the total agricultural income generated in Kirindi Oya System by alternative cropping patterns and intensity at 1989 prices	212
7.01	Command area of field canals in RB Tract 01 distributary canal 5	237
7.02	Rainfall distribution in right bank tract 5 at Weerawila	238
7.03	A comparison of computed evapotranspiration (ET) based on pan evaporation measurements at Weerawila with evapotranspiration values adopted for the design based on climatic variables at Angunukolapelessa	239
7.04	S&P values (mm/day) in RB tract 01	240
7.05	Factors affecting progress of land preparations	241
7.06	Canal losses between Sub-DC and FC-52	242
7.07	Relative water supply (RWS) and water delivery performances (WDP) for right bank tract 1 DC 5	243

PREFACE

The research reported in these three volumes was made possible through a Technical Assistance grant from the Asian Development Bank, and through the close cooperation of the Government of Sri Lanka. **IIMI** is grateful to both for their support, assistance, and cooperation during the study period. We pay special tribute to the project and field level officers in the two systems studied, Kirindi Oya and Uda Walawe. Without their active cooperation and assistance the study could not have been completed. Their positive approach to the study is especially appreciated since during most of the period they were working under very serious constraints and threats due to the disturbed conditions in the country, **and** since our study **was** somewhat critical of the management of the projects.

Our major objective in this study has been to identify and diagnose problems affecting the performance of the two systems, and recommend practical steps that could be taken to solve these problems. Thus, we measure our success as much by the impact of our study, i.e., its usefulness to our clients the irrigation agencies, policy makers and donors, as by its contribution to irrigation management knowledge itself.

The present report reflects some additions and changes over the Draft Final Report. Volumes II and III provide detailed analyses of our data on Kirindi Oya and Walawe, respectively. We have added a new chapter to both volumes analyzing changes that occurred during the 1989/1990 maha season, i.e., since the Draft Final Report. In both systems very significant developments have occurred, **some** of them in response to the Draft Final Report itself. We have also revised the chapter on crop diversification (Chapter 6) in the Kirindi Oya volume to include additional potential crops, and the chapter on irrigation system performance (Chapter 4) in the Walawe volume to include data from the same distributaries for **maha 1989/1990**. Otherwise, we have made corrections and clarifications throughout the other chapters, to reflect comments and suggestions received from various readers.

For volume I, containing the overall recommendations **and** conclusions on both systems, we have not changed the original recommendations, which still stand, except for some editorial corrections. We have added additional sections providing additional recommendations and observations for both systems, based on the more recent fieldwork.

This Final Report provides the data base for the proposed Phase II study, which will be an action program to field test and evaluate some of the recommendations contained in this report, and will also provide additional data required for overall system planning and performance monitoring. Taken together, this work should provide a model of the kind of impact management-oriented field research can have on improvement of problematic irrigation systems.

CHAPTER I

INTRODUCTION

CONTEXT OF THE STUDY

This study of Irrigation Management and Crop Diversification was carried out under a Technical Assistance Agreement (T.A. No. 846 -SRI) dated 27 November 1987, between the Government of the Democratic Socialist Republic of Sri Lanka (GOSL), the International Irrigation Management Institute (IIMI), and the Asian Development Bank (ADB). The study was implemented by IIMI in the Kirindi Oya and Uda Walawe projects in southern Sri Lanka in close collaboration with the agencies in charge of development and management of these projects. It addresses, through field-level research, priority issues of importance and relevance to the two projects in the processes of irrigation system management, with particular attention given to the requirements of crop diversification.

PROGRESS OF THE STUDY

The study commenced on 1 February 1988 and was of 30 months duration, including an additional four months' extension to finalize the Final Report. The first season of field research in the Kirindi Oya project was started in March 1988 which corresponded to the delayed maha (or "mid") season of 1987/1988. Due to the unsettled social and political situation that prevailed in the study area as well as inadequate water availability at the storage reservoir, only two seasons of research (maha 1987/1988 and yala 1989) could be captured during the period of study in addition to the last maha (1989/1990) season. The Draft Final Report synthesized the research results of the two seasons of completed study along with the preliminary results obtained during the ongoing maha 1989/1990. This Final Report includes an additional chapter on the impact of the draft final report on the implementation of the project, analysis of research results of the maha 1989/1990 as well as incorporation of suggestions received on the draft report.

REPORTING OF THE STUDY

An Inception Report (IIMI 1988a) was submitted in mid-March 1988 at the end of stage 1 of the study. It contained the findings of the literature review, and the research proposals and program, detailing data collection, field observations, analysis, and expected results, and other details of implementation for stage 2 of the study covering four seasons of field research. The identification of the sub-system for research was also part of the research planning described in the report. A Progress Report (IIMI 1988b) and an Interim Report (IIMI 1989a) were submitted in October 1988 and April 1989 respectively during the on-going research. The Progress Report described the progress in the implementation of the first season of field research, and preliminary findings. Based on the full season research of yala 1989, a Seasonal Summary Report (IIMI 1989b) was prepared which summarized the findings of that season. The Draft

Final Report analysed the results of all the previous seasons including a preliminary assessment of the work during maha 1989/1990. This report was reviewed at the meeting of the Project Central Coordinating Committee on 15 February 1990 and a committee was constituted under the chairmanship of the State Secretary for Irrigation to suggest remedial measures urgently to improve the management of the project. The Draft Final Report was also reviewed at a tripartite meeting (ADB, GOSL and IIMI) held on 20 March 1990. This Final Report incorporates views and comments of the tripartite meeting and others. It also contains further analysis and recommendations for improvements and follow-up studies which are considered necessary.

The Appendix to chapter 1 provides extracts from the Inception Report on the selection of the sub-system and Figures 1.01 to 1.05 (maps and scheme layout) for easy reference regarding field research locations.

IMPLEMENTATION

Field offices: A house was rented at Tissamaharama to serve as field office for research staff and also as residential accommodation for the research officers.

Staffing -- International: The following senior staff of IIMI worked on the study:

Dr R. Sakthivadivel, Engineer/Team Leader
 Dr C.R. Panabokke, Agronomist/Senior Associate
 Dr D.J. Merrey, Social Scientist
 Dr M. Kikuchi, Agricultural Economist

Dr P. S. Rao, Team Leader associated with the project up to 22 August 1989, left IIMI and Dr R. Sakthivadivel succeeded him from that date.

Staffing- National: Research Associate: Mr W. A. A. N. Fernando (Irrigation Engineer), based in Tissamaharama, was in charge of field research operations and coordination and supervision of research activities in both Kirindi Oya and Walawe projects until 15 March 1990. After his tenure with IIMI was over, he went back to his parent Irrigation Department to assume charge as Deputy Director, Moneragala Range.

Research officers: The following research officers worked on the project.

Mr P.G. Somaratne, Sociologist
 Mr B.R. Ariyaratne, Agricultural Engineer
 Mr A.P. Keerthipala, Agricultural Economist (till 20-12-1989)

COUNTERPART

Mr B.K. Jayasundera, senior irrigation engineer, was nominated by the Irrigation Department as counterpart for the study. After his transfer from the Kirindi Oya project, Mr Sarath Wijesekera, his successor, was the counterpart for the study.

COMMITTEE

The first Study Coordinating Committee meeting was held on 11 May 1988 at the office of the Chief Resident Engineer in Deberawewa to discuss the Inception Report prepared by IIMI. The meeting provided useful suggestions for implementing the research project. The second Study Coordinating Committee (SCC) meeting was on 7 March 1989 at the office of the Chief Resident Engineer in Deberawewa; the second Study Advisory Committee (SAC) meeting was in Colombo on 16 March 1989 at the office of the Director, Irrigation Management Division. Mr T.C. Patterson, Manager, Asia West Division 1 of the Asian Development Bank participated in the SAC meeting and also visited the field research location on 13 March 1989. The Progress Report submitted in October 1988 was discussed in these two meetings and useful comments and suggestions regarding research were made by the members of the Committees.

The third Study Coordinating Committee (SCC) meeting was held on 25 May 1989 at the office of the Chief Resident Engineer in Deberawewa; the Interim Report submitted in April 1989 was discussed in the meeting. Crop diversification issues received particular attention at this meeting.

The Interim Report was presented to the Asian Development Bank at Manila in the third week of June 1989. In response to the suggestion made in this report, Mr Peter Smidt of the Asian Development Bank visited Sri Lanka during the second week of July 1989. During his visit, a number of decisions were taken, the most important one being the constitution of an action committee with all relevant state departments represented, to prepare an implementation plan for other field crops from yala 1990.

The fourth Study Coordinating Committee meeting was held on 25 October 1989 at the office of the Chief Resident Engineer, Tissamaharama, to discuss the Seasonal Summary Report. The third Study Advisory Committee (SAC) meeting was held on 16 November 1989 in Colombo, with the participation of Mr Peter Smidt. The research results of yala 1989 season were presented and the importance of improving the water delivery performance was brought out.

The fifth Study Coordinating Committee meeting was held on 27 March 1990 at the office of the Chief Resident Engineer, Tissamaharama to discuss the Draft Final Report and the draft terms of reference for a phase II research study prepared by IIMI. The fourth Study Advisory Committee (SAC) meeting was held on 20 March 1990 in Colombo, with the participation of Mr Peter Smidt from ADB. The draft terms of reference for phase II research based on the recommendations of the Draft Final Report were discussed in detail and the comments of the Study Advisory Committee were taken into consideration while reformulating the terms of reference.

COLLABORATION WITH THE DEPARTMENT OF AGRICULTURE

The research component on "On-farm Irrigation Management for Upland Crops" was to be conducted in collaboration with the Department of Agriculture. In order to carry out the research, an Agricultural Research Station had been proposed to be established at Weerawila. Because of the disturbed conditions

in the study area, only a part of the proposed station with field channels could be established in April 1989. Some field crops had been raised in the research farm during yala 1989 with no systematic monitoring of water measurement. IIMI has been instrumental in establishing this research station, bringing it to the present working condition and preparing an agenda for taking up action and adaptive research. In addition, IIMI was also involved along with other line agencies in preparing the action plan for other field crops in yala 1990 as stipulated in the Memorandum of Understanding of a recent ADB mission. During maha 1989/1990, IIMI staff provided technical assistance and interventions to the operating agencies in developing an action plan for cultivation of non-rice crops in yala 1990 in respect of cropping patterns, cropping calendars, irrigation delivery scheduling and land preparation methods.

PROBLEMS AND ISSUES

It was unfortunate that the period selected for the research was socially and politically so unstable that contemplated research could not be implemented in full. Research staff had to be withdrawn often from the field for security reasons; the IIMI field vehicle allocated to the project was set on fire by an unknown group in July 1989. In spite of all these impediments, field research was carried out for at least three seasons and the credit for this must go to the field research staff.

ACKNOWLEDGEMENTS

In spite of the sensitive security situation and difficult circumstances under which they were functioning, the agency officials, field level staff, and farmers of the project area have offered excellent cooperation and assistance for the conduct of the field research which is gratefully acknowledged. Some of our observations have been critical and controversial, but this has not affected the wholehearted cooperation of officials. We are also grateful to the members of the Study Coordinating Committee and Study Advisory Committee for their comments and suggestions on previous reports, and to the Asian Development Bank for its continuing interest and strong support for the study.

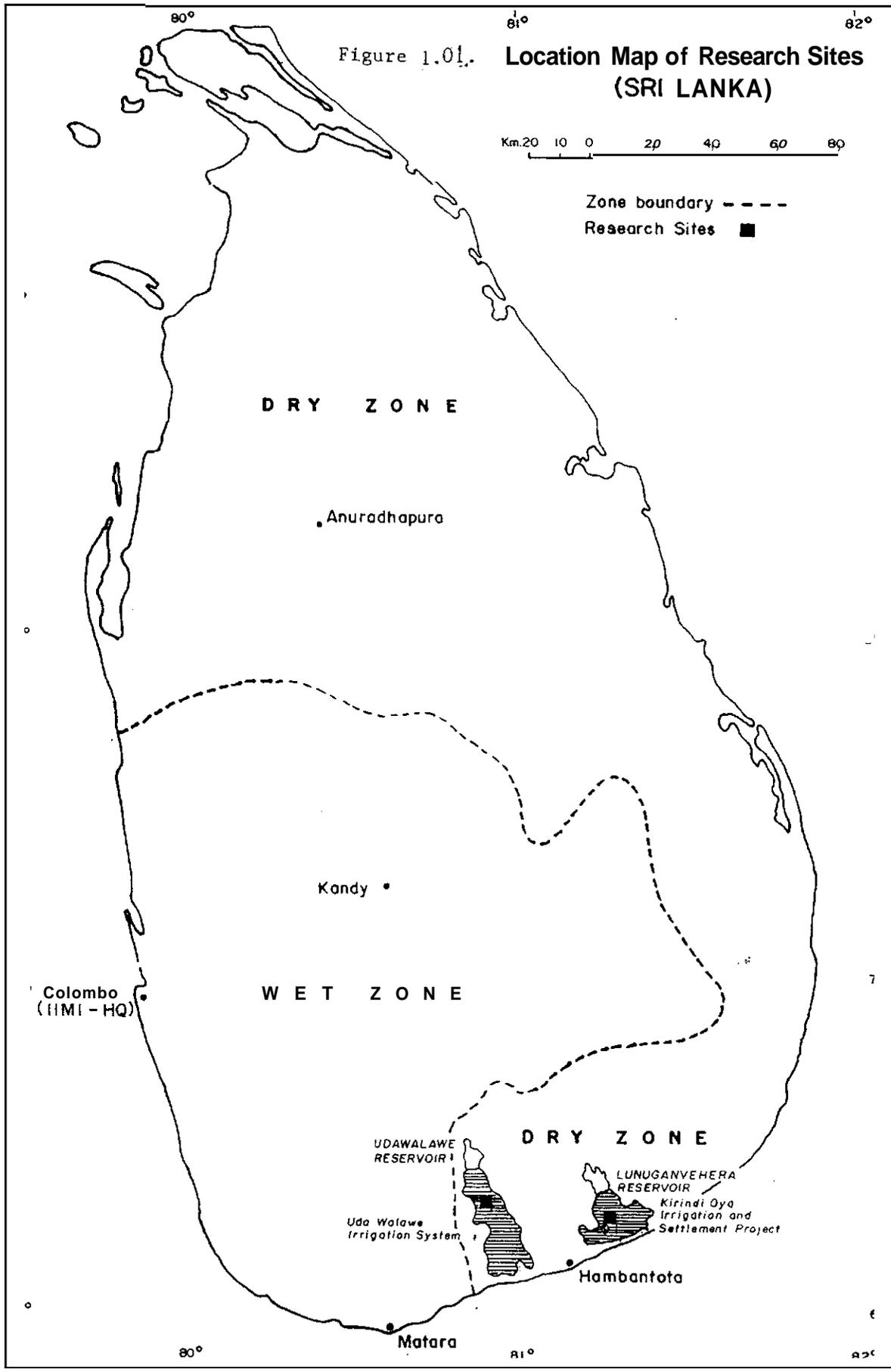
Appendix

(Extract from inception report)

Selection of subsystem

The study envisages the selection of one sample subsystem in Kirindi Oya project, for intensive **data** collection and analysis (the intensive sample), supplemented by extensive and intermittent monitoring at the next higher level subsystem (extensive sample). Each sample subsystem should comprise the total command area of one distributary canal and its field canals and should also include both upland (well drained) and lowland (poorly drained) soils, The subsystem for Kirindi Oya should be selected in the newly developed Phase I area. Based on these considerations the following subsystems have been selected for the study.

The intensive subsystem consists of the Distributary Canal (DC2) of Branch Canal 2 (BC2) on the Right Bank Main Canal (**REMC**). It serves a command area of **91** ha in Tract 5. Each fanner has an allotment of **1** ha. There are thus **91** fanners. BC2, from which DC2 takes off, has a command area of 528 ha. **The** schematic layouts of BC2 **and** DC2 are shown in Figure 1.03 and 1.04 respectively. The blocking-out plan for DC2 is shown in Figure 1.05. While DC2 will form the intensive sample for the study, BC2 will provide the basis for the extensive sample from the next, higher level subsystem.



- KEY**
- VILLAGE CENTRES (NEW)
 - ⊙ VILLAGE CENTRES TO BE EXPANDED
 - ⊖ HAMLETS (DIAGRAMATIC - NEW)
 - MAIN CANAL AND ROAD
 - - - TRACT BOUNDARY
 - ▭ IRRIGABLE PADDY AREA (NEW)
 - ▭ EXISTING PADDY AREA
 - ▭ CLASS B ROADS EXISTING
 - ▭ CLASS C ROADS
 - - - CART TRACT
 - FOOT PATH
 - ⊖ MAJOR RESERVOIRS
 - ⊖ MINOR RESERVOIRS
 - ⊖ MINOR RESERVOIRS (ABANDONED)
 - EXISTING FEEDER CANAL
 - - - PROVINCE BOUNDARY
 - ▭ HAMLETS (FINALISHED)

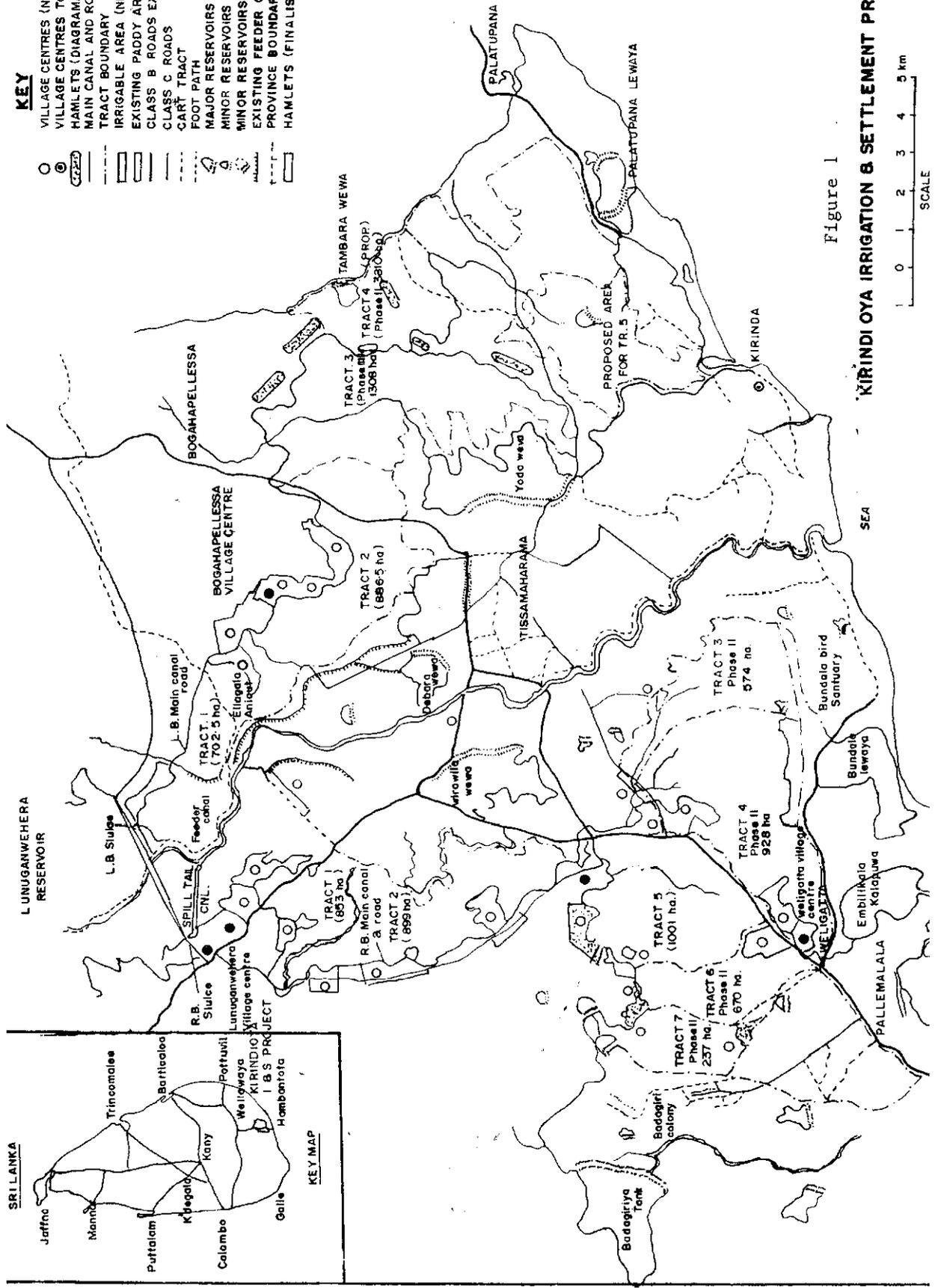
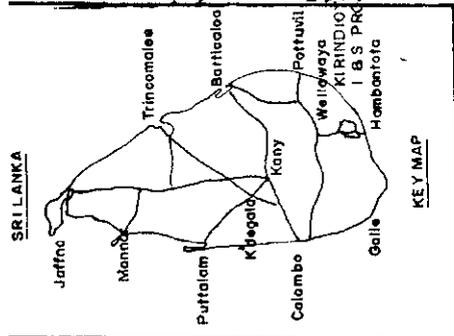


Figure 1

KIRINDI OYA IRRIGATION & SETTLEMENT PROJECT



KEY MAP

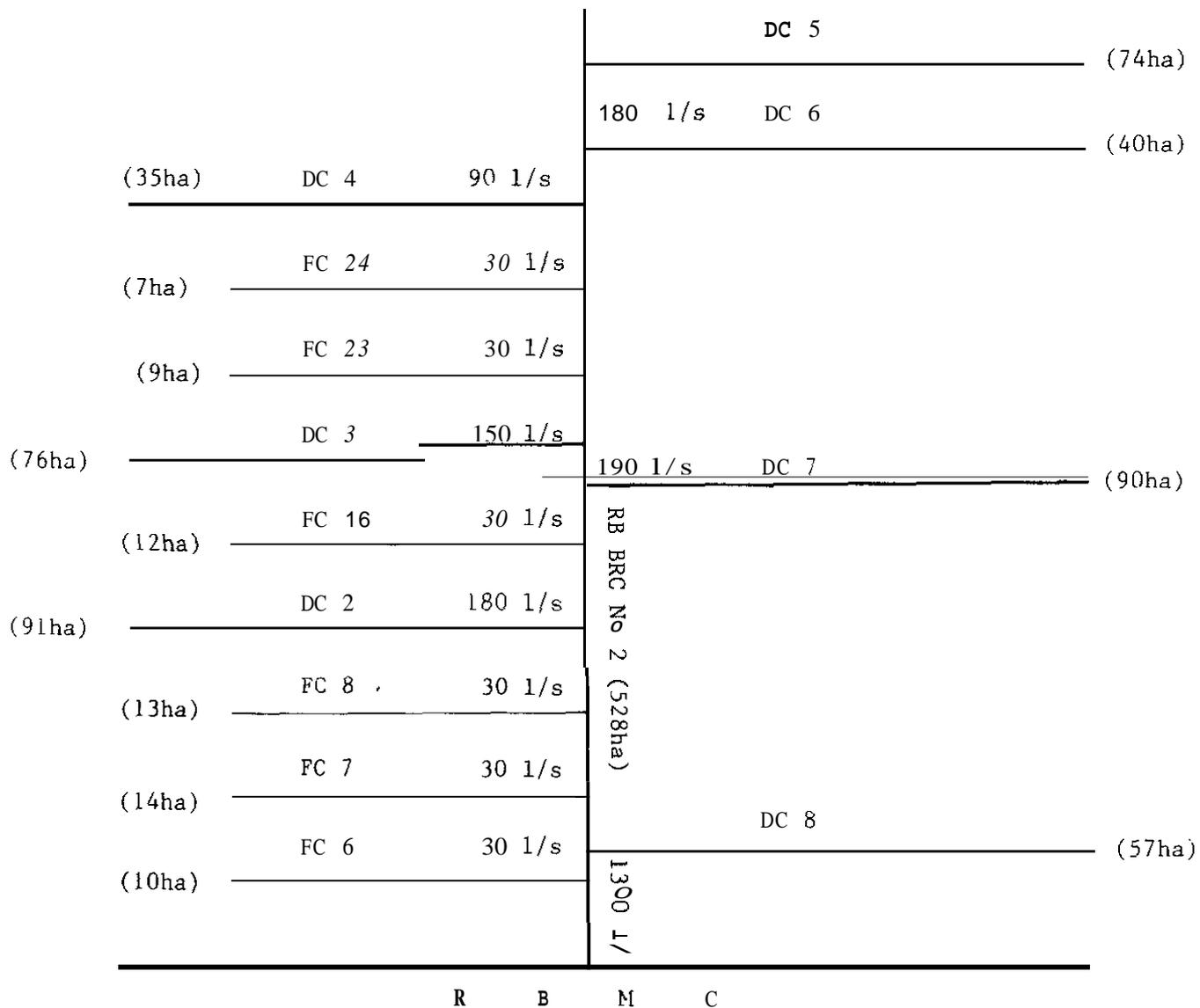


Figure 1.03. Schematic Layout of RB Branch Canal No 2, Tract 5, KOISP

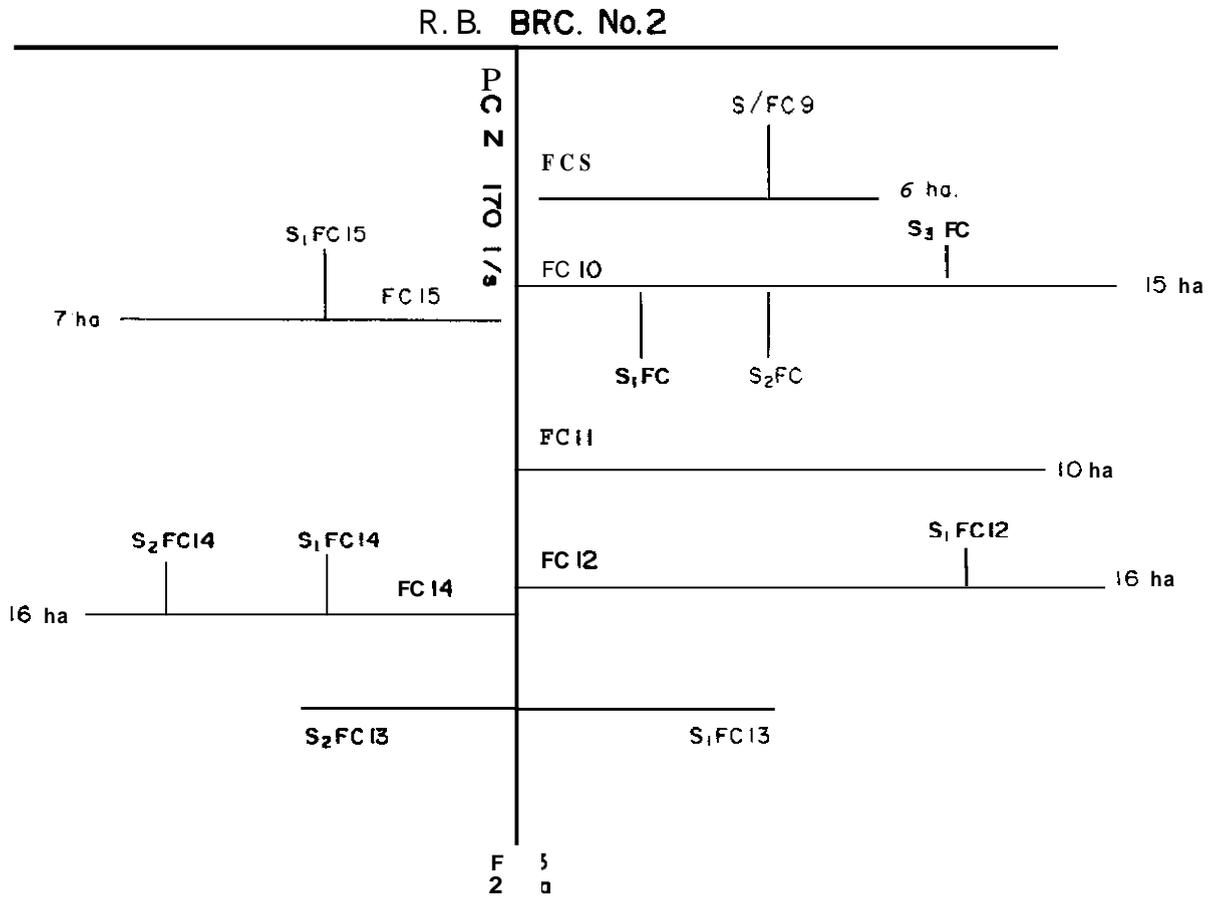


Figure 1.04.
Schematic Layout of DC 2, Tract 5 KOISP

Figure 1.05,

Blocking-cut Plan for DC 2 Branch No.2 of Kirindi Oya Right Bank

metres 100 50 0 100 200 300 400 500 metres



CHAPTER II

PLANNING AND MACRO-LEVEL ISSUES IN KIRINDI OYA PROJECT

AN OVERVIEW OF THE PROJECT

The Kirindi Oya project area is located in the dry zone of the southeast quadrant of the island, about 260 km from the city of Colombo. The service area of the project including the reservoir covers about 21,000 hectares (ha) on the left and right banks of the lower Kirindi Oya basin and a portion of the adjacent drainage areas.

The climate of the project area is tropical and is characterized by nearly constant year round temperatures (26 to 28°C). Evaporation is uniform throughout the year, with an annual average approximating 2100 mm. Mean annual rainfall is 1000 mm in the project area. The maha season (October to February) rainfall is approximately three times the yala season (March to August) rainfall.

Soils in the project area consist of well-drained reddish brown soils (RBE) in the upland and intermediate zones, and poorly drained low humic gley soils (LHG) in the lowland areas.

The Kirindi Oya project is being developed with financial assistance from Asian Development Bank, Kreditanstalt for Weideranfbau (KfW), and the International Fund for Agricultural Development (IFAD). The project envisages augmentation of irrigation water supplies for the existing irrigation systems (Ellegala and Badagiriya) which cover about 4500 ha, provision of irrigation facilities through right bank and left bank main canals from the newly constructed Lunugamvehera reservoir for an additional area of approximately 8400 ha, and settlement of about 8320 families on the newly irrigated lands (see Figure 1.02). Increasing food production and providing employment through settlement of landless people are important national objectives for such projects.

Under phase I of the project, the reservoir at Lunugamvehera was commissioned in early 1986 and new and improved irrigation facilities were provided for 8775 ha of which 4584 ha were already under cultivation. Phase II construction, with Asian Development Bank financial assistance, commenced in 1987 and is intended to develop an additional 4100 ha of new land. The phasing of the project was necessitated by large cost over-runs and time delays, so that the Government had to seek additional assistance from the Asian Development Bank.

The project has been in operation for the past four years. During this period, it has met with a number of problem, many of which relate to faulty planning assumptions, and policy and management problems. The most important planning and macro-level issues relating to water distribution in Kirindi Oya are discussed below.

A REVIEW OF WATER RESOURCES AT KIRINDI OYA BASIN

The water resources potential of the Kirindi Oya basin has been a subject of discussion since the project was initiated. Over the years, there have been

a number of estimates of water potential of the basin and the area that can be irrigated. This section critically reviews the various estimates of water availability and area of irrigation put forward by different agencies in their reports.

-The first Asian Development Bank Appraisal Report

The Asian Development Bank in its 1977 Appraisal Report (ADB 1977), indicated that the average annual rainfall in the basin varies from 2667 mm in the mountains at the upper end of the Kirindi Oya watershed to 865 mm at the river mouth. The catchment area of the river at the dam site, 24 km from the mouth, is 914 sq. km. The estimated run-off coefficient varies from 0.10 to 0.45, as the average rainfall varies from 1270 mm to 2540 mm and the average annual reservoir inflow will be 393 mcm. Similarly, the inflow of the wewas (Tissa, Yoda, Debara, Weerawila and Pannegamuwa) will be 102 mcm and the average annual yield of the reservoir is 375 mcm. (The cropping pattern suggested is 7428 ha of rice during the maha and the yala in lowland areas, and 5506 ha of upland crops (pulses, cotton, cereals) during the wet and dry seasons. The irrigation requirement of rice at the reservoir sluice level is assumed to be 1289 mm for the yala and 1244 mm for the maha; totalling 2533 mm. Similarly, the irrigation requirements during the yala and the maha for other field crops are assumed to be 1137 mm and 432 mm, respectively. The river discharge required to satisfy the above requirement is 382.74 mcm.

The Second Asian Development Bank Appraisal Report

In its 1982 Appraisal Report (ADB 1982), the Asian Development Bank divided the project into two phases. Under phase I, new and improved irrigation facilities were planned for an area of 8775 ha including 4584 ha of land presently irrigated under the old Ellegala and Badagiriya system. Under phase II, 4191 ha will be brought under irrigation, of which 2560 ha is upland, 670 ha is land with intermediate soils, and 961 ha is lowland. In the existing old systems, rice will be raised during both the maha and the yala seasons. The cropping pattern suggested for the new area is 71 percent lowland rice and 29 percent upland rice for the maha and 63 percent lowland rice and 37 percent subsidiary food crops during the yala season. A field efficiency of 90 percent and conveyance efficiency of 80 percent are assumed for rice crops and a field efficiency of 50 percent was assumed for other field crops. The total water release required from the reservoir for the above cropping pattern is 294 mcm.

In its 1986 Appraisal Report (ADB 1986), the Asian Development Bank had indicated that the precise impact of tank construction in the catchment area on the basin's water yield has not yet been quantified, but it has definitely affected the project's water resources. Based on a study of 20 years' inflow data for the reservoir, the average annual inflow is worked out as 319 mcm, with an average maha inflow of 205 mcm and an average yala inflow of 114 mcm. The combined average annual inflow into the old tanks has been estimated at about 102 mcm. The inflow in the Badagiriya Tank is the most significant: 51 mcm in the wet season and 31 mcm in the dry season.

The diversion requirement at the reservoir sluice level is assumed to be: for maha rice 1395 to 1888 mm; for yala rice 2001 to 2319 mm; for upland rice 776 mm and for subsidiary food crops 1121 to 1352 mm.

To assess the adequacy of the water resources, a reservoir operation study was carried out with the reservoir inflows corrected for the irrigation development in the catchment area. Furthermore, return flows from low lands in tracts 1, 2 and 3 on the left bank and tracts 1 and 2 on the right bank were taken into account. The reservoir operation study results show that the storage is insufficient to irrigate the total project area year-round under the envisaged cropping pattern. It is adequate, however, for a 100 percent cropping intensity for the maha season and about 70 percent on an average for the yala season. The average annual project diversion works out to 297 mom.

Water Management Strategy Report

The Water Management Consultants (Water Management Consultants 1987) have introduced the concept of irrigation-secured rainfed farming for intermediate and upland soils. The cropping pattern suggested by the consultants has been to a large degree taken from the one frequently encountered in the project area, namely rice fields in the lowest area and rainfed fruit trees on the higher ridges between the lowlands. Rainfed upland crops and watered vegetables are grown, either inter-cropped with fruit trees or as a uniform field crop mix. On the intermediate lands, farmers grow rainfed commercial crops; rather intensive in maha and less in the yala season.

The Kirindi Oya irrigation system is to be operated mainly for cultivating rice. Other cropping patterns differing in the mix of crops and crop calendars have been studied in view of the anticipated water shortages imposing either:

- restriction of the irrigated area; this measure would safeguard the planned yield per hectare on a reduced area.
- reduced water issues leading to a decrease of the specific yield.

To minimize yield decrease, decisions must be made on **balanced** water allocations during the time of water shortage in order to obtain the best possible results, which in most cases will lead to a combination of the above measures.

On the strength of these considerations and with the objective not to influence adversely the operation of the Ellegala system (whose present irrigation intensity is an average 167 percent), six irrigation regimes have been defined for various degrees of water scarcity in the Lunugamvehera reservoir for the following condition: the irrigated area and the irrigation intensity in the Ellegala system will remain the *same* under any of the six irrigation regimes. Each regime is characterized by the hectareage to be irrigated and by the irrigation intensity. The hectareage of the new area is to be kept constant under the 1st, 2nd and 3rd irrigation regimes. Only the water issues will be gradually decreased. Under the crisis regimes (4th and 5th) the hectareage of the new area is gradually reduced and the irrigation issues remain the same as for the third irrigation regime.

6th regime
not

The consultants have **worked** out the water requirement from the reservoir for six regimes as given below:

Gross requirement mcm	Area cultivated %	Intensity of irrigation %
295	100	100
270	100	82
241	100	62
185	77	62
126	35	62
95	0	0

onsiderable change with
percent to 14 percent,
Also, since the 1940s

ch

Recently the Hydrology Division of the Irrigation Department reexamined the rainfall, stream flow and other hydrometeorological data available at the

downward

Based on the analysis of long term (since 1935) point rainfall at Tanamalwila (Sudupanwela and Ella) the long term annual average rainfall of the basin is estimated as 1596 mm. The maximum average rainfall of 2229 mm recorded occurred in 1944 and the minimum rainfall of 1070 mm in 1970. The temporal distribution of rainfall (Figure 2.1) shows a downward trend of the basin rainfall and this decline was estimated as 4.5 mm per year. It is not clear whether this is an indication of a long term trend or is due to changes in land use pattern coupled with deforestation. As a result of this downward trend, the run-off series could get affected.

A hydrometric station had been in operation at Ellegala from 1944 to 1952 and subsequently the site was shifted to Lunugamvehera dam site, which is about 15 km upstream of the original site. This was maintained until 1979. When the estimated annual basin rainfall was correlated with the annual stream flow, it was found that there was no acceptable correlation between these two events (correlation coefficient 0.60), indicating the presence of outliers or other erroneous observations or both, in the series.

In order to obtain a fresh stream flow series for comparison with the available original series, comparison of observed stream flow data at the new hydrometric station at Tanamalwila during 1986/1987 and 1987/1988 water years with the original historical series was attempted. The new hydrometric station is well equipped with modern instruments and intercepts 735 sq.km (78 percent) of Kirindi Oya catchment. The rating curve recently developed for this site is sufficiently accurate. The following is the summary of observations during these two years.

Water year rainfall	Basin average Tanamalwila (mm)	Run-off at at Tanamalwila. (mm)	Run-off/Rainfall %
1986/1987	952	50 (37 mcm)	5
1987/1988	1624	446 (328 mcm)	27.5

It was found from the original records that water years 1944/1945, 1970/1971 and 1973/1974 had similar rainfall distribution to the 1987/1988 water year. Moreover, the 1987/1988 water year rainfall was 1624 mm, very close to the average. By comparing with the measured run-off in the 1987/1988 water year after making necessary corrections to the annual rainfall, it was found that the estimated run-off in the original data series was 40 to 60 percent higher. Results of this comparison are given in Table 2.01. In this case, the incremental inflow from 169 sq.km from the Tanamalwila gauging site to Lunugamvehera reservoir is computed on the basis of 120,000 m per square km. On this basis the total run-off works out to 347 mcm. This figure compares favorably with the inflow into the Lunugamvehera reservoir of 333 mcm computed from Kittulkote hydrometric station (Water Management Consultants, May 1989: 10). On the other hand, if one uses the area ratio for computation of increased run-off due to additional area of catchment contributing to it, then the total run-off works out to 387.5 mcm. Using both the methods, the percent decrease in discharge has been worked out as shown in the Table 2.01.

Table 2.01. A comparison of recent discharge measurements with original series

Year	Rain fall mm	Discharge mcm	Corrected discharge mcm	Excess as computed by Hydrology Division %	Excess as computed on area ratio %
44/45	1627	494	493	42	27.2
70/71	1696	548	523	50	35
73/74	1640	563	555	59	43.2
87/88	1624	347	347	--	--
			(387.5)*		

*387.5 mcm is the total run-off when area-ratio is used for computation.

The above comparison brings out the fact that the estimated inflow into the reservoir is less (on a conservative side) than previously assumed by anywhere between 30 to 40 percent. Additional data are needed both for rainfall and reservoir inflow to substantiate the above findings. It is suggested that a few more recording rain gauges be installed in the Kirindi Oya watershed and systematic data collection with respect to rainfall, run-off, and water use be initiated. The Hydrology Division has not used the above reduced inflow in their further computations. On the other hand, they have modified the observed historic series by omitting some years of discharge which they consider as outliers. Accordingly, they have come up with an estimate of dependable yield based on a modified annual inflow series which is nearer to normal distribution than the original inflow series as:

50 percent dependable flow	346 mcm
75 percent dependable flow	240 mcm

The above figures suggest that even when the rainfed cropping pattern suggested by the consultants is adopted, the intensity of irrigation with the 75 percent dependable supply arrived at by the Hydrology Division (240 mcm) will be sufficient to irrigate only 62 percent of the design area during the yala season. Once in four years, it will be less than 62 percent. During the last three years, both the old and the new areas in the Kirindi Oya project were raising rice during both the maha and yala seasons and were using an ex-sluice discharge of roughly 2.44 m/ha (8 acre ft/acre) during each season. The present use of water for rice cultivation is high compared to what has been assumed in the Appraisal Reports as well as by the water management consultant for maha seasons. In fact, the present use of water per ha is roughly 50 percent more than the requirement assumed by the Asian Development Bank and the consultants. Though the planning assumptions regarding water requirements for rice are not too far off from reality, the main divergency between the Phase II planning assumptions and the reality today is, apart from the low reservoir inflows, the present rice monocropping system and the increased water allocation to the Ellegala system.

A number of issues arise out of the above discussions.

1. Do we have at the present state of development of the project, adequate information to estimate the reservoir inflow fairly reliably? If not, what measures have been taken or are to be taken to get these data?
2. The present estimation of reservoir inflow seems to be on the high side by 30 to 40 percent. Also, upstream development in the catchment area seems to reduce the reservoir inflow. What will be the effect of this reduced flow on the proposed irrigated area in the project in the next 5 to 10 years?
3. The research conducted so far indicates that many assumptions made in the project proposal such as percolation losses, conveyance efficiency, land soaking and land preparation water use, land preparation period, and cropping pattern do not match with actual observations. The present water use is very much higher than what was assumed in the project design. Under these conditions, would it be possible to realize the project objectives contemplated in the original project proposal, or does this need a course correction at this stage?

4/ ANALYSIS OF CROPPING PATTERN EVOLUTION

The relatively prosperous old Ellegala system (3734 ha) receiving its water supplies through interconnected tank systems diverted from the Ellegala diversion structure of the Kirindi Oya river existed before the construction of the Lunugamvehera reservoir. The farmers of the system grew their own local rice varieties which required about 5 to 6 months during the main maha season. The yala season which was called the "opportunity season" was used **for** raising short duration varieties of rice (5 month duration) when water supply was abundant, or for yala rainfed crops (mung and cucurbits) that could also use the soil moisture retained from the previous maha season. Between 1920 and 1950, the cropping intensity for irrigated rice was around 90 to 100 percent for the maha and 20 to 30 percent for the yala season. Average yields of rice during this period were on the order of 1.8 to 2.2 t/ha, i.e., about half the present yield levels (ADB 1982). It was **only** after the introduction of the new high yielding varieties (3.5 to 4.5 month duration) during the 1950s that intensive irrigation started in this area.

During the maha, the cropping intensity approached 100 percent in the Ellegala system while in the Badagiriya system (850 ha), another old irrigation system in the project area, the cropping intensity was 67 percent, giving an overall cropping intensity of 94 percent for the **maha**. In the yala season, because of water shortages, only 50 percent of the Ellegala area and 16 percent of the Badagiriya tank area were cropped with rice, while of the remaining area, about 2 percent was planted with pulses. The overall cropping intensity in the yala season is estimated at 45 percent, giving a total intensity of 139 percent for the entire existing rice areas. Of the cultivable upland area of 4,927 ha, only 1145 ha (23 percent) was planted with various crops like maize, sorghum and **pulses**. Of the planted area (1145 ha), 945 ha were cultivated with shifting cultivation and the remaining 200 ha was cropped regularly once a year. The

yields of the subsidiary crops were low due to non-availability of irrigation water. The **total** cropped area before the construction of the Kirindi Oya project was **8,038** ha (out of the **9452** ha of the cultivable area) giving an overall cropping intensity of 85 percent.

In the first Appraisal Report (**ADB 1977**), the Bank suggested that under the proposed project, a total of **12,934** ha be brought under irrigated agriculture. This includes the existing old area of **4525** ha. The lowland areas would be planted with rice in both the wet and dry seasons. Subsidiary crops such as pulses **and** cereals would be grown in upland areas in the wet season, while cotton and pulses would be grown in the dry season. The Report estimated a cropping intensity of **189** percent for this cropping pattern based on water availability. A point to be noted is that during both the wet and dry seasons, rice would be grown in the lowland areas.

Subsequently, in its second Appraisal Report (**ADB 1982**), the Bank indicated that double cropping of rice in the maha and yala seasons in the lowlands as originally envisaged **was** reconfirmed to be appropriate for the climatic, topographic and soil conditions of the project area. However, the crops that were envisaged for cultivation in the upland soils were examined in detail with respect to the crop preferences of settler farmers, the experience in the neighboring Walawe Project, the economic returns for the crops, and the crop water requirements in relation to soil characteristics. Rice being the main staple crop in Sri Lanka, it was thought that any cropping pattern proposal which did not include rice would be unacceptable to the farmers and therefore, the Bank introduced upland rice cultivation as part of its revised cropping pattern (**ADB 1982**). It should be mentioned that growing upland rice is new to southern Sri Lanka. Neither the farmers nor the officials have much experience in growing upland rice.

The Bank also argued that cotton, in the absence of suitable varieties, organized pests management and adequate price incentives, would not be a suitable crop for the project. The marketing and pricing systems would also need to be improved. Under these conditions, it **was** considered desirable to omit cotton from the project's cropping pattern. ~~Sugarcane was~~ also considered by the mission as an alternative to cotton. However, in view of the need for a sizeable investment in setting up a sugar factory, this proposal **was** found to be impractical. Based on the above considerations, the following cropping pattern **was** suggested:

	Old system		New area	
	Upland	Interm. soils	Lowland	
maha	100% rice	upland rice	rice	rice
yala	100% rice	OFC [†]	OFC	rice

* OFC is non-rice other field crops.

Again in 1986, the Bank revised its cropping pattern as follows (ADB 1986). The revision was with respect to percent of crops grown and not with respect to the crops.

Old system		New area		
		Upland	Interm. soils	Lowland
maha	100% rice	60% upland rice 20% rice 20% rice	80% rice 20% OFC	100% rice
yala	50% rice 50% OFC	100% OFC	20% rice 80% OFC	50% rice 50% OFC

The water management consultants, based on detailed reservoir simulation and operation studies (Water Management Consultants 1987), state that the cropping pattern suggested by the Asian Development Bank in its 1986 report deals with multiple cropping but is static and not fully adapted to local conditions. **Also**, this cropping pattern results in a lower irrigation intensity, lower guaranteed rate of irrigation demand satisfaction and lower average yields. Further, presently the farmers irrigate only rice during both the maha and yala seasons. The present practice of cultivating rice during both seasons results in a severe water supply crisis in the yala season. This would require a substantial cut in the area irrigated and a decrease of irrigation intensity. The implementation of this plan would lead to under-development of the new area, cause social discrepancies and jeopardize the economic viability of the project. If the aim is to maximize production per unit of land, then the cropping pattern suggested must be dynamic and sufficiently flexible. For maximization of crop production, the cropping pattern must be adapted to the hydrograph of water availability.

Preference should be given to crops with high water utilization efficiency, high yielding varieties, deep rooted crops, and crops with low sensitivity to water stress especially in the yala season. Based on the above considerations, they have suggested the following cropping pattern:

Old system		New area		
		Lowland	Interm. soils	Upland
maha	100% rice	60% rice 40% OFC	20% rice 80% OFC	20% rice 80% OFC
yala	50% rice 50% OFC	50% rice 50% OFC or 67% rice * 33% OFC	100% OFC	100% OFC

* This depends on water availability.

The water management strategy plan proposed above is a mixture of simultaneous cultivation of rice in lowland areas and subsidiary food crops in the intermediate and upland soils in the new area even during the maha. This cropping pattern appeared to result in the best use of water for the available soils and limited water resources. However, the Irrigation Department raised serious objections to this cropping pattern with regard to scheduling of irrigation water at the field channel level due to mixture of rice and other field crops. The Department also argued that farmers on the upland and intermediate soils may strongly object to this cropping pattern by arguing that while the bulk of water is passing through their fields to supply the lowland rice fields, they are forced to grow only other crops. Farmers on the intermediate and upland soils would like to grow their staple food which is rice at least during one season.

Another scenario suggested by the water management consultants is that all the farmers in the new area will irrigate rice during the maha season and subsidiary food crops in the yala season, irrespective of the soil type of their land. Such a cropping pattern would allow phase I and II areas to be cultivated during the maha one year out of five years, with a reduction in the irrigation intensity had to be reduced. In yala season, phase I and II areas could be fully cultivated in 13 years and partly in 10 years out of 32 years of simulation. In 4 years only part of phase I was irrigable and in 5 years no water remained for the new areas at all. The average annual production area would be 18,740 ha on an annual basis, only 1690 ha less than that suggested for rainfed crops with secured irrigation.

Kirindi Oya presents a special problem not faced in most other Sri Lankan irrigation settlement schemes. It is a severely water short system, which has been justified economically from the beginning on the assumption that farmers would grow a lot of non-rice crops. To date, in spite of the recommendations of the Asian Development Bank (ADB 1986) and the Water Management Consultants (May 1989) to grow subsidiary field crops, the Kirindi Oya system continues to be operated as a rice-based system in which only small patches of non-rice crops are grown with special assistance from the Department of Agriculture. One may ask what could be the reasons for such non-compliance. Farmers of the new settlement area argue that rice has a ready market, is less labor intensive, is the staple food in Sri Lanka, can be stored and sold at any time, they know how to cultivate rice, and above all it is risk free compared to other crops. Moreover, they question why they alone should raise other crops even during the maha season, when the old Ellegala system farmers cultivate rice during both the maha and the yala. Thus, we see that there is a continuing "rice bias" or "rice-based thinking" underlying the management of the system. Both farmers and officials share a fundamental and deep rooted bias towards rice. There are strong cultural reasons for this, but this probably has so far prevented farmers and managers from seeing alternatives, such as the one proposed by the water management consultants, as practical, or at least worth a serious test.

Recently a committee consisting of all the line agencies including IIMI was constituted on the recommendation of an Asian Development Bank review mission to prepare an action plan for the introduction of other crops during yala 1990. This committee had decided to grow only two crops, namely greengram and soyabean. The rationale for selecting these two crops is discussed in chapter 6; the planning process is discussed in chapter 7.

The whole exercise of choosing a cropping pattern for the project appears to be based on the availability of water. Annual water availability per hectare is on the order of 2.3 to 2.6 m/ha. Compared to other settlement schemes in Sri Lanka, for example Mahaweli System B with an annual availability of about 3.2 m/ha, this is quite low. Moreover, the present water utilization for rice cultivation in the new area is between 2.0 to 2.6 m/ha which means that with the present water use efficiency, the water in Kirindi Oya project is just sufficient to raise only one rice crop in the whole contemplated project area per year. Under these conditions, the choices left to the planners in increasing the cropping intensity can be listed as follows.

1. One possibility is to go in for rice during the maha and some kind of rotational distribution of water during the yala season in the old Ellegala system and the new area, thereby forcing the farmers to switch over to other field crops or to find additional water through groundwater extraction.
2. The second alternative is to change the cropping pattern between the seasons -- the maha and the yala -- by having rainfed irrigation-secured cropping in the maha. Depending upon the water availability, at the end of maha season, the yala cropping pattern can be decided. In this connection, the following points deserve special consideration. The Kirindi Oya project is a water deficit project, and therefore, the reservoir is likely to be at the minimum drawdown level at the end of the yala season. As such, starting the maha season in time is very much dependent on the inflow into the reservoir. Because of the insufficient reservoir storage, many decisions taken in the cultivation (kanna) meetings are not implementable. During the maha, 75 percent of the annual rainfall occurs in this project area. The effective use of this rainfall is constrained by the water release from the reservoir. If one can go in for rainfed cropping during the maha with supplemental irrigation, then the reservoir water can be saved and effectively used during the yala season. By this change, the uncertainty involved in estimating the reservoir inflow can be minimized to a considerable extent, rainfall can be effectively utilized during the maha, and the planning for the yala can be on a firmer footing since the water availability at the end of maha is known.
3. The third alternative is to go in for rotational irrigation in the new area to cultivate non-rice crops during both yala and maha, irrespective of the soils, and in the old system one rice crop in maha and other crops in yala.

The success of the Kirindi Oya project depends to a considerable extent on switching from rice to non-rice crops throughout the project including the old Ellegala system. This can be achieved at least theoretically through rotational water scheduling. Then, is it practicable and politically feasible? This needs a long range innovative strategic plan with committed officials backed by the Government to implement it. One feasible solution that appears attractive is to set up process industries for those crops to be grown in the project area, develop a sustainable market to make growing other crops attractive, and at the same time make water an expensive rather than free input.

MACRO-PLANNING ISSUES

Planning of Water Issues from the Reservoir

The present practice of deciding the area to be irrigated during a season is based on the following procedure. The storage position of the reservoir at the beginning of the season is looked into. The expected inflow into the reservoir at a certain level of probability is estimated using the inflow-duration curve prepared on the basis of past historical records. The reservoir storage in conjunction with the estimated inflow forms the basis to estimate the area that can be irrigated for the assumed cropping pattern. Generally, the irrigation officials are cautious and conservative in deciding the area to be permitted for irrigation during the season since any extra area thrown open for irrigation at the beginning of the season will become their responsibility for supplying water throughout the season. Therefore, they try to convince the farmers and officials during the pre-kanna (pre-season) and kanna meetings the minimum possible area that can be taken up for irrigation at the beginning of the season. Subsequently, the storage position in the reservoir is reviewed periodically and depending on the strength of storage position, additional area is declared for starting the irrigation in that season.

This sequential decision-making procedure has certain advantages in that the possibility of a crop failure in a tract or region due to lack of water is minimized. On the other hand, a sequential decision-making strategy has a number of disadvantages. Because of the uncertainty and communication problems between the farmers and the agency, the farmers are not ready to receive the water and use it immediately when the water is released. Even if the farmers are ready to use the water, lack of an adequate number of tractors for land preparation appears to be a major reason for a prolonged land preparation period. On an average, a farmer has to wait seven to ten days before he can get hold of a tractor. Puddling and land opening (three runs) cost anywhere between 3000 to 3500 rupees (US 5 83 to 5 97 at the 1989 exchange rate of Rs 36 = \$ 1.00). In view of the limited credit facilities, it becomes difficult for many farmers to generate this capital to pay in cash to tractor owners for using their tractors. All these constraints prolong the cultivation season and sometimes it encroaches into the next season.

The prolonged season has many disadvantages of which the most important ones are: insufficient time for pre-seasonal maintenance, and interference with water distribution operation of the system for the subsequent season, as has been witnessed during yala 1989. This overlapping of two seasons throws out of gear all operational plans for water distribution in the subsequent season. It also spreads pests and diseases from one season to the other and does not allow effective use of maha rains and drainage water from the upper tracts.

The above discussion raises the important question as to whether the present practice of decision-making in a sequential way and increasing the irrigated area in installments during the season is the best way of managing the system. Or should decisions be made at the beginning of the season and unless there is a huge shortfall, should that decision be maintained without adding any additional area during the season? The farmers in this case know at the beginning of the season what to expect for the season. Any additional water

received during the season should be ear-marked for the subsequent season. In other words, a well-defined policy of water release has to be formulated with regard to allocation between the seasons, the time of release, and the pattern of rotation between the tracts in the case of shortfall. This should be done in consultation with the farmers and must be given wide publicity among the farming community.

Water Allocation Among Old and New Irrigation Systems

Many settlement projects in Sri Lanka with old and new areas have had problems of **water** sharing among themselves. The old settlers **who** gain considerable benefits after construction of the project by way of stabilized irrigated agriculture due to a more reliable water supply and increased intensity of irrigation look upon the new settlers as intruders in their domain of influence. The farmers in the old area generally use more than their allotted share of water, complicating and distorting the allocation of water to different areas.

This can be illustrated with data from the Kirindi Oya project, where the Ellegala old system used to irrigate approximately 130 percent of its service area before the construction of Lunugamvehera reservoir. In the project proposal, an irrigation intensity of 160 percent with some non-rice crops for the old system was assumed (without, unfortunately, consulting the farmers); but the farmers in the old system now irrigate two rice crops (nearly 200 percent intensity), thereby depriving the newly developed areas of their share of water. The concept of riparian right is clearly prevalent in the farmers' minds. In addition, the water **supply** pattern to this area does not follow any well defined policy. To prove this point, let us look at the source of water supply to the old system and the water utilization pattern during the three seasons of operation as given in Table 2.02.

Table 2.02. Actual sluice water duty in three seasons
- Kirindi Oya Project

Season	Area	Ext. of cultivation area (ha)	Requirement as estimat. mcm	Release from reservoir mcm	Rainfall mm	Duty m/ha
Maha						
1987/88	Ellegala	3530	40.2	49.4	413	1.40 ^e
	RB ^a	2743	31.7	55.7	413	2.03
	LB ^b	1594	20.2	31.3	413	1.95
Maha						
1988/89	Ellegala	3710	41.7	16.3	-	0.44 ^c
	RE3	2532	33.8	64.3	-	2.54
	LB	1660	21.3	45.7	-	2.75
Yala						
1989	Ellegala	3778	42.5	34.2	-	0.91 ^d
	RB	1912	23.8	51.8	-	2.71
	LB	-	-	-	-	-

a. RB is right bank

b. LB is left bank

c. Ellegala system in addition gets run-off water from wewa catchments.

The old Ellegala system receives its water supplies from four sources: 1) water released from Lunugamvehera reservoir; 2) run-off from its own catchments; 3) substantial drainage water from right bank tract 1 and left bank tracts 1 and 2 of the new areas; and 4) rainfall. Presently, the contribution from rainfall and releases from the Lunugamvehera reservoirs are quantifiable while the contributions from the other two components are not quantified clearly. Unless we know these contributions fairly accurately, the release from the Lunugamvehera reservoir to the old system cannot be made more precise. Also as Table 2.02 indicates, in those years when rainfall is above normal as in the case of maha 1988/1989 and the storage position is comfortable, the withdrawal to the old Ellegala system is minimal (0.44 m/ha). On the other hand, in years of low rainfall and insufficient storage position as in maha 1987/1988, the water use in the old system is considerably higher (1.40 m/ha). This is understandable because during heavy rainfall years, the supply from the tank catchments is considerably more and there is less requirement because of the copious supply from the tanks, rainfall and drainage contributions. On the other hand, during dry years, much of the water from the Lunugamvehera reservoir is diverted to the old system allowing very little water to be used for the new settlement areas. This undefined and unplanned allocation of water between the old and new systems creates a lot of problem from the point of water planning and scheduling from season to season.

Therefore, there is a clear need to initiate a detailed water balance study of the old Ellegala system by monitoring the inflows into the tanks and measuring the drainage water emanating from left bank and right bank tracts 1 and 2 of the new settlement area. The allocation of water to these areas has to be fixed considering available water in the reservoir, their requirement, and additional water that can be obtained from other sources such as rainfall and drainage. Such an allocation policy would allow the Irrigation Department to develop scheduling which can be implemented with farmers' assistance and cooperation. The two water sources which are to be effectively used for the success of the Kirindi Oya project are rainfall and drainage water. The scheduling for the old system must give utmost importance to these two components with particular reference to the time of starting cultivation to capture the maximum of drainage water from the upper tracts.

System Parameters for Operational Efficiency

For preparing the irrigation schedules for maha 1987/1988, maha 1988/1989 and yala 1989, the system parameters used are given in Table 2.03.

Based on the assumed parameters, the estimated water requirement and computed duty are given in Table 2.02. Table 2.02 also gives releases from the reservoir and the corresponding duty. One can see from the table that there is a large difference between the estimated and actual duty indicating that there are certain discrepancies either in the assumed parameters of the system or deficiencies in the management and water use of the system. The difference is as much as 100 percent, indicating that by improved management one can reduce the wastage of water as well as the values of some of the loss parameters. Again Table 1 indicates that the total efficiency of the project during maha 1987/1988 was better than that during maha 1988/1989. This appears to be related

Table 2.03. Parameters used for system irrigation scheduling

Parameter	Old area	New area	Measured values in RB Tract 5, BC2 **
Application Efficiency	80%	70%	
Conveyance Efficiency			
FC	---	93%	
DC	---	93%	71%
P i ,	---	93%	
MC	---	93% (85%)*	
Distribution Efficiency			
Area < 150 ha	80%		
Area > 150 ha	70%		
Percolation loss	3 mm/day	6 mm/day (upland) 3 mm/day (lowland)	10.8mm/day 3.9mm/day

I 85 percent used for right bank tract 5 only

** Measures by IIMI

Source: Water Management Consultants (1987 and 1989).

to the availability of water; the smaller the reservoir storage the better is the use of water resources. Table 2.03 indicates that there exist large differences between the assumed and measured parameters, especially in canal conveyance efficiencies, seepage and percolation (S&P) values, and water used for land preparation.

The values of these parameters are also related to the level of management input and water control adopted in the field. Some of these differences can be minimized by proper management input to the system. For example, consider water conveyance efficiencies: it could be that the channels are not maintained properly; because of the silt and weeds, the conveyance losses are high. By proper maintenance, the losses can be reduced considerably.

The above discussion leads us to conclude that by proper management input and water control, the operational efficiency of the system can be increased considerably. For this a close monitoring of the water distribution system at different subsystem levels is required with proper water measurement. The monitoring of the system would also indicate which one of the parameters is far in excess of the design values and at what places. The reasons for such discrepancies can be investigated and rectified. Presently there is a monitoring cell under the senior irrigation engineer which is not very effective. It is suggested that the monitoring cell should concentrate on getting more reliable data, quick analysis of the data and feedback to the operational division to make use of the information for effective management.

INSTITUTIONS AND MANAGEMENT ISSUES

The Irrigation Department and Irrigation Management Division are the two institutions directly responsible for the operation and maintenance (O&M) of the system. The Irrigation Department is responsible for system O&M to the field channel level. The water-related activities are directly under the charge of a chief resident engineer. A senior irrigation engineer for water management working under the chief resident engineer is responsible for the operation and maintenance of the new areas of the project including allocations between the new and old areas.

Below the field channels, farmers' groups organized by the Irrigation Management Division are supposed to be responsible for O&M. There are two project managers from the Division, one each for the old and new areas. They are responsible for integrating and coordinating various departmental inputs into the agricultural production process, and for organizing farmers into groups and committees at field channel, distributary and project levels to obtain their cooperation.

Presently, the old system and the new settlement areas act as two independent units and there is not much coordination among either the irrigation officials or the farmers of the two areas. They hold separate kanna meetings and make decisions with regard to starting and closing dates of water releases. It is difficult for the irrigation managers to make a unified decision with regard to water sharing, water scheduling and distribution under the existing division of old and new settlement areas. It is suggested by the officials of the Irrigation Department that the old and new settlement areas can be integrated by dividing the total project area into two divisions under the right bank and left bank canal systems. Each of these two divisions will be manned by a project manager who has the task of integrating both the old and new settlement farmers. Also they feel that the water allocation can be rationalized under this division and the cropping calendar can be selected in one kanna meeting to be held for the whole project to maximize the use of rainfall and drainage water from the upper tracts. Conceptually, the above idea appears attractive and technically sound. However, the farmers in the old Ellegala system are socio-politically much stronger and may not easily agree to this idea. Integrating the farming communities living in the old and the new systems is essential for equitable use of reservoir water. How this can be achieved is a subject for further discussion.

In addition to these two agencies, other departments provide supporting services such as agricultural extension and inputs, land administration, banks and crop insurance, and marketing. The present project management structure is not very conducive for achieving long term goals of the project through effective management. Presently, each department has a set of objectives and specified tasks to perform. For example, the Irrigation Department's job is to deliver water, within the constraints imposed by water availability, finances, the physical condition of the system, etc. It responds to farmers' demands to the extent possible, but since both farmers and the Department are accustomed to irrigate rice crops, that is what they do. Other agencies have their own specified technical functions. But no agency is responsible for achieving the long term objectives of the project. There is therefore a de facto policy of

catering to short-term objectives i.e., providing water for rice in a few tracts, on an ad hoc tract-wise rotating basis, depending on the water in the reservoir at any given time, but with old areas always getting sufficient water for growing rice two seasons per year. This satisfies some farmers' short term interests, as they wish to grow rice, and it is easy for the agencies to support their decisions without much exertion since all the line agencies know how to support rice production. New area farmers have not yet organized against the old area farmers, but the latter are organized to demand priority. Further, the various farmers' objectives may be quite at variance with the objectives of the management agencies.

The result is that the system management is unable to get the system as a whole onto a seasonal rotation, i.e., maha-yala-maha. Because rice is raised during both maha and yala, the reservoir gets depleted at the end of the season. For the next season, one has to wait to receive the water in the reservoir and then start with rice in the old area and subsequently add one or two tracts from the new area for rice cultivation. The precedence of short term objectives reduces the likelihood of achieving long term objectives as the farmers get used to a certain pattern.

Since the root of this problem is institutional and managerial, the solution would appear also to lie in this realm. It is necessary to establish an overall project management aimed at achieving the long term objective of making best use of the limited water to maximize farmers' income, with the authority to insure other departments contribute their efforts to achieving this objective. Performance of the overall management would be assessed based on its achievement of the longer term objectives. Assessment of the performance of other departments would be based on their contributions to achieving the overall project objectives. Institutions to facilitate consultation with, and involvement of, legitimate farmer representatives would be a requirement, as would political support from above.

CROP DIVERSIFICATION ISSUES: EXPERIENCE ON OTHER SYSTEMS

An earlier section of this chapter has dwelt on the analysis of the cropping pattern evaluation in the Kirindi Oya Project as proposed in the successive Appraisal Reports of the Asian Development Bank, as well as the Water Management Consultants' report of 1987. Despite the detailed operational plan outlined in the latter report, the project management has not been able to accomplish any measure of crop diversification in the 1988 and 1989 dry seasons. Several factors have been responsible for the management's inability to pilot test crop diversification even within a single tract with a view to getting an understanding of the operational modes for irrigation management for non-rice crops. This section discusses some of the technical issues, drawing on IIMI's analysis of experience in other systems in Sri Lanka. The economic issues related to cropping patterns are elaborated in chapter 6; the planning experience for yala 1990 is discussed in chapter 7.

It would be unrealistic to have expected any major shift to growing of non-rice crops in any of the past yala seasons without having tested the proposed cropping patterns within a single tract or some selected distributary command

areas. Experience in Mahaweli System H over a period of ten years commencing in 1978 shows that a slow start in the first year (70 ha of non-rice crops) was followed by a rapid increase from the third year to 1,100 ha, until it reached a peak of 8,600 ha of non-rice crops in the eighth year. A similar sequential increase over a period of years could be postulated for the Kirindi Oya project, except of course with the added problem of more unstable and lower annual water availability per hectare. This would, of necessity, impose a greater strain on planning and management of water deliveries for non-rice crops in the Kirindi Oya system as compared with the Mahaweli System H, and would eventually result in a different growth pattern over a similar span of years.

Despite the very limited accomplishments recorded over the last two yala seasons in respect of crop diversification, a more significant achievement has been the clear demonstration of the potential for growing of non-rice crops during the wet maha season on the well drained soils in farmers' allotments in this southern dry zone environment which receives a lower maha season rainfall than the North Central Province (NCP). This confirms the validity of the recommendations of cropping patterns made in the above mentioned reports in respect of non-rice crops for the upland or well drained soils under irrigation command during the maha season.

The first meaningful step taken towards promoting the growing of non-rice crops in the yala season has been the preparation of the action plan for growing of non-rice crops in yala 1990 by a working group drawn from the respective line agencies presently working in the project, and chaired by the project manager (settlement) of the Land Commissioner's Department. The first draft of the action plan report was discussed on 7 December 1989 in the office of the chief resident engineer, at which a substantial input was made by IIMI drawing on its experience and understandings gathered since yala 1985 from studies on irrigation management for crop diversification conducted in Mahaweli System H and Dewahuwa systems located in the NCP (Panabokke 1989) (see chapter 7).

Arising from the deliberations at this meeting and based on IIMI's own experience and understandings developed at Kirindi Oya over the last 2.5 years, the more important issues concerning crop diversification in this environment can be considered under the three headings of: 1) cropping patterns; 2) cropping calendar and irrigation scheduling; and 3) organization and farmer participation.

CROPPING PATTERNS

Yala - Dry Season

In view of the very tight water situation that will be faced in almost every yala season in the future, the shortest possible planting-to-harvest duration commensurate with economic yield should be the primary aim in selection of crops. Farmers familiarity with growing of such crops even under rainfed conditions should be a further selection criterion.

In the broad group of grain legumes, the Department of Agriculture has been successful in developing short duration (65-70 day) varieties of greengram. In respect of cowpea, soyabean and blackgram, the well known popular varieties fall

within a 90 day duration. Almost all farmers in this region are familiar with the cultivation of greengram, cowpea and blackgram mainly under rainfed conditions in maha, while some are familiar with the cultivation of greengram and cowpea under irrigation in yala. There is substantial research information in respect of the frequency and amounts of irrigation for this group of crops. Irrigation intervals can be extended to once in ten days for these crops without seriously depressing yields especially when irrigation water at source become scarce. Irrigation scheduling and delivery is the same for all these crops, and this should be considered a special advantage in systems management. There will also be a ready market for greengram as indicated by Department of Agriculture, and a potential market for soyabean. Cowpea and blackgram will be largely for consumption with limited amounts entering the market.

On the foregoing considerations, the main thrust for non-rice crops during yala should be grain legumes, particularly greengram and cowpea.

The research station at Weerawila should develop the technology for growing a gingelly (sesame) crop in yala by making use of the late March - early April rains for seeding and subsequently a minimum number of irrigations. Gingelly is normally grown as a rainfed crop in the maha season in this region and its sowing-to-harvest duration is around 70 days. It needs a well drained, well aerated seed bed for proper germination and crop establishment, and it is more fastidious in this regard than the grain legumes. It is reported however, that it could manage with two to three irrigations after initial establishment. Since there is a good market for this crop, and because of its short duration it should receive more research attention for being grown as an irrigated yala crop.

While the foregoing crops are best adapted to well drained and imperfectly drained soil conditions, the issue of what crops can be recommended for the poorly drained LHG soils during yala has to be decisively addressed. This has to be viewed together with the nature of the irrigation delivery schedules that will be operative, and will therefore be disussed in the subsequent section.

Cultivation of chillie is not recommended for the present because the presently available varieties are of 120-140 days duration. In respect of tree crops such as mango, citrus and papaw it will be wise to confine these to well drained or imperfectly drained sites that benefit from seepage from irrigation channels, rather than to grow them on land developed for rice cultivation.

Maha - Wet Season

In the light of the last two years experience it is almost self evident that any approach to crop diversification should take into consideration opportunities that are available during the maha season, and that are also linked with the subsequent yala season. There is no rationale for considering crop diversification as a solely yala enterprise as in the case of the NCP, both on account of the less wet maha environment in the south and also the very restricted annual water availability of 2.3 to 2.6 m/ha in Kirindi Oya, compared with 3.2 m/ha for Mahaweli System H.

As mentioned earlier, one of the significant achievements has been the demonstration plots of non-rice crops, especially chillie on parts of farmers'

allotments in maha 1988/1989 conducted under the guidance of the Department of Agriculture extension staff. There is clearly a limit to the extent of chillie that could be grown to match with the available market. Furthermore most of the coarse grain and grain legume crops are grown as rainfed crops under upland non-irrigated conditions in the maha season throughout the dry zone. Crops that respond to irrigation application during the maha season will therefore have to be considered. The ideal fit will be crops that complete their vegetative phase by late December, and then have their reproductive phase from January to early March which coincides with a period of maximum solar radiation. The former 5 to 5.5 month cotton variety HC 101 would be an excellent choice in this regard. It should be one of the added tasks of the Weerawila research station to test the appropriate maha season supplemental irrigated crops that give a high return per depth of irrigation application discounting rainfall contribution.

CROPPING CALENDAR AND IRRIGATION SCHEDULING

Selection of optimum dates for land preparation and for sowing or crop establishment, and appropriate scheduling of deliveries for subsequent crop growth with a view to maximizing the use of rainfall and limited irrigation supplies is of crucial importance for the Kirindi Oya system.

Equally important is the issue of appropriate delivery schedules at the heads of distributary and field channel turnouts that would enable a proper allocation of water to both well drained and poorly drained soils which support different kinds of crops with different water requirements; as for example non-rice crops on the well drained soils and rice on the poorly drained soils. Experience gained in Mahaweli System H and Dewahuwa provides us some important guidelines to resolve this hitherto intractable problem which operating engineering staff usually shy away from.

Yala - Dry Season

The optimum time for commencing land preparation for yala crops is between the fourth week of March and the first week of April when there is a high reliability of the afternoon convectional rains. For this to be possible the preceding maha crop should be harvested by the third week of March. When the onset of land preparation for maha is delayed beyond mid-October, the maha harvest gets extended beyond mid-March of the following year and this causes severe problems for timely commencement of yala crops. The 75 percent rainfall expectancy for April is a little over 55 mm, and this has to be captured for timely land preparation and crop establishment.

The foregoing points to the need for pursuing a policy of growing non-rice crops in maha beginning with the October rains and providing supplementary irrigation for such crops between October and January. Rice should therefore be restricted to the lowland LHG soils and that too only if adequate water supply is available at the source. This could be on the basis of selected tracts or distributary command area within a tract.

A practice that should be fostered at Kirindi Oya for yala as developed by farmers at Dewahuwa is to spread the rice straw on the field soon after the

maha harvest in late March and burn it in-situ in the field. This enables a weed-free field which could be prepared with subsequent minimum hoeing into which grain legume seed could be dibbled in rows with the initial yala rains. For farmers who wish to till the land with a rotavator in order to prepare a better seed bed, they could avail of both rain and an irrigation issue of 70 mm for land moistening.

Again, based on our experience at Dewahuwa, irrigation deliveries for yala should commence in the first week of April. Two to three deliveries of 70 mm each at the field channel turnout within a period of 14 days is adequate to prepare the seed bed and drill the grain legume crops before the Sinhala New Year which falls in mid-April. In the case of Dewahuwa, land preparation and seeding for non-rice crops was completed in 8 days using 174 mm of delivery in yala 1985; in 15 days using 121 mm of delivery in yala 1986; and in 12 days using 172 mm of rainfall only and no delivery in yala 1987.

Daily evaporation rates increase markedly from June onwards. In order to conserve and maximize use of the limited water resource at some, crop duration in the field should be terminated as early as possible. Crop growth period commencing early April should therefore be limited as far as possible to around 80 days. Irrigation deliveries at seven day intervals with a 70 mm delivery ex-field channel turnout for each delivery is considered adequate for grain legumes.

Maha - Wet Season

Past studies on rainfall confidence limits have shown that the optimum time for sowing of rainfed upland crops in this environment is around the second to third week of October. This is also the traditional practice in the chenas in this region. However, the same land preparation methods practiced for chena crops cannot be implemented on land that is developed for puddled rice cultivation. In order to induce sufficient friability to the upland soil so that it could be easily tilled by conventional tillage implements, the soil has to be moistened to a moisture status close to field capacity. To achieve this around 40 mm of rain is needed to bring the upper 15 cm depth of soil to the moisture status of field capacity. The expectancy of receiving this amount of rain during the month of October is above 75 percent. Land preparation for seeding can therefore be completed by end of October in most years and sowing completed by the first week of November. Among the crops that are known to respond significantly to supplementary irrigation during the maha season in this environment are chillie, cotton, maize, and soyabean.

In the case of rice on lowland LHG soils, commencement of land preparation will mainly depend on the inflow to the reservoir and the minimum reservoir level that has to be reached before commencement of water issues.

Scheduling Deliveries to Turnouts Commanding both Upland and Lowland Soil

Both distributary and turnout command areas consist of well drained RBE soils on the upland and poorly drained LHG soils in the lowland, with intervening imperfectly drained RBE soils located in the mid-slopes. This is similar to conditions in Mahaweli System H. In situations where non-rice crops are grown

on the upland soils and rice is grown on the lowland soils, management problems are encountered in trying to achieve an equitable delivery to the two contrasting cropping systems. In Mahaweli System H the problem is overcome by permitting farmers located on the upland soils and **who** are growing non-rice crops, to use the 1 cusec (28.3 liters per second) discharge in the field channel during the day time for a 6 hour period each, and to permit farms located in the lowland soils to share the 1 cusec flow during the night under an informal arrangement of taking turns.

Since there is no night storage capacity in the irrigation system, and since it will also be impracticable to open and shut turnout gates each morning and evening, the foregoing management method is the most feasible option. This method however, requires a high degree of cooperation among farmers and good communication between agency staff who manage the turnout gates and the farmers who use the water.

It will have to be clearly understood by farmers who grow rice on the lowland that they will receive the same rotational schedule as the upland farmers and not a continuous supply for the duration of the rotation.

In the long term there should be a shift towards using the LHG lowland soils for non-rice crops during the dry yala season. The experience both in System H and Dewahuwa has been that farmers who are located at the tail-end of very long field channels on LHG soils have been able to grow non-rice crops by providing minimal on-farm drainage. It is observed that soyabean is more tolerant to imperfect drainage conditions than most other non-rice crops, and would therefore be the logical choice for lowland soils in yala. This would, however, require a high degree of control and regulation of the field channel water deliveries in a manner that would minimize the build up of a high water table in the lowland area.

ORGANIZATION AND FARMER PARTICIPATION

The Kirindi Oya project is essentially a very new system in which the organizational structure is in its early stages of evolution and where farmers themselves are in the initial **stages** of settling down to a new form of irrigated agriculture apart from puddled rice cultivation and rainfed chena cultivation which they were accustomed to prior to their settlement in this project. Commencing 1986 late yala, there have been only two seasons when all the three tracts on the right bank and the two tracts on the left bank have been able to successfully raise a crop of puddled rice. The experience up to now has therefore been oriented towards managing a rice irrigation system. Similarly farmer participation modes have also been largely conditioned to growing rice.

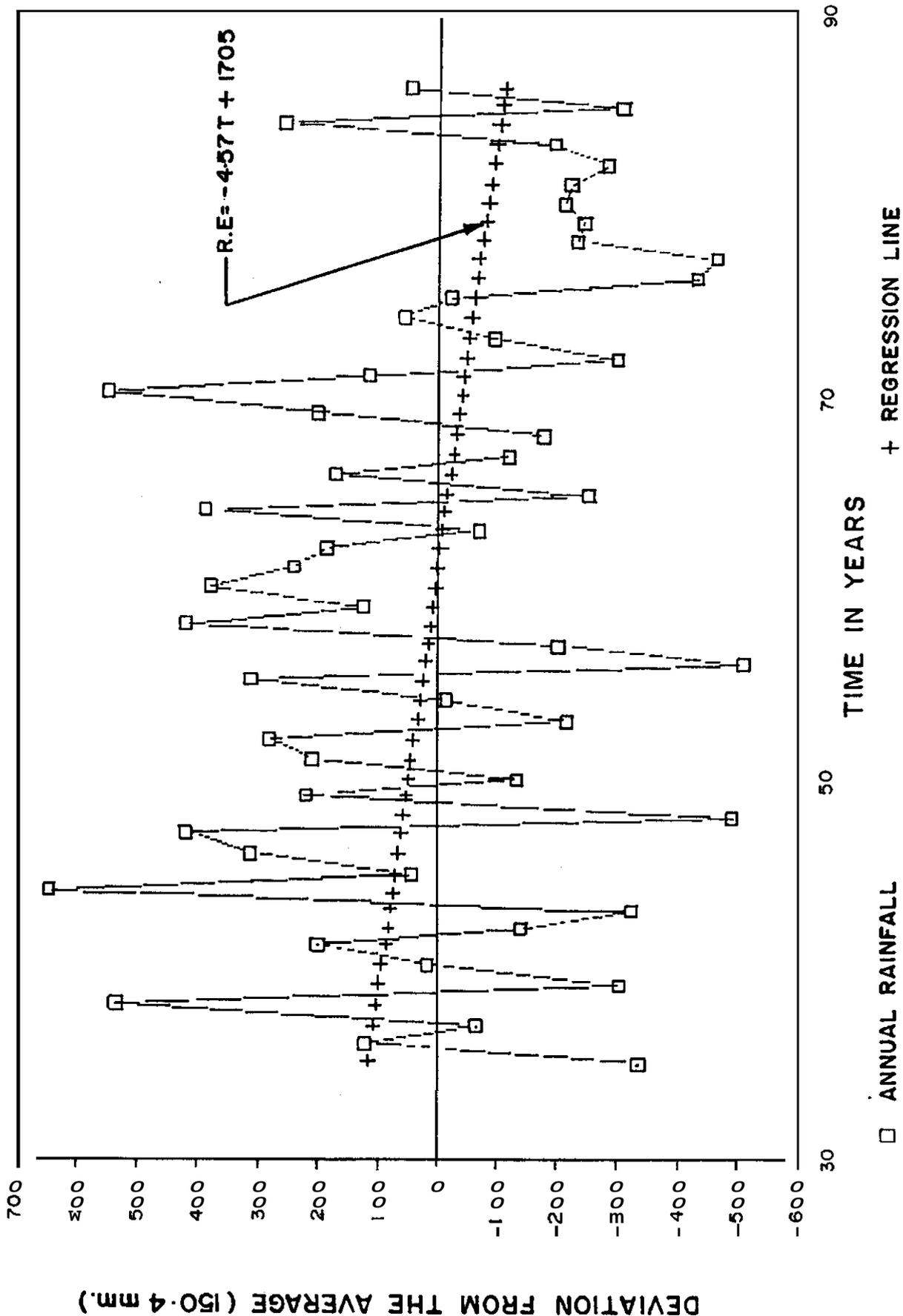
In the light of the foregoing situation it would be unrealistic to expect a major shift in growing of non-rice crops to take place over a short period. At the same time, it is opportune at this stage to set in motion the formation of the institutions and organizational forms that are necessary for farmer - agency cooperation in managing the system for irrigation scheduling and delivery for growing of non-rice crops as in contrast to rice.

IMI's studies both in Dewahuwa and Mahaweli System H have clearly borne out the fact that in the scheduling and timing of irrigation deliveries below **the** distributary level there is a big gap between the planned quantity and timing of deliveries and their actual implementation. It is also observed that much of the overrun occurs at the land preparation phase (see chapter 5, below). In the water tight situation encountered in Kirindi Oya the management agency will have to endeavour to minimize this gap as far as possible. This would imply the need for considerable organizational strength and a competent monitoring service which monitors deliveries in a systematic manner and feeds back the information rapidly to **the** agency water management staff.

As mentioned earlier, scheduling deliveries to turnouts commanding both upland and lowland soils requires a high degree of cooperation among farmers and an effective communication between agency staff and farmers. IMI's field research in the NCP had identified that the unreliability and inequity recorded at the turnout level is closely linked to the lack of organization and management for sharing water below the secondary level, and also the poor communication between agency staff and farmers in scheduling of water deliveries. These conditions also characterize Kirindi Oya. It is therefore necessary to develop the organization needed for crop diversification from the initial stages, and also to build into it the appropriate management and communication approaches that are required for proper implementation of water deliveries at the turnout level. This problem is discussed further in chapters 3 and 4.

Given the complex nature of the kind of organization that will be needed to **support** crop diversification and also the important role that will have to be played by farmer participation, the more prudent approach would be to conduct a well planned and properly organized crop diversification activity in a single tract, or else, in a single distributary in each of two or three tracts in the initial phase. This could be treated as a learning process, and could be followed by a gradually expanded program in each subsequent season.

Figure 2.01. VARIATION OF ANNUAL RAINFALL
KIRINDI OYA BASIN FROM 1935 — 1986



CHAPTER III

IRRIGATION INSTITUTIONS IN KIRINDI OYA

INTRODUCTION

Objectives and Research Questions

As outlined in the Inception Report (IIMI 1988a:17), this component of the research has two broad objectives:

- * to document and assess the present functioning, strengths, areas needing further strengthening, and impediments to improvement in the irrigation institutions at the project and farmers' level; and
- * to propose structural and management innovations that could be adopted in the short run to improve the project performance, and others that could be tested and adapted over a longer period that would strengthen efforts to achieve the project goals.

With these two broad objectives in mind the research on irrigation institutions was guided by the seven research questions listed in the Inception Report (IIMI 1988a:17-18). We attempt to answer these questions based on our findings on three cultivation seasons (1988 late maha, 1988/1989 maha and 1989 yala) and developments at the beginning of the 1989/1990 maha season. Further developments during maha 1989/1990 are described in chapter 7. The seven research questions are summarized here for easy reference.

1. What is the overall organizational structure of the agencies involved in irrigation management at the project/system level, and how has it evolved? Are there structural factors inhibiting management efficiency? How does the organizational structure affect the incentives for various agency personnel to provide efficient irrigation service and for farmers to cooperate in O & M on the system?
2. What are the formal and informal processes of decision-making and information flow both up and down and laterally, and of performance monitoring and evaluation of personnel? How effective are these processes, and where could improvements be proposed?
3. What are the patterns of communication, cooperation, collaboration, and conflict (if any) among the different agencies for setting and achieving project goals? Is this an area where further improvements could be suggested?
4. What efforts are currently underway to establish water users' groups at the field channel, and above? What methods are being used for organizing them, and how effective are they? What are the task expectations of both the agency officials and the farmers in regard to the farmers' groups? Is the level of resources invested in this area adequate to achieve the objectives? What could be done to further strengthen the groups? What tasks and functions do they perform now, and what others could be contemplated?

5. What are the patterns of communication, cooperation, and collaboration between the key irrigation management agencies and the farmers' groups? Are the agencies effective in encouraging self-reliant, effective farmers' organizations, and if they are not, what are the reasons for this? What could be done to further strengthen the cooperation between farmers and the management agencies?
6. Are the present patterns of cooperation among farmers, or the potential for cooperation with no outside assistance, consistent with the technical requirements and technically feasible options for efficient water distribution of the present turnout/field channel design? What level of effort would be required to match cooperative behavior with the technical design?
7. What are the relationships between the institutional factors addressed in this module, and the performance of the system as documented in the module on irrigation system performance? To what extent, if at all, can shortfalls in system performance be attributed to institutional factors? To what extent can irrigation system performance be improved through organizational and management innovations?

Methodology and Definitions

"Institutions" are defined by social scientists as "complexes of **norms** and behaviors that persist over time by serving collectively valued purposes." They persist because they are valued as well as useful. "Organizations" are "structures of recognized and accepted roles." Organizations, thus, may be institutions, or not, depending on whether they have continuity because they are valued and useful .

The term "irrigation institutions" is defined here as those institutions directly related to the operation and management of the water conveyance, i.e., irrigation, system. For the Kirindi Oya Irrigation and Settlement Project, the Department of Irrigation and the Irrigation Management Division, the two agencies directly involved in the operation and maintenance of the irrigation system, are the major "irrigation institutions." This definition thus excludes such agencies as the Land Commissioner's Department, Agriculture Department, **and** Department of Agrarian Services. However, since these departments are functionally important to the management system (INMAS) introduced in Kirindi Oya, their roles and functions are briefly discussed when necessary.

As indicated in the Inception Report (IIMI 1988a:19), the data on irrigation institutions has been collected using a combination of participant observation and formal and informal interviews, as well as analysis of documents and files. Participant observation involves attending meetings and other events and observing behavior. Interviews have been carried out with a wide variety of people, including officials at various levels, farmer leaders, and ordinary farmers. These methods result in qualitative data on processes of decision-

1. See Uphoff (1988:chapter 1) and our Interim Report (IIMI 1989a) for a more complete explanation of these terms and their uses.

making, on behavior patterns, and on peoples' explanations and rationalizations for what they do or see others do.

Ideally, these data should be supplemented with quantitative data based on sample surveys to get a more precise picture **of** the distribution of variation. Unfortunately, for most of the period of study the security and political situation was extremely disturbed. At times it seemed unwise even to try to carry out sample survey interviews. At other times, we discovered that farmers and others were reluctant to respond in ways that would have provided reliable data. Given the extreme situation faced by farmers and officials, it is to their credit that they were able to assist and cooperate with the research at all.

We cannot offer precise data on the extent of variation, and cannot offer quantitative data to substantiate the observations. Nevertheless, we are confident that the observations and generalizations provided in this section, and the conclusions and recommendations derived from them, are valid and reflect social reality in the Kirindi Oya Project.

IRRIGATION ORGANIZATIONS AND THE **COMMITTEE SYSTEM**

The main organizations involved in the project are the Land Commissioner's Department, Irrigation Department, and the Irrigation Management Division, all within the Ministry of Lands, Irrigation, and Mahaweli Development; and the Departments of Agriculture and Agrarian Services, under the Ministry of Agriculture, Food and Cooperatives. A number of other departments and semi-government agencies, such as the banks and the Crop Insurance Board, are also involved in the project activities.

The Land Commissioner's Department, Irrigation Department, and Irrigation Management Division are headed at the project level by no less than four "project managers." These are the project manager (land and settlement), the project manager (irrigation) or chief resident engineer of the Irrigation Department, and the two project managers from the Irrigation Management Division, respectively. One Irrigation Management Division project manager is in charge of the new area while the other is in charge of the Ellegala and Badagiriya old systems.

The Department of Agriculture functions in the project under an agricultural officer who has responsibilities toward both the new and old systems as well as to areas beyond the project boundaries. He is under the assistant director (extension) for Hambantota District. The activities of the Agrarian Services Department are handled by an assistant commissioner for Hambantota District.

We see, thus, a rather large proliferation of departments, and a rather surprising number of positions called "project manager." As will become clear, this proliferation reflects a serious fragmentation and dilution of authority, limiting the ability of project management to make coherent plans and implement plans effectively. The project management structure has evolved rapidly over time. See Merrey and Somaratne (1989) for a detailed description as of 1981, and Stanbury (1989) and IIMI (1988b) for more recent developments.

The Project Officers and their Responsibilities

The project manager (settlement). The project manager (settlement) is responsible for the custody, alienation and settlement of state lands, providing infrastructure and associated facilities to settlers, and administration of the aid under the World Food Program. He is assisted by an assistant project manager. His field staff includes colonization officers and field instructors to handle settlement activities. Colonization officers have been appointed on the basis of one for each tract while field instructors are deployed on the basis of one for each hamlet in the new system. The project manager (settlement) has a separate construction cadre engaged in development of non-irrigation infrastructure.

The project manager (settlement) also has responsibilities for coordination of project activities on behalf of the Government Agent. Since the project has been implemented in two phases, he needs to play an important role until the completion of phase II activities. His involvement in the completed phase I area continues because the land administration in the phase I area has not yet been handed over to the Government Agent.

The project manager (irrigation)/chief resident engineer. The chief resident engineer was initially responsible for the implementation of irrigation construction work under the project. However, when the irrigation system in phase I area began functioning, he became responsible for both operation and maintenance activities in phase I and the construction work in phase II. Until very recently he employed his construction cadre for both operation and maintenance (O&M) activities as well as construction work. We analyze the O&M organization below. His construction cadre includes four resident engineers in charge of right bank, left bank, headworks, and a number of design engineers attached to his office, as well as irrigation engineers, technical assistants, work supervisors, and skilled and unskilled laborers.

The project managers (Irrigation Management Division). Two project managers under the Integrated Management of Major Irrigation Schemes (INMAS) program were appointed in 1986, just before the first water issues for the new area of the project. Their main functions are development of linkages for coordination among the various agencies involved in agricultural planning and implementation, and promotion of farmer participation in both the decision-making on agricultural planning and the operation and maintenance of the irrigation system.

The two project managers have established their project offices and necessary committee systems for coordination based on a division between the "new" and the "old" areas of the project. We paid primary attention to the organizational activities in the new area of the project (right and left bank canal systems). The organizational structure of the Irrigation Management Division in the new area is described in detail below.

Officers of the Department of Agriculture. Hambantota District has been divided into three segments for administrative and other functional purposes of the Department of Agriculture. The project comes under the agriculture officer in charge of segment III. These segments are further divided into agrarian

services divisions² under the charge of agricultural instructors. There are five agrarian services divisions, four of which fall within the project area, Weerawila, Pallemalala (Badagiriya), Yodawewa, and Meegahajadura. The first four cover the new and old areas of the project. The agricultural officer with the assistance of agricultural instructors is responsible for agricultural extension work in the project. The agricultural instructors are normally assisted by Krusha Viyapathi Sevakas (KVS), the grass roots level extension officers until early 1989. They have now been absorbed to the Poverty Alleviation Program as grama sevakas (local level officers) and receive instructions from the assistant government agent.

Officers of the Department of Agrarian Services. The Agrarian Services Department in the project area functions under an assistant commissioner for Hambantota District. There are four divisional officers assigned to the four agrarian service centers in the project to assist the assistant commissioner in his functions. The field level officers are cultivation officers, who are supposed to provide a wide variety of services to farmers in the established irrigation systems. However, they too have been absorbed into the Poverty Alleviation Program as grama sevakas. The major functions of the Agrarian Services Department is settlement of disputes between landlords and tenants, maintenance of land holders registers, collection of acre levy from farmers, issue of identity cards to farmers, estimation of damage to crops by stray cattle and settlement of disputes among farmers on such damages, taking legal action against those who do not clean and maintain their field channels, and supply of inputs such as weedicide, pesticide and fertilizer.

THE IRRIGATION DEPARTMENT

The O&M Organization

As discussed in previous reports (IIMI 1988b; 1989a; 1989b), the O&M organization of the Irrigation Department has evolved through several development stages. Initially, the O&M activities in the phase I area of the project were handled by the left and right bank resident engineers, from the yala 1986 season to the end of maha 1986/1987. The resident engineers simultaneously *managed* some construction work in the phase I area and other construction-related activities in phase II. With the assistance of an irrigation engineer in charge of construction, the resident engineers prepared water issue schedules and were in charge of operation. The field level operational activities were handled by technical assistants who also supervised construction work, and they were assisted by work supervisors and irrigation laborers. The resident engineers had the authority to instruct the resident engineer (headworks) for the operation of main sluices and were responsible for distribution and monitoring of water down to the field channel turnouts.

². At this level, the divisional boundaries of the Departments of Agrarian Services and Agriculture are the same and the officers are together in the Agrarian Services Centres.

There was a severe drought in the 1986/1987 maha, which was the first season for many farmers in the new system. More than 60 percent of the cultivation in the new area failed due to the drought and created serious problems for the settlers in the new area. The settlers blamed the Irrigation Department, and accused it of advocating cultivation in the entire command area with a very low reservoir (Merrey and Somaratne 1989).

The second stage of development was introduced in maha 1987/1988 with the appointment of a senior irrigation engineer in the office of the chief resident engineer to prepare water issue schedules. He was also given authority to control the issues from the main sluices. The resident engineers now had to contact the senior irrigation engineer whenever they wanted to increase the discharges in the main canals, as their previous authority to instruct the resident engineer (headworks) for such purposes had been withdrawn.

However, the resident engineers remained responsible for the operation and maintenance of the system below the main sluices, and monitoring of discharges. They appointed irrigation engineers (O&M) with some subordinate staff to attend to these duties while also attending to construction work in the area as well. The technical assistants and work supervisors were appointed on the basis of one for each tract, with seven to eight irrigation laborers to assist them. The senior irrigation engineer was given formal authority to give instructions to the resident engineers on operational matters towards the end of the season.

As described below in chapter 5, our observations on the irrigation water delivery performance in the 1987/1988 maha season revealed:

- * inequity of irrigation supply to the field channels under DC2 (FCs 9 to 15) in the sample area and to DCs 8, 2 and 5 located in the BC2 in tract 5;
- * oversupply of water to the sample area during the season; and
- * failure to implement rotational water issues after land preparation.

The first two problems are clearly associated with the ineffectiveness of the O&M organization, as further discussed below. The third problem relates more to the weakness of farmers' organizations, and other community-level problems.

Problems Associated with the O&M Organization

Our observation on the problems with the O&M organization, as discussed in the Progress Report (IIMI 1988b:71-72), revealed the following:

- * The priority given to construction over O&M by the resident engineers and irrigation engineers in charge of operation. This is mainly due to the fact that Irrigation Department evaluations are based primarily on the achievement of construction targets, as well as a natural tendency of civil engineers to prefer construction work. Solid skills and experience in construction is an essential requirement for fresh graduate engineers to get their professional qualifications and become chartered civil engineers. Young engineers thus naturally favor construction over O&M to achieve their professional qualifications as early as possible, as this will affect their seniority and increments in the Department.

- * Lack of incentives for the O&M staff, and the non-existence of clear indicators to measure their performance.
- * Division of authority over the operation of the system among resident engineers and the senior irrigation engineer.
- * Lack of understanding and awareness of the role assigned to the senior irrigation engineer by some officers engaged in O&M.
- * Inadequate communication system for irrigation system operation by the senior irrigation engineer via the resident engineer (headworks) and resident engineers for the left and right banks.
- * Lack of communication among the technical assistants in charge of operational activities in different tracts (upstream and downstream) of the system.
- * Non-existence of a communication feedback system from the field to the resident engineers, other than requests by farmer representatives for increasing the discharges at times of shortage. This is mainly because the channeling of information from the irrigators (lowest level Department employees) to the technical assistants and irrigation engineers via work supervisors does not occur.
- * System operation remained entirely in the hands of unskilled-f laborers temporarily hired for this purpose; there was no guidance or supervision by senior field-level staff.
- * Irregular field visits by engineers, technical assistants, and work supervisors in charge of system operation.
- * Lack of a proper system for monitoring discharges.

These research findings demonstrated that institutional factors were affecting irrigation system performance. Therefore, attempts were made by the chief resident engineer on instructions from the Director of Irrigation to reorganize the O&M organization, effective from January 1989. The proposed reorganization included the following features, as reported in the Interim Report (IIMI 1989a:31).

1. Establishment of a separate O&M organization under the senior irrigation engineer, who has been delegated complete responsibility over O&M matters, including administrative and financial control. He reports to the chief resident engineer, whom he is to keep informed on his work.
2. Appointment of an irrigation engineer (O&M) for each of the two new sub-systems (left bank and right bank). The O&M engineer receives his instructions directly from the senior irrigation engineer for O&M work, and exercises financial and other authority for all O&M matters in his respective area.

3. Appointment of one technical assistant and one work supervisor for each tract to be responsible for supervising the O&M work under the supervision of the O&M engineer. Turnout attendants (irrigators) have also been appointed on the basis of one for approximately 200 ha, to be supervised by the work supervisors.
4. Allocation of specific vehicles, machinery, and other equipment to the O&M section.

The O&M engineers were to continue to work out of the resident engineers' offices, and to remain under the resident engineers for certain administrative purposes. They were required to keep the resident engineers informed of their work. However, the proposed reorganization did not come into effect as expected and there were conflicts and contradictions over the question of the financial autonomy of the O&M section. At one instance the senior irrigation engineer and one resident engineer came into conflict over assigning **some** residual construction work in phase I by the resident engineer to technical assistants for O&M on the system. The senior irrigation engineer viewed this as an attempt by the resident engineer to divert them from O&M work. The resident engineer, on the other hand, explained that his intention in assigning the improvement work in the phase I area to the O&M technical assistants was to insure the work is completed satisfactorily as they are the people who know the problems and their implications as system operators.

These conflicts and contradictions manifested in themselves a kind of underground, i.e., unstated, resistance to change of the dominant construction-oriented Irrigation Department structure at the project level. Finally the O&M section was not given financial autonomy on the understanding that the delegation of financial autonomy for certification of payments to more than one officer assigned to the same office is contrary to the rules and financial regulations. As a result, the senior irrigation engineer had neither financial control over O&M funds nor administrative control over the O&M engineers operating from the resident engineers' offices. However, the senior irrigation engineer could issue direct instructions to the O&M engineers and their staff regarding the operation of the system.

The new O&M organization, with these changes, started functioning in yala 1989. Though the organization was not fully autonomous, and its operational activities were interrupted by the unsettled political and social disturbances, it showed some definite improvements in its performance (IIMI 1989b). The following observations on water delivery performance substantiate the improvements.

- * The overall water supply from the system to the farmers during the season was not adequate. This was because the Irrigation Department attempted to save water towards the end of the season as the water level in the reservoir was very low. However, farmers managed to obtain adequate water because of rains and re-use of drainage water by some tail-end allotments.
- * There was no serious inequity in water deliveries in the sample area except for FCs 10 and 13. The problems on FC13 at the tail are related to upstream farmers' interventions at field channel turnouts.

However, the rotations again could not be initiated in time, and therefore could not be implemented, because of delays in land preparation by farmers, farmers' interventions at field channel offtakes, and disturbances in the area. But the Irrigation Department did attempt to communicate with farmer representatives by holding meetings with them to make them realize the impact of water scarcity and the necessity of finding ways to manage with the available water supply.

These slight improvements, however, cannot be explained solely in terms of the organizational changes. In the right bank system where we conducted our research, the resident engineer and O&M engineer worked cooperatively, and the O&M engineer was more or less under the resident engineer for administrative, financial and other practical purposes. In addition, the previous senior irrigation engineer who had conflicts with the resident engineers over their role and interference in O&M matters went on transfer and a new officer took over. The new senior irrigation engineer tried to avoid conflicts and adjust to the situation. The improvements are thus clearly associated with personalities and personal relationships as well as with the organizational changes. The new structure did focus responsibilities for O&M on particular individuals, rather than spread them *among* officers also doing construction. But the present O&M structure, from an organizational point of view, still appears to have several problems.

The division of O&M authority among so many officers (chief resident engineer, senior irrigation engineer, three resident engineers, two O&M engineers) seriously affects the performance of the staff. In the case of the senior irrigation engineer, he functions without financial authority over O&M. He is supposed to supervise the work conducted using O&M funds without having financial authority. The O&M engineers execute work funded by O&M funds, but the financial controls are exerted by the chief resident engineer or resident engineers. It is difficult to hold an officer responsible for executing O&M functions effectively without delegating him sufficient authority over the control of O&M funds. As a result, the senior irrigation engineer's activities are limited to instructing the O&M engineers on operational matters; he has no involvement in maintenance work other than **some** paper work such as allocation of O&M funds to the resident engineers on the sanction of the chief resident engineer. This division of authority hinders his ability to exercise direct authority over O&M.

The O&M engineers are administratively under the resident engineers, and the O&M organization under the main canals actually functions under the resident engineers and not under the senior irrigation engineer. No job descriptions with details on who is responsible to whom and for what and how he is supposed to do it have been issued to the O&M staff. **As** a result, there is a great possibility for the O&M engineers to be assigned other duties by the resident engineer. It is no secret that construction carries better rewards than O&M work, and there is no surprise if O&M engineers willingly take such responsibilities in addition to their O&M work.

Clear definition of roles through specific job descriptions is also [required for technical assistants, work supervisors, and irrigation laborers. Though we observed technical assistants attending to their job by making regular

field visits, we have strong doubts about the work supervisors' involvement. Effective system operation requires their participation for supervising irrigation laborers and giving instructions on certain operational matters, as well as being a liaison with farmers and farmer representatives.

There is no incentive for the officials of the O&M organization to motivate them to attend to their duties as required by the operational assumptions. Proper incentives cannot be offered without **some** policy decisions at the national level. The major constraints for offering such incentives are:

- * the lack of financial resources for O&M work; and
- * the non-existence of indicators to measure the performance of O&M staff.

These constraints particularly affect the performance of the middle- and lower-level field staff who are the "kingpins of water management from the agency side" (Raby and Merrey 1989:77).

Conclusions and Recommendations on the O&M Organization

1. The organizational structure. Based on our finding over several seasons of research and recent developments in the project, we have concluded that a weak O&M organization in the project cannot compete with the dominant construction-oriented culture of the Department at the project level. Further, given the serious water supply constraints faced by the system, a strong O&M organization is essential. We therefore propose that management responsibility for the completed areas of the Kirindi Oya Project be handed over to the **Range** Deputy Director, Hambantota, without any further delay. Under the range deputy director, we suggest that an experienced chief irrigation engineer be appointed as the overall irrigation manager of the irrigation system. The positions of the chief resident engineer and three resident engineers are temporary, until construction is completed; these positions will be phased out as the construction is completed. Until that time, we suggest the chief resident engineer's and resident engineers' activities be confined to the construction work in the phase II area of the project. *Our* proposed organizational set-up for the O&M division of the entire Kirindi Oya Irrigation System, including the new areas and Ellegala and **Badagiriya** systems, is given in Figure 3.01.

The proposed organizational structure provides for a senior engineer having overall authority, and O&M engineers for the three hydrological subsystems and the head works. It also provides for the Hydrology Division working in the catchment to report directly to the chief irrigation engineer rather than to the deputy director of the Hydrology Division in Colombo, as recommended in chapter 2. Finally, it provides for a monitoring and evaluation unit to be responsible for collecting **data** and using it to evaluation performance, and providing timely feed back,

The density of personnel deployed could be as follows: one technical assistant **per** 2000 ha; one work supervisor **per** 1000 ha; and one irrigator per 200 ha. It is assumed that **Badagiriya** will continue to receive water from the main system (right bank canal); hence its inclusion under the right **bank**

subsystem is justified (this is based on the new development in the project described under the organization structure of the Irrigation Management Division). The Ellegala system includes Gamunupura area, Tissawewa, Yodawewa, Debarawewa and Weerawila Tanks.

Several steps have to be taken before handing the system over to the deputy director, Hambantota. These include completion of residual work in phase I area; lot improvement and many other minor works reported by farmer organizations remain undone according to the minutes of meetings of the Project Committee.

A number of construction defects are still to be observed in the system. **Even** in the case of DC 2, the canal cannot convey the design discharge in certain reaches. The identification of such defects in consultation with the farmers, and taking remedial action is necessary prior to the handing over, as the O&M organization is weak in resources.

Rehabilitation of broken field turnouts and other structures is also required. We have observed many broken field turnout structures and other regulating structures in many field channels in the sample area. Strict rotations cannot be implemented without these repairs. This will have a serious impact on the proposed crop diversification program for yala.

2. Professionalize irrigation management. At present Irrigation Department personnel conceive of themselves primarily as civil engineers, not irrigation managers. The Department's own values and incentive system reinforce this attitude. But nationally, not only in Kirindi Oya, the role expected from the Department places greater emphasis on irrigation management, and less on construction. It is time for the Department to begin adjusting to these changing needs.

The Department should take a clear position that emphasizes and values professional irrigation management as an important role of its employees. The senior Department staff should be given clear and full responsibility matched by appropriate authority for improved management of irrigation systems. Both in-service and on-the-job training, and a system of incentives for high professional performance, are required. Incentives could include non-monetary ones, such as selection of good system managers for valued overseas training opportunities, and letters of commendation from the Director for a job well done.

The middle and field-level O&M staff should be issued clear job descriptions (the Irrigation Department manual defines the roles of irrigation engineers and technical assistants in a general way, but these are rarely consulted). The guidelines in the final draft of the O&M Manual prepared by the water management consultants (Water Management Consultancy 1989) can be followed in their preparation. Recruitment and training should be based on the skills required for carrying out the jobs.

3. Performance monitoring. Introduction of clear job descriptions will provide a basis for developing measures of performance of O&M staff. In addition, effective management of irrigation water deliveries will require an

effective timely system for ascertaining real time demand as against available supply; changing delivery patterns to meet the demand; monitoring delivery performance in relation to targets; and making further adjustments based on performance.

4. Working committee in the Irrigation Department. The Irrigation Department is at the early stage of a major transformation from a construction agency to an agency with primary technical responsibility for management of irrigation systems. The management function will require new skills and procedures for participatory and joint management with farmers. The above recommendations also point in this direction. To facilitate the process of transformation from a "bureaucratic technical-engineering" approach to a "strategic organization" with a participatory approach, we propose that the Irrigation Department establish a "working committee" modeled on the one that has guided the transformation of the National Irrigation Administration in the Philippines (Korten and Siy 1989). This would be an advisory committee, including both Department officials and some outside expertise, to assist the Department in learning from its experiences and adapt itself to work more effectively in the new mode.

THE IRRIGATION MANAGEMENT DIVISION

Formal Organizational Structure and Objectives

Kirindi Oya is one of about 35 major schemes on which the Irrigation Management Division is implementing its program for Integrated Management of Major Irrigation Schemes (INMAS). The Division itself is quite small, with minimal staff and very little authority or funds. In Kirindi Oya it is represented by two project managers (one each for the old and new areas), who are each assisted by an institutional development officer. Until recently, they had a number of institutional organizers to work at the field level.

The general guidelines for INMAS advocate the establishment of a pyramidal committee structure operating on three tiers: field channel groups, distributary channel organizations, and the project committee. The structures and the functions of the committees at each level are conceived as follows (see IMD Handbook 1985).

1. Field channel groups. All the farmers under a field channel are members of the field channel group and are expected to appoint a "farmer representative," preferably by consensus, to represent its members at higher levels of the committee structure. Before the formation of field channel groups, the institutional organizer is supposed to **work** in the community and explain the program. He is supposed to play the role of a "change agent" to bring about an attitudinal change in the community in order for them to adjust to the new requirements such as cooperation for sharing water and channel maintenance demanded by the irrigation system. The major function of the field channel group is to organize water distribution and maintenance of field channels and drains in the turnout area. The group is supposed to meet regularly to discuss issues and problems relating to water distribution maintenance and take timely action. Problems that the field channel group cannot solve can

either be referred to the distributary organization or to the appropriate line agency. Field channel representatives are supposed to have close contacts with the field level irrigation staff to find solutions to irrigation problems at field level.

2. Distributary organizations. The field channel representatives appointed by fanners under one normal distributary channel (or several adjacent small ones) form the distributary channel organization. It is a formal organization with a constitution and a secretary, a president, a treasurer, and other office bearers appointed by the fanner representative members. This organizational meeting is also supposed to be initiated by the institutional organizer (if any) with the participation of the project manager. Meetings of the distributary organization are supposed to be attended by field level officers of line agencies to discuss problems and find solution to those problems that can be solved at this level. The responsibilities of distributary organizations are to (IMD Handbook 1985):

- a. organize activities relating to water distribution and maintenance of field channels;
- b. arrange for the equitable distribution and rotation of water along field channels;
- c. encourage fanners to improve on-farm water management;
- d. facilitate fanners' participation in decision-making, planning and implementation of all matters concerned with agriculture and irrigation;
- e. identify areas needing improvements and rehabilitation;
- f. organize collective **work** that can be handled by farmers under the supervision of the officers;
- g. keep the authorities informed of irrigation offenses, pest attacks, disease outbreaks, and crop damage caused by animals; and
- h. encourage farmers to pay O&M fees.

3. The Irrigation Management Division-Project Committee. The project committee convened by the project manager is at the apex of the committee structure implemented under the INMAS program. The members of the committee include farmer representatives on the basis of one from each distributary organization, technical assistants of the Irrigation Department, colonization officers of the Land Commissioner's Department, agricultural instructors of the Department of Agriculture, and divisional officers of the Agrarian Services Department. The O&M engineers of the respective canal systems also attend meetings though they are not members of the committee. Officers of other line agencies are invited to committee meetings, which are held regularly once a month. The functions of the project committee are (Perera 1986):

- a. formulating and implementing the seasonal agricultural program;
- b. holding pre-kanna meetings and making arrangements for holding of timely kanna (pre-season cultivation) meetings;
- c. coordinating the provision of credit and other inputs in time;
- d. making arrangements for operation and maintenance of all capital assets and approval of items to be handled under the maintenance program for the irrigation system;
- e. reviewing the agricultural program during the season in order to take any necessary corrective action;
- f. attending to problems connected with water distribution reported to the committee by farmer representatives;
- g. promoting farmer participation in the project through formation of farmer organizations;
- h. organizing farmer and officer training; and
- i. reporting to the District Agricultural Subcommittee on the problems that cannot be solved at the project committee level.

The project committee is linked to the district level through the District Agricultural Subcommittee which is the main implementing body at district level for the management of INMAS projects. The District Agricultural Subcommittee is linked to the national level through a central coordinating committee which reviews policy and provides guidelines for implementation.

The Irrigation Management Division Committee Structure in Kirindi Oya

Two project committees have been established in the project, one for the old area and one for the new area. Our main concentration was on the Committee structure in the new area of the project. The Irrigation Management Division project manager for the new area has attempted to form the three tier committee structure following the INMAS guidelines. Though the committees reflect the pattern advocated in the program, they have not yet developed to take responsibilities as anticipated.

Field channel groups. Field channel groups were initiated at the **beginning** by the project manager without the assistance of a field staff. It is not surprising, then, that he could not explain clearly to all the farmers and farmer representatives the objectives of the program. Therefore, the farmers were not aware of their roles or those of the farmer representatives in the program.

Though the institutional organizers were fielded in 1988, their stay in the project **was** limited to a period of one year in many cases. They did not leave any significant imprint on the farming community during this short period. **As** a result, the majority of the farmers are still unaware of the objectives of the program.

A majority of the farmers were temporarily settled in the project at the beginning. After the crop failure in 1986/1987 maha, the majority moved out of the settlement for economic reasons. They lost confidence in the system (Merrey and Somaratne 1989). Though the situation has improved now, a significant number (20 percent in our sample) are still not permanently settled. This is a major problem in organizing farmer groups.

Irrigated agriculture was not the main concern of the farmers stricken with severe hardships. It was very difficult to organize them for such purposes at the beginning. When the cultivation started, many farmers found that they could not irrigate their lands without some improvements in the canals and levelling work in allotments. On such occasions they rallied round the organization to find solutions to such problems but lost interest when the work was over.

The field channel representatives who were appointed by the farmers at the beginning did not have the leadership qualities demanded by the program. There **was** no training for them. Therefore many did not have a commitment to the program. Even those who were committed to some extent lost interest in the program, because of other farmers' lack of cooperation. The farmers attributed the traditional role of "water headmen" (*velvidane*) to field channel leaders and wanted them to take the responsibility for doing much of the required work.

For all these reasons, there was no active involvement of farmers or field channel representatives in canal cleaning and other maintenance activities. Since there were no rotational issues **and** water was in abundance, there was no perceived necessity for them to participate in water distribution.

Distributary organizations. The field channel **groups** are conceived by the Irrigation Management Division as informal "groups", not formal organizations; but the distributary organizations are expected to develop into formal organizations. More recent thinking is that these organizations will be legalized and asked to take formal authority and responsibility for system O&M from the distributary level down. However, the evolution of these organizations at Kirindi Oya has not been very promising so far. There are several reasons.

1. The farmer organizations at Kirindi Oya were initially formed as hamlet-based organizations. This **was** because the people living in different hamlets located four to six kilometers apart had, in principle, been allocated lands to share water from one or more common distributaries (Stanbury 1989). Therefore people getting water from different distributaries but living in the same hamlet were included in the hamlet level organization (Merrey and Somaratne 1989 provides **an** example; see chapter 7 for another). This is a common problem in all the hamlets of the right bank system; out of the seven distributaries under BC2, three fall into this category. Though attempts were **made** to **base** the

organizations on distributaries, the settlement pattern has reduced the participation of field channel representatives living in other hamlets.

2. Distributary organization meetings were not regularly attended by farmer representatives. In the case of the Hamlet II organization comprising of 22 field channel representatives, the number attending meetings never exceeded 12. The problems of farmers on some field channels could not be discussed at the meetings because of this.
3. The leaders of distributary organizations tried to find solutions to irrigation problems and other community level problems through the involvement of the Irrigation Department and other relevant organizations. For example, after the loan funds for phase I construction had been used up, the farmer representatives were successful in getting the remaining land, irrigation and drainage construction work completed by using phase II funds. Recently lining of a portion of DC5 in right bank tract 1 was done through the project committee and subcommittee of the project coordinating committee.

But the organizations failed to issue invitations for meetings to the officers concerned on many occasions. Some officers did not attend even when they were invited. As a result either the distributary representatives or project manager had to take the problems to the relevant organizations for solutions. There were no attempts by distributary organizations to solve problems by community participation or by the participation of field-level line agency officials.

4. Farmer representatives took decisions about seasonal cultivation programs that were biased towards farmers' views as there were no line agency officials to influence their views and decisions at distributary organization meetings. This sometimes has led to inappropriate decisions; the issue of first water before harvesting was completed, lack of time allocated for canal maintenance at the start of yala 1989, and the decisions to cultivate rice in both 1988 and 1989 yala seasons are examples.
5. The Irrigation Management Division and the Land Commissioner's Department representatives had conflicts over certain issues; these came out for example during discussions of community problems at distributary organization meetings. On some occasions there were criticisms against some field level officers of the Land Commissioner's Department. In a previous publication we had documented attempts to undermine each others' programs (Merrey and Somaratne 1989). The Land Commissioner's Department had no effective program at that stage to solve these problems. This led to conflicts between its field level officials and the leaders of distributary organizations. Many farmer leaders became discouraged as a result of these conflicts. The conflicts between the two departments are no longer predominant, but many of the community level problems still remain unsolved. Because of the tensions associated with the transition from the settlement stage to the agricultural production stage, and the ineffective organizational strategies adopted, the Irrigation Management Division could not address the on-farm water management issues at this

stage. This remains a serious problem. The distributary organizations almost everywhere in the project have inherited these problems. In many cases the organization rests on one or two leaders who liaise with the Irrigation Management Division project manager to solve their problems.

The project committee. The Irrigation Management Division project committee for the new areas of Kirindi Oya is comprised of the divisional level officers of the Departments of Irrigation, Agriculture, Agrarian Services, and Land Commissioner, and the distributary organization leaders. Though O&M engineers are not members of the committee, they attend meetings regularly. However, the management capacity of the committee is still not developed for the formulation and implementation of agricultural programs for a number of reasons.

1. The District Agricultural (DAC) Subcommittee did not function for a long period, hence the project committees in the entire district had been paralysed. The INMAS program requires an effective DAC subcommittee in order for the lower level committees to function. Even when the subcommittee started functioning, the project level officers did not attend the meetings. The farmer representatives of the new area who attended the committee were frustrated, because there were no higher officers of the important agencies like the Irrigation and Land Commissioner's Departments at the subcommittee meetings. Therefore, they came to prefer attending the subcommittee of the project coordinating committee established in the project (see below). However, the farmer representatives of the old area attend the DAC subcommittee meetings but avoid the subcommittee of the project coordinating committee because line agency officers involved in the old area attended these meetings. This situation has now improved and the project level officers also participate in the meetings held once every three months. However, this situation weakened the functioning of the project committee in the area until mid-1989.
2. The project committee received less attention because of the existence of a more powerful "project coordinating committee" established for implementation of the project activities. However, its major function was to oversee construction and settlement in the project and not agricultural plan implementation. Higher level project officers of other line agencies did not attempt to develop the management capacity of the Irrigation Management Division project committee, for example by attending meetings regularly and using it as a forum for consultation with farmers on agricultural planning. The conflict between the Land Commissioner's Department and the Irrigation Management Division further reduced the development of the management capacity of the project committee and also seriously affected the launching of crop diversification programs in yala 1988 and 1989. This situation improved with the arrival of a new project manager for land and settlement activities. The participation of the chief resident engineer at a recent (late 1989) project committee meeting also shows the recent change in the Irrigation Department attitude towards the program.

3. Achieving the objectives of the INMAS program demands a bureaucratic reorientation. However, because the Irrigation Management Division has failed to give the necessary training to the officers of other departments, the objectives of the program and their responsibilities toward it are not clear to them. Therefore, the officers tend to work primarily for the narrower objectives of their agencies without involving themselves much in the INMAS program activities. For example, an agricultural officer once refused to give the assistance of his field level staff to the project manager (Irrigation Management Division) for data collection to prepare the seasonal agricultural program because they themselves prepared a program for the entire district. This is in spite of clear directives from the center ordering cooperation in seasonal planning.

Conclusions and Recommendations on the Irrigation Management Division

Conclusions. Our findings in the three seasons covered in this study clearly demonstrate the structural weakness of the Irrigation Management Division organization at every level of the committee structure. The following are our observations in this context.

1. Though the field channel representatives and distributary organization leaders generally propose the cultivation calendar, they make no serious effort to clean canals on time, as agreed at cultivation meetings. This reflects the weakness of the organization to a great extent, though some settlement issues such as temporary residence of settlers are also important factors. But in our experience in Kirindi Oya even those who are permanently settled attend to canal cleaning only after the water issues are made. They never clean field channel roads or de-silt the channels; they only clean weeds from the canal.
2. The rotations could not be commenced in time (and thus were not implemented) during any of the observed seasons because of the delay in land preparation. The delay in land preparation is attributed by farmers and officials to delays in the supply of inputs, for which better arrangements could be made through coordination. However, the line agency support for the Irrigation Management Division's attempts to solve these problems remains unsatisfactory, especially in the case of credit and tractors.
3. One of the main responsibilities of the Irrigation Management Division is to formulate and implement the agricultural program and monitor its progress. However, the Division has failed to attend to these functions because of lack of line agency cooperation and because its main focus has been on irrigation problem solving. It could be seen that the cultivation calendar agreed upon was not adhered to in any of the seasons and as a result water issues had to be extended.

Overall, then, we find that despite rhetoric in support of turning over authority to farmers and gaining farmers' participation, the government agencies have in fact consistently given very low levels of support to building institutions through which farmers could participate effectively. This is

reflected in the low level of resources and central support provided to the Irrigation Management Division, and the minimal interest and support for the Division's efforts provided by other departments. We find that the actual impact so far has been to confirm and encourage farmers' dependency on the bureaucracy, rather than creation of self-reliant farmers' organizations, or true joint management. The Irrigation Management Division and the committee system it has tried to create are not effective. Farmers' groups and organizations exist to some degree, but are not being "institutionalized," i.e., infused with a value and usefulness that would lead to strong and continued sustainability.

Recommendations. The government policy regarding the management of major irrigation schemes demands the proper functioning of the project committee system proposed under INMAS. Though alternative management innovations could be proposed for the Kirindi Oya Project, our focus here is to develop the management capacity of the project committees to handle the irrigation and agriculture-related activities in the project.

1. The Irrigation Management Division should take the initiative to train the project- and field-level officers to enable them to understand the program better. They are not very knowledgeable about the program at present.
2. The Irrigation Management Division should identify training needs of the farmers and farmer representatives, through a formal participatory "training needs assessment" process. The training should emphasize on-farm water management and crop diversification issues as these are key areas for the success of the project.
3. The project committees should be **formally** recognized as the mechanism for policy decisions. As part of this recognition, we suggest re-naming them as "Project Management Committees" to emphasize their role. They should focus on formulating, implementing and monitoring the agricultural program. Agreement on a realistic cultivation calendar, and adherence to this calendar, will be essential in order to use the limited water supply effectively.
4. We recommend forming three project management committees, one each for the right bank, left bank, and Ellegala subsystems. Under the overall project management structure we are proposing (see below), it will be at this level that project management committees can be most effective.
5. The project level higher officers need to participate at project management committee meetings when decisions on seasonal agricultural program are taken, to influence farmers to take rational decisions.
6. The responsibilities of the field level officers of line agencies towards the INMAS program, and their relationship to the Irrigation Management Division, should be included in their job descriptions and the heads of line agencies need to take action to insure adherence. We believe the Irrigation Management Division could increase the Rs 250/= allowance paid to members of the committee to motivate more active participation.

7. The problems that the project management committee cannot solve should be attended to by field level officers of line agencies, in consultation with their superiors, and the results should be reported to the committee at subsequent meetings.
8. The DAC subcommittee needs to evaluate the performance of project management committees in the district periodically, and attempt to strengthen their management capacity.

Conclusions on the Other Committees in the Project

Our previous three reports discussed a number of other committees functioning in the project. They are:

1. The project coordinating committee
2. The subcommittee of the project coordinating committee
3. The committee for crop diversification.

The project coordinating committee is required to function in the project until the completion of Phase II. However, its functions need to be limited to construction and new settlement issues in order to pave the way for the project management committees to develop their management capacities. It is necessary to take a policy decision at the central coordinating committee to limit its functions and allow the project management committees to function through the DAC subcommittee.

The subcommittee of the project coordinating committee, established in part as a result of observations in an earlier IIMI report, was useful as a forum for the project manager (Irrigation Management Division) because the DAC subcommittee was not functioning, and later higher level project officers did not attend DAC subcommittee meetings. Now the situation has changed. Therefore, we recommend the abolition of the sub-committee of the project coordinating committee.

However, the committee formed to address crop diversification issues needs to be retained for a longer period because the project management committee is still not developed sufficiently to take this responsibility. The committee had prepared an agricultural program for year 1990. All the line agencies were involved in the preparation of the program and worked as a team to realize its objectives. This is the first such group attempt we have observed in the project for crop diversification. The Irrigation Management Division has contributed to the program through primary data collection with the involvement of distributary organizations in the project.

DECISION-MAKING, INFORMATION FLOW AND PERFORMANCE MONITORING

Decision Making

Making decisions regarding the cultivation season is very important in irrigated agricultural schemes. It requires information on the availability of water, data on the inflow and rainfall assumed for a particular season, the extent of area to be cultivated, the crop varieties to be cultivated, the availability of seed and other inputs, marketability of the products, and other information. Therefore, decision-making involves information and data collection for the formulation of a program for the season.

The project committee is supposed to prepare this program before the commencement of a season. However, for various reasons discussed above, it has not succeeded in preparing such a program. The decisions for the previous three seasons were taken at the cultivation (kanna) meetings without having any such program. The procedure followed in the previous three seasons was as follows.

1. The project manager (Irrigation Management Division) arranged distributary organization meetings with farmer representatives and arrived at decisions regarding the cultivation season. Since the meetings were not attended by officers of other line agencies, they had no influence on the decisions. For yala 1989, the project manager could not discuss plans with the farmers at distributary organization meetings since the meetings could not be held for security reasons. Plans were discussed only at the project committee level.
2. The farmer representatives then proposed dates for the cultivation season at the project committee meetings. These meetings are attended by field level officers, but they did not know much about the program of their own department for the season and therefore, could not influence the farmers' thinking.
3. The project manager then arranged pre-kanna meetings with line agency officials and farmer representatives. By this stage the farmer representatives had a program agreed upon by them at the project committee. They attempted to maintain their own decisions. The officers were forced to accept these decisions.
4. The decision of the pre-kanna meeting **was** ratified at the kanna meeting.

There were attempts by other project level officers to influence this decision-making process on three occasions. In maha 1988/1989, the sub-committee of the project coordinating committee, with the participation of project level higher officers, was formed to guide this decision-making process. The last two seasons (maha 1989/1990 and yala 1990) the decisions taken at the project committee have changed, and the dates proposed for the cultivation season postponed after discussions with the farmer representatives, and ultimately changed completely.

In yala 1989, the project committee decided to cultivate rice in the right bank tract 1 and left bank tracts 1 and 2 even though the project authorities

intended to cultivate only non-rice other field crops. The project manager (Irrigation Management Division) was accused of taking farmer-biased decisions against the project plans for cultivating non-rice crops in yala. Similarly, in yala 1989, the farmer representatives and project committee decided to cultivate rice. The project authorities failed to change this decision because they had no solutions to farmers' problems such as credit, marketing and crop insurance. Neither the project committee nor the project coordinating committee had made any plans before the commencement of the season. Instead, officers attempted to launch programs without any prior preparation to study and address the constraints involved.

A recent development in the project has complicated the seasonal decision-making. A pre-kanna meeting for the entire project was held recently with the participation of farmer representatives from both the new and old areas of the project. It was initiated by the chief resident engineer to present a technical solution to the water crisis in the scheme. The solution was, basically, to provide tanks in the old area with drainage water, especially from tracts 1 and 2 on the right and left **bank** systems.

Though the Irrigation Department officers claim that they had no intention to deprive the old area farmers of priority rights over water by the **proposed** plan for water issues, the old area farmers as well as the Irrigation Management Division project manager for the old area were suspicious. The old area farmers generally hold negative attitudes towards the whole development project. Their attitude might have been very different if the Asian Development Bank-funded rehabilitation work in the old areas had been carried out in consultation with farmers or existing farmer organizations. From the farmers' point of view the rehabilitation program has not led to any significant improvement in their irrigation systems. In addition they fear that the drainage water from the new area would tend to cause salinity in their rice fields without sufficient drainage.

As a result, the farmers in the old area attempted to retain their priority water rights and they were successful at the meeting. The priority claimed includes priority water rights in both yala and maha for 200 percent cropping intensity. More recently, Badagiriya farmers have also claimed some priority over water from the main system. If these priorities remain, the new area farmers will face serious shortages, even for cultivation of non-rice crops, and even if phase II is not completed. This is a very complicated situation which should receive attention at central coordinating committee level and at the political level (see chapter 2),

Recommendations on Seasonal Decision-Making

1. The project committees should prepare a tentative cultivation program for the season at least three months prior to the commencement of the season, with at least two scenarios for "water abundant" and "water short" seasons, respectively, in collaboration with senior Irrigation and Agriculture Department officials.

2. The proposed plan should be discussed with farmer representatives at distributary organization meetings, attended by other line agency officials to influence the decision making.
3. A final decision on the seasonal program needs to be agreed upon at a project committee meeting when the water level in the reservoir is sufficient to commence the cultivation. The project committee can hold a special session in case it has already held its monthly meeting. The participation of the senior irrigation engineer and other high level project officers is required to explain the reasons for changes to the program, if any, such as the curtailment of the cultivation area due to scarcity.
4. Then, either a meeting of the DAC subcommittee attended by farmer representatives of both systems, or a pre-kanna meeting restricted to farmer representatives with the participation of key officials is needed to discuss common issues and confirm the decision.
5. Finally, the government agent should hold kanna meetings based on tracts or tanks to explain and ratify the decisions taken at the pre-kanna meetings.

Information Flow

Information is required not only to take decisions on the **seasonal** agricultural program, but also for monitoring the implementation of the agreed upon program. The Irrigation Department has to make water issues for the season. The Irrigation Management Division has to attend to water management activities in the turnout areas and arrange the necessary inputs. All these activities involve information sharing and decision-making at various levels.

In the case of the Department of Irrigation, the senior irrigation engineer has to prepare a water issues schedule, including information on the discharge quantities at various offtakes and duration and timings of rotations. He requires from the field information such as:

1. discharges made to various offtakes in the system;
2. progress of land preparation in the command area;
3. rainfall and other climatic data from weather stations located in various places in the system; and
4. data on inflow and water availability in the reservoir.

Our observation on the various aspects of information sharing demonstrate that the information is not received in time by the senior irrigation engineer and even if it is received it lacks accuracy. The following are our observations with regard to the information flows in the Irrigation Department.

The discharges at offtakes of the system. Measuring discharges at various offtakes is necessary to know whether the farmers receive adequate amount of

water in time and in an equitable manner and also for the monitoring of system performance. The Department did not succeed in collecting these data in the first two seasons but was successful in yala 1989. However, the data could not be used for any practical purpose. The normal practice of the Department is to use theoretical rating curves of the measuring structures for calibrating discharges, but this does not reflect reality. In many cases the measuring structures are defective and some theoretical rating curves have never been checked in the field. As a result there is no possibility to know whether the distributary structures are delivering the design discharges.

The progress of land preparation. The water issue schedules assume three staggers in the season with 20 percent progress in land preparation in the first three weeks, and 60 percent and 20 percent respectively in the subsequent three weeks. The land preparation period is assumed to be five weeks. However, land preparation takes a longer time than assumed for various reasons discussed elsewhere. The Irrigation Department is forced to change the schedule **based** on the progress of land preparation to avoid wastage of water. The Department could not collect systematic timely data on the progress of land preparation in the two previous seasons; in yala 1989 the Department adjusted discharges based on data being collected during the land preparation.

Rainfall and other climatic data. Rainfall data are very important in a water short scheme like Kirindi oya. Though weather stations with instruments are available in the project we find that the data collected are not accurate, apparently because of the lack of experienced personnel. Other climatic data, such as evaporation, humidity, and speed of wind, are required to prepare schedules based on more realistic values instead of theoretical or assumed ones.

Data on inflow and water availability. Though the data on water availability in the reservoir can be obtained from the headworks resident engineer, there is a strong doubt about the accuracy of the inflow **data** received because the Irrigation Department officers cannot closely supervise the measurement activities done at a station located in a distant place in the catchment.

Information Flows within the Irrigation Department. Our findings show clearly that the collection of information in the field is not satisfactory. However, channelling of information from the senior irrigation engineer to the field, and communication within the higher level of the organization, have improved since the reorganization of the O&M section. Certain communication problems such as channeling of information to the O&M engineers and technical assistants from the senior irrigation engineer have been avoided by regular field visits by the senior engineer and other O&M staff. As a result the following improvements can be observed now:

1. The unusual fluctuations in the right bank main canal have been avoided by establishing communication between tracts through daily visits along the canal by technical assistants assigned to the O&M section.
2. Regular field visits by the senior irrigation engineer and his staff have given them an opportunity to communicate and share information with the field level staff.

However, we observed that the O&M section does not have any formal meetings to discuss and evaluate the performance of the irrigation system or to identify operational and distribution problems.

Though the situation at higher levels of the system shows some improvement, there is a serious lapse in communication and information sharing in the field. This is largely due to the ineffectiveness of fanner level institutions in the project. The Irrigation Department attempted to solve *some* field level problems by arranging weekly meetings with fanner representatives and farmers at unit offices, and through a complaint book kept at the unit offices for fanners to lodge complaints. But the farmers have preferred to find temporary solutions to the shortage of water in canals through irrigation laborers who can offer immediate solutions by increasing the discharges to a particular field channel. This kind of problem solving mechanism could be observed throughout these seasons in our sample distributary.

To further elaborate on this issue, the tail-end field channel (FC13) of DC2 is water short throughout the season. The scarcity is grave during the land preparation period because the canal cannot convey the design discharge due to defects in the design. Since this is not brought to the notice of the higher level officers, the problem remains unsolved. In some instances the canal design assumes that all the allotments under a particular canal are poorly drained soils though the situation is entirely different. In such cases water shortages are unavoidable. However, due to the lack of feedback, these problems do not receive due attention.

Information flow within the Irrigation Management Division *end* with Fanners

The Irrigation Management Division is supposed to communicate and share information through the three tier committee structure established in the project. As we have pointed out above, some organizations are defunct, hence **two way** communication does not occur. In hamlets where the organizations are active, various kinds of irrigation problems and other field level information are brought to the project committee and solutions are intimated to the fanners concerned through distributary leaders. The Irrigation Management Division has been successful in solving irrigation and other agricultural problems in this way.

In tract 5, the organizations were defunct and as a result communication flow upwards and downwards did not occur. Because of this serious lapse in communication, the Irrigation Department took a decision for an early water issue for yala 1989 when many rice fields in tract 5 were still not ready for harvesting. The following are our observations on communication lapses in tract 5:

1. Both distributary organizations and field channel groups are defunct, though the leaders of the distributary organization attend the project committee meetings. As a result the Irrigation Management Division cannot effectively share information with the fanning community.
2. The most vital information such as the dates of pre-kanna and kanna meetings are often intimated to the community by posters and leaflets rather than through the farmer representatives.

3. The agricultural data are collected in many cases by distributary leaders themselves who, as field channel leaders, are ineffective. This leads to unnecessary delays in the collection of some vital information necessary for formulating agricultural programs. For example, the Irrigation Management Division tried to collect information through the distributary organizations in previous seasons on farmers' willingness to grow **other** field crops, and this led to delays in obtaining the data. In the preparation of maintenance programs, the Division expects the project committee leaders to collect information on broken structures in the field and distributary channels. But the field channel representatives are ineffective, *so* only a few of the distributary leaders do this. Since they cannot meet all the farmers, their data are incomplete.

Conclusions and Recommendations on Information Flows

A good management information system does not develop on its own. It results from serious attempts at monitoring and evaluating of system performance to fill real management needs. The monitoring and evaluation of system performance leads to communication with farmers and the field staff and finally to the development of a good information system. Therefore, our recommendations emphasize evaluating the performance of the irrigation system.

1. The Irrigation Department needs to shift its attention to evaluating system performance by monitoring discharges at distributaries instead of the present practice of evaluating only ex sluice duty. This involves construction of more effective measuring structures as the existing ones are defective in many cases. In addition, the theoretical rating curves for distributaries and field channels in the entire command area need to be re-calibrated in the field. This may require a lot of money and energy, but is necessary for developing an information system. It may be most practical to start with a few key measuring points scattered along the main canals, and add other points slowly as management capacity and resources allow. The measuring structures king constructed using phase II funds must be calibrated.
2. The Irrigation Department needs to train its field staff to enable them to collect data with accuracy. Senior field staff should supervise and guide them in order to enable them to be more accurate.
3. Irrigation Department field staff need to establish rapport with fanners and try to identify problems associated with construction and design defects instead of offering temporary solutions and blaming the farmers for their present irrigation practices. This would also enable them to collect more accurate information.
4. The senior irrigation engineer needs to attend farmer organization meetings, project committee meetings, etc., to collect information on the irrigation system from the users' perspectives.
5. The Irrigation Management Division needs to strengthen the farmer organizations in order to have an effective communication mechanism which can be used for information sharing. Recently, under an Institutional

Strengthening Activity supported by the Asian Development Bank, the consultants recommended a set of simple, appropriate irrigation performance indicators, and a methodology for collecting these through farmers' organizations (Uphoff n.d.). We strongly recommend that this approach be pilot-tested in Kirindi Oya, both as a way of improving information flows, and as an activity that could strengthen farmers' organizations.

6. The Irrigation Department should hold regular monthly meetings with its O&M staff and discuss ways to improve irrigation system performance.

Performance Monitoring and Evaluation of Personnel

In almost every government department, the performance of personnel is evaluated annually in terms of the conditions laid down in the Administrative Regulations. The normal practice, however, is to grant annual salary increments to an officer if he has not committed a serious offence. This allows the officers to do the minimum and still get their annual increments. On the other hand if an officer works hard or has a high level of commitment, he cannot get any formal reward other than the usual annual increment granted to others whose actual performance is minimal.

Therefore, performance monitoring and evaluation of personnel is a strange idea in the Sri Lankan context. Even promotions are granted on seniority and in many cases are based on examinations and not on the commitment or work performance of the officer. Though commendations and recommendations by higher level officers are important, they are perceived as personally biased and are not an encouragement for better performance.

The performance monitoring of personnel can be done based on the task expectations in the job descriptions issued to employees. If we take the job descriptions proposed by the water management consultants in the operation and maintenance manual for Kirindi Oya, the O&M staff is supposed to prepare and submit various reports, collect field data, and attend to specific operational functions as and when required by the Department. In addition they are supposed to attend project level and farmer level meetings and attend to complaints made by farmers in the complaints books kept at unit offices. Therefore immediate supervisors can prepare evaluation reports on staff performance on a monthly basis to use in their annual evaluations. The monthly reports can be kept in the personnel file of the particular employee.

Though the employees can be evaluated based on their performance as per the job description, it is very difficult to recognize and reward them for good performance in the present context. As we have pointed out earlier, a revision of present administrative and financial regulations is required for granting monetary recognition of better performance. In the case of middle and field level officers, the most effective incentive is monetary recognition, since they are poorly paid in comparison with their task expectations. Therefore we suggest paying the field staff an additional allowance based on performance.

Irrigators now hired on a temporary basis should be extended based on their performance as evaluated at the end of every season by a board comprising

of technical assistants, work supervisors, and O&M engineers, chaired by the senior irrigation engineer. In the case of irrigation engineers engaged in operation and maintenance, the Department should arrange valued overseas training on O&M both as an incentive and for further improvement of skills.

PATTERNS OF COMMUNICATION, COOPERATION AND CONFLICT AMONG AGENCIES

In previous reports we had documented conflicts between the Land Commissioner's Department and Irrigation Management Division at the project level. It seriously affected the launching of a successful crop diversification program in the project. At the same time we observed a general lack of effective cooperation among the Irrigation Department, Irrigation Management Division, and the Agriculture Department.

But recent developments in the project show much greater cooperation, communication and collaboration among key management agencies. All the agencies were actively involved in planning the crop diversification program for the yala 1990 season. The new project manager (settlement) who is responsible for the overall coordination of this committee has been able to bring the agencies together and they mesh very well for this purpose.

Improved cooperative and collaborative attempts to realize project goals and objectives could be seen in other committees as well. Even the project coordinating committee shows improvement by its attempts to solve various problems. Recent examples include the efforts of the new project manager (settlement) to solve encroachment problems, and the implementation of a land survey in the new areas to settle land questions.

The project manager (settlement), chief resident engineer and other line agency officials attend meetings organized with farmers by the project manager (Irrigation Management Division) in the new area and extend their cooperation to Division activities. The change of attitude of field level officers to the Irrigation Management Division is also noteworthy. The field level officers attend Division meetings more regularly and the chief resident engineer also recently attended a project committee meeting to discuss irrigation problems with farmer representatives. We believe that this cooperative attitude will continue and would enhance the project committee's capacity to handle agricultural plan implementation in the new areas independently when the lower level field channel groups and distributary organizations are strengthened.

While the trends in the new area of the project show some improvement in collaborative and cooperative attempts to realize project goals and objectives, a different trend is observed in the old area. The farmer representatives in the old area as well as the project manager (Irrigation Management Division) for the area feel that the Ellegala system is independent and autonomous from the new project and that it should have priority water rights in both yala and maha seasons for rice cultivation. They prefer that their way of life should remain undisturbed by the various activities and programs in the new area. In chapter 2, we have discussed the serious problem of allocation of water among the subsystems.

Some officials suggest that the priority issue arises because the project committees have been established on the basis of "old" and "new" areas of the project, and therefore the project managers have a natural tendency to become spokesmen for the farmers in their respective areas. One solution suggested by some Irrigation Department officials is to reorganize the Irrigation Management Division activities based on the banks of the Kirindi River and not on "old" and "new" systems in order for the two project managers to be responsible for both types of systems (Weerawila, Pannegamuwa and Badagiriya tanks are located in the right bank of Kirindi Oya while Tissa, Yoda and Debara tanks are in the left bank).

However, this proposal contradicts the basic organizational principles of the Irrigation Management Division committee structure which advocates the establishment of committees based on hydrological boundaries. Field channel and distributary organizations as well as project committees have been formed on this basis. Though the Weerawila and Pannegamuwa tanks are located on the right bank of Kirindi Oya geographically, they have no hydrological relationship with the right bank main canal system. Weerawila and Pannegama tanks as well as Yoda, Debara, and Tissa tanks on the left bank of Kirindi Oya are supplied with water from Ellegala Anicut which is linked to the left bank main canal by a feeder canal. The Ellegala system consisting of these five tanks is a separate hydrological unit depending on the Lunugamvehera reservoir. In addition, at present the O&M and financial responsibilities of the Ellegala and Badagiriya systems lie with the irrigation engineer (Tissamaharama) who is directly under the range deputy director of irrigation in Hambantota.

Further, this proposal does not take account of the human aspects of organizations. The two communities in question have great differences in interests, problems, and needs. Ellegala farmers are an established community with certain norms and practices regarding irrigation water. They attend to canal cleaning and related work without much influence from outside. Their problems are associated with sharecropping and rehabilitation, while the settlers in the new area have many problems such as encroachments, lack of credit and other inputs, lack of participation for canal cleaning without some outside influence, lack of solidarity and sense of community, and lack of water. Therefore the project managers have to prepare training programs and committees based on these field problems. It is easier to deal with organizations based on the system structure, i.e., Ellegala, right bank, and left bank. If the project were divided following the Irrigation Department officers' proposal, it would overburden the project managers with coordination work. Both would have to interact with agency officials in both systems and would have to include the officers of both in their project committees. This would create many difficulties in organizational activities.

Therefore, we do not see any rationality behind the proposal to divide the project into two areas based on banks as far as the Ellegala system is concerned. Badagiriya needs a separate treatment. Even in the case of

³. But since these tanks get drainage water from the right bank, this proposal may be the Department's way of achieving its objective of reallocating priorities.

"administered" rigidly, should be perceived as "fair", and must have high level political support. Much negotiation would be required to come to an acceptable definition of "fair" given the serious conflicting views at present.

Within each of the subsystems, as recommended above, there would be a project management committee at the apex of a structure of farmers' organizations, to decide on the policies for each season given the allocation for that subsystem. At this level there would be flexible, responsive, participatory "entrepreneurial" management of the system.

Therefore, for overall project management, we recommend that the Government of Sri Lanka appoint a senior person as "resident project director" at the rank of an additional government agent. This person would be responsible for overseeing the establishment of decision rules for water allocations among the subsystems in future, setting up the mechanism for making and implementing these decisions, developing plans for achieving the long term objectives of the Kirindi Oya project, and insuring the effective cooperation among the supporting departments and agencies for their full contributions to planning and plan implementation. In order to be effective, the resident project manager must have full political and administrative support. The position of resident project director need not be permanent: we recommend phasing out the position after four to five years, when the project policies should be stabilized.

We also recommend that the Government establish a "water allocation panel" consisting of high-level representatives of the concerned government departments and political interests. This panel, modeled after the Mahaweli Water Management Panel, would be responsible for validating and legitimizing major water allocation decision rules, and the implementation of the agreed water allocation policies each season. Reaching agreement among the various interests will be a political process supported by technical data and advice on possible scenarios. Political support will be required subsequently to institutionalize and implement the agreed policies.

Under this structure, then, two contrasting management principles will be explicitly recognized. At the highest level, there will be strict adherence to administrative rules agreed upon as being fair to all parties given the water resource constraints. At the subsystem levels, there would be flexible management in response to farmers' needs, with a high degree of farmer participation through the project management, distributary, and field channel committees.

WATER USERS' GROUPS

The fourth research question identified in the Inception Report is a series of questions relating to the program to form water users' groups at field channel and above. We have discussed in detail the field channel groups and distributary organizations under the section on the organizational structure of the Irrigation Management Division at project level when answering the first research question. Our three previous reports also focussed much attention on this aspect.

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There have been attempts to form water users' group since the commencement of the first agricultural season in the project. The Kirindi Oya irrigation system, with its design for rotational water issues within field channels, demands such groups for efficient water management. In spite of these attempts

we find that both the field channel groups and the distributary organizations are still weak, ineffective and not valued by their members. We suggested in earlier reports that this is mainly due to the problems associated with the strategies adopted by the Irrigation Management Division at the beginning, as well as the serious settlement problems experienced by the farmers at the initial stages of the project, development.

As we have already pointed out in our previous reports, the Irrigation Management Division's initial approach to farmers' organizations in Kirindi Oya had been from the "top and not the bottom," i.e., the distributary level had been organized without adequate attention to the foundation at the field channel level. This could have been avoided if the Division had taken the initiative to send institutional organizers to the project as soon as the project managers were appointed. However, the project manager had to try to organize farmers without adequate financial resources, and had no other alternative but to approach members through developing a distributary (or rather hamlet) organization. As a result the objectives of the program could not be explained clearly to farmers and farmer leaders.

Though institutional organizers were appointed later, they left to take up permanent appointments as teachers after a period of one year. Their short stay in the project left no significant imprint on the farming community. The majority of institutional organizers lacked the commitment to work with farmer groups and were highly pessimistic of any possible change in the ideology of peasantry, whom they viewed as a "corrupted lot", i.e., people who are unable and unwilling to adopt "modern" ideas. The pattern of losing institutional organizers before the end of their two year contract is a major problem even in the other projects under INMAS and cannot be avoided without a change in recruitment policy. Their pessimism about a possible change in the community raises fundamental questions about the past recruitment of institutional organizers, which we are unable to answer. However, more recent recruits are GCE A Level-educated, not university graduates, and are from the community, not outside. Their initial work is discussed in chapter 7.

The Irrigation Management Division has thus not yet been able to bring about necessary changes in the farm community to work with other farmers and farmer groups as required by the INMAS program. Instead, the way the program was introduced has tended to promote dependency thinking in the farming community. For instance, the project manager (Irrigation Management Division) tried to solve irrigation problems of the farmers through creating distributary organizations and the project committee. These problems were channeled to the organization by one or two leading farmer representatives. The problems identified were actually those which needed the direct involvement of the Irrigation Department, i.e., things to be done by outside agents. Those problems were directed to the relevant organizations by farmer representatives or by the project manager himself.

There were no activities to encourage farmers to do things by themselves. Though the distributary organizations have been successful in solving irrigation problems and various other community problems this way, the farmer community does not have a high regard for the organization which has contributed so much to solving their problems. Their view is that it is the responsibility of the

farmer leaders and distributary organizations to solve their problems without their involvement in the organizational activities. In other words, farmers seem to view the organizations not as farmers' organizations, but as extensions of the government.

In addition, the farmers' perception of the program is that the distributary organizations and project committee should take action to solve all the problems of the community, such as poverty alleviation, providing free rations, and other issues not related to water. This kind of dependency is not strange in the Kirindi Oya farmer community because they have been depending too long on the aid of various agencies even for subsistence. The farmer representatives and distributary leaders who did not have training for guiding people to achieve the objectives of the program tended to play the role of patrons, further encouraging the farmers to depend on them.

The Tasks and Functions of Farmers' Organizations

There are said to be 306 field channel groups and 19 distributary organizations established in the new areas of the Kirindi Oya scheme. They have been formed from the "top and not the bottom" as described above. Some of these organizations, especially those in tract 5, are defunct, though some distributary leaders attend project committee meetings and discuss various problems of the community with the field level officers representing the line agencies concerned.

The major function of the farmers organizations at present is irrigation problem solving through the involvement of the Irrigation Department. In addition they act as pressure groups in the decision-making process for cultivation seasons. However, their involvement in water distribution and maintenance work at field channel level is very unsatisfactory. The on-farm water management practices adopted by farmers results in wastage of water and inequity in water distribution. The rotational issues could not be practiced in any of the seasons observed. The farmers' behavior reflects a highly individualistic pattern and an absence of a sense of community.

Task expectations of farmer organizations by farmers and officials. The task expectations of the water users' groups by farmers are mainly problem solving by the leading men of their organizations. In their view the farmer leaders should work to solve their problems. They should distribute water among the farmers under field channels and organize canal cleaning activities. In this respect they attribute the traditional role of vel vidane (water headmen) to the farmer leaders. The "failure" of the leaders to fulfill these expectations leads to serious criticism of them by farmers. All the seven farmer representatives in tk2 are waiting to resign because of this attitude of farmers, and their lack of cooperation for canal cleaning and water distribution. Though farmers are well aware that they have to clean and maintain field channels, their work in this respect is limited to cutting weeds and excludes desilting and minor repairs to canal bunds and structures under the field channel.

The officers of the Irrigation Department expect farmer organizations to clean and maintain field channels, adhere to the cultivation calendar, inform

them of irrigation difficulties and problems associated with irrigation water, and distribute water equally within field channels. From their point of view the organizations have so far failed to attend to these functions, especially to distribute water equally. Their contributions to O&M of the system are also not satisfactory. However, the organizations have been effective in channeling irrigation difficulties to the Department from the engineers' point of view.

The Irrigation Management Division has high expectations of the organizations. It expects farmers to handle O&M activities at the field channel level at present, and take responsibility at the distributary level in the immediate future, and participate actively in planning and implementation of agricultural programs in the project. However, farmers, farmer lenders, as well as the officers of the other government departments view the organizations as still too weak to carry out many of these functions. Since the farmer groups are still not in a position to attend to O&M work under field channels independently, handing over additional responsibilities would create many more problems in their view.

Are the Resources Adequate to Achieve the Objectives?

As we have emphasized in our previous reports, the problem of promoting farmer organizations is seen as peripheral to the overall project objectives, and as something only the Irrigation Management Division is responsible for -- as a marginal agency without power and authority dealing with a peripheral problem. In Kirindi Oya the organizational activities rest on the project manager who had neither office nor staff at the initial stage. The institutional organizers were sent some two years later to assist him. They left after one year. The program still suffers from lack of resourceful personnel to organize farmer groups in an effective way. Instead of appointing graduates without any organizational skills, action should have been taken to try alternatives such as using officers in the government service with such talents and skills, on secondment to the Division, or using less-educated personnel such as Agriculture Diploma holders or even, as now being tried, A-Level people. Lack of financial resources to hire more qualified personnel by offering better salaries has been mentioned as an important constraint.

It is also evident that the financial resources invested for the promotion of farmer organizations is inadequate. The funds allocated to train farmers and farmer leaders in this year suffice only to train a very insignificant number of them. The entire amount allocated for training is less than Rs 75,000/-, i.e. under US\$ 2,000., for 1989 in the new area of the project. In addition the training program suffers due to lack of resource persons to conduct them. This also illustrates the position of the Irrigation Management Division without sufficient financial resources to hire experienced personnel to conduct such training programs.

Conclusions and Recommendations on Farmers' Organizations

Many of the impediments to organizing effective farmers' organizations are beyond the control of local project officials. The security situation is one obvious example. Another is the continuing lack of a legal framework for legitimizing farmers' organizations for irrigation management. This section

focuses on things we think are actionable by the Irrigation Management Division and other agencies involved in Kirindi Oya.

1. It **was** evident from our interviews with fanners and fanner representatives that they are not aware of the objectives of the program and their responsibilities towards it. Therefore, the Irrigation Management Division needs to field effective institutional organizers and guide them to work with farmers to explain the objectives of the program. By December 1989 some A-Level people had been recruited and were under training in Polonnaruwa, though we question whether two weeks' training is sufficient. The Division must monitor their performance closely and guide them to establish rapport with fanners and organize farmers effectively. As discussed in chapter 7, these organizers were not very effective in the first half of 1990.
2. The institutional organizers should guide farmers to solve the problems within field channels with community participation instead of directing even minor difficulties to the Irrigation Department. Field channel cleaning and maintenance activities should be encouraged on a group basis instead of the present practice of individuals doing assigned sections as and when they prefer. This would encourage them to participate in group work and contribute to developing solidarity.
3. The Irrigation Management Division should avoid the present practice of problem solving by becoming directly involved with the Irrigation Department and other line agencies. Instead, the members of the field channel groups should be encouraged to discuss their problems and develop solutions themselves. Only serious problems needing the attention of higher level officers should be taken to the distributary organizations. The line agency officials should be encouraged to participate at those meetings to discuss these problems and assist farmers in finding solutions. The farmer representatives in turn should be encouraged to inform the other farmers about the decisions taken at distributary organization meetings.
4. Related to the previous point, project managers of the Irrigation Management Division must be encouraged to stop acting as the farmers' spokesmen. We have documented in previous reports the perception of other officers that fanners need not be invited to some committee meetings as the project manager could speak for them. This perception has been encouraged to some degree by project managers, since it is the only source they have for claiming any authority in the absence of control over budgetary or other resources. This tends to continue the dependency syndrome characteristic of Sri Lankan settlement schemes.
5. The farmer representatives are not entitled to claim any payments for the work they do for the community. It is therefore necessary to encourage the farming community to consider whether some compensation ought to be offered. Perhaps appointing them under the Agrarian Services Act would provide some incentive, since they would then be entitled to compensation from farmers.

6. The farmer leaders should be encouraged to study various alternative methods for water distribution within field channels during the land preparation period and to find solutions to problems by discussing them with group members. They should be trained in on-farm water management practices and informed on the practical implications of the design of the irrigation system and the necessity for rotational issues. Other farmers should also be trained on these aspects eventually.
7. The Irrigation Management Division project managers should encourage the institutional organizers to organize farmer groups independently, i.e., without the direct intervention of the project manager; and he should focus more on the supervision and performance evaluation of institutional organizers. Weekly meetings with institutional organizers, and periodic in-service training to understand their problems and provide guidance would help.
8. The Irrigation Management Division should provide sufficient financial assistance and experienced personnel to strengthen the training program at the project level. The training program needs to be prepared in consultation with project managers in order to address field level problems specific to the project.
9. Irrigation Management Division officials from head office need to supervise and evaluate the performance of the project managers by holding regular meeting with them in the field.
10. The Irrigation Management Division should proceed very slowly with the handing over of responsibilities for distributary management to farmers' groups until they exhibit the management capacity to manage the system below the field channel turnout. Handing over these responsibilities prematurely would further discourage the farmers and farmer groups. An intermediate step might be to implement the proposed participatory performance monitoring system (LBI 1989: chapter 4; see above).

COOPERATION AND COMMUNICATION AMONG AGENCIES AND FARMER GROUPS

In previous reports, we have documented a pattern of resistance to the Irrigation Management Division-formed farmer groups among some officials, and resistance to farmer representatives participating in project level committees. However, with the appointment of a new project manger to handle settlement- and land-related activities, the situation shows a change for the better. Our recent, observations substantiate that there is a more cooperative attitude towards farmers' organizations by the major agencies involved in the project. There is a genuine attempt by the Land Commissioner's and Irrigation Departments to solve farmers' problems in consultation with farmer representatives attending the subcommittee of project coordinating committee.

However, the fanner organizations are still weak. One of the main problems documented is the existence of a vast communication gap between the farmers and farmer representatives as well as between the officers and farmers. The reasons for this include the lack of participation at distributary

organization meetings by the field level officers, and the lack of initiative by farmers to hold regular field channel group meetings.

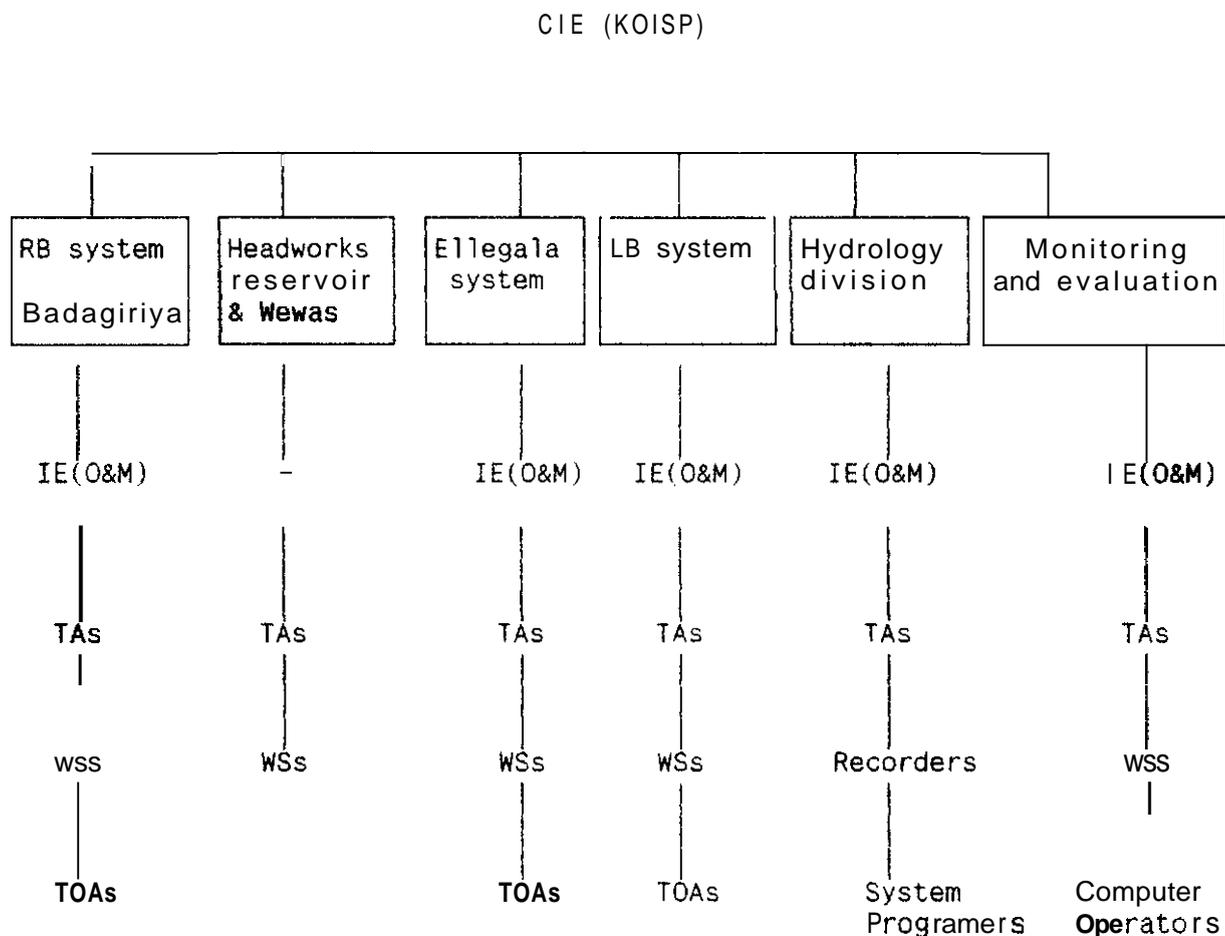
Previously, the lack of participation by some officials at distributary organization meetings was mainly due to conflicts that some line agencies had with the Irrigation Management Division. This problem has been resolved now. But in many cases the field level officers still do not participate at these meetings because they do not receive regular invitations indicating the date and time of meetings, and agenda. We recommend that the Irrigation Management Division should take the initiative to guide distributary leaders to invite the field level officers to such meetings through the heads of agencies. This is vital to build up a cooperative attitude, communication and mutual trust between the farmer groups and officials.

In addition we have recommended above that the responsibilities of the line agency officials to the program for promoting farmer organizations be written into their job descriptions, and payment of some allowances be made for their active participation in the program. We further recommend that project level higher officers and field level officers of line agencies be given some training in order to assist them to adjust to the requirements of the program as this work involves a considerable bureaucratic reorientation, which does not happen automatically. Finally, we recommend that field channel groups be encouraged to hold regular meetings to reduce the communication gap between farmers and farmer representatives.

Beyond these points, a fundamental weakness remains in the overall project management structure. This is that there is no overall authority with a mandate to achieve the overall long-term objectives of the project, in terms of balanced socio-economic development, and supporting the development of an implementable and profitable cropping pattern. Officials of each department focus on achieving the objectives defined for that department, which may or may not completely support the longer term objectives. A more integrated, authoritative, politically supported management structure is required.

We have therefore strongly recommended above the appointment of a senior overall "Resident Project Director" (the term "manager" is already over-used in Kirindi Oya) with full authority to insure the integration of each department's contribution to the overall objectives. This Director should have budgetary authority over line department heads in the project area. He would also administer the water allocation rules, and chair the water allocation panel meetings recommended above.

Figure 3.01. The proposed organizational structure for O & M organization in Kirindi Oya



Key to abbreviations

CIE is chief irrigation engineer

KOISP is kirindi Oya Irrigation and Settlement Project

IE is irrigation engineer

RB and LB are right bank and left bank, respectively

TA is technical assistant

WS is **work** supervisor

TOA is turnout attendant (irrigator)

CHAPTER IV

DESIGN-MANAGEMENT INTERACTIONS

I ———

Research conducted in many parts of the world reveals that there is a gap between the levels of potential and actual performance of irrigation projects. This gap can be attributed to various physical, social, institutional and managerial factors. One important factor is the inadequate attention being paid in planning and design of irrigation infrastructure to ensure a high degree of conformity between the design and actual operation. It is often evident that the design of the physical system embodies a set of fundamental operational and institutional assumptions, upon which the degree of success and quality of operation depend. In most instances, there is a high degree of interdependency between the technical, operational and institutional assumptions and requirements. In some cases, the technical and operational assumptions are either not realistic or difficult to realize within the institutional environment under which the irrigation system operates. Therefore, in a new irrigation settlement project like Kirindi Oya it is useful to review the design-management interactions within the institutional environment.

Research Questions

As outlined in the Inception Report (IIMI 1988a:15), this research component **assesses** and compares potential and actual performance, management options, and organizational requirements of the field channel and turnout designs and suggests alternative water distribution methods that will improve performance and manageability.

With these broad objectives in mind, the research on design-management interactions was guided by the five research questions listed in the Inception Report (IIMI 1988a:15). Those research questions are summarized here for easy reference.

1. What were the operational and institutional assumptions made in designing the turnouts and field channels?
2. What are the feasible options for water distribution among farmers? What is the flexibility in operation that farmers can utilize particularly when there is a mix of rice and other diversified crops under the turnout?
3. What are the levels of cooperation among farmers and types of organizations of farmers required for operating the rotations and sharing water under different conditions of resource availability --when water supply is adequate, and when there is shortage of water supply compared to the demand?
4. What is the impact of the field channel and turnout design and operation on the operation of the distributary canal? How frequently does the flow vary in the distributary and field canals?

5. What are alternative water distribution methods and practices that can lead to improved performance at the tertiary level in terms of equity of water distribution and water use efficiency? What are the management implications of adopting them?

Objectives of Irrigation-Settlement Projects

The choice of the basic elements of design and the size and scale of the project components are largely determined by the basic objectives of the project. The size and scale of the basic physical project components emerge from a complex interaction of the objectives of the project along with physical factors such as hydrology, topography and climate, and social, economic, and agronomic considerations.

The objectives of a typical irrigation settlement project can be viewed from different perspectives: the levels of farmers, agency personnel operating the system, and the nation. The objectives at these different levels show differences in interests and some degree of incompatibility among objectives. It is the planner's responsibility to blend these differences in interests and objectives at different levels in order to have an optimal choice of design elements.

At the national level, the objectives are to increase the food and fibre production, provide land and shelter for a maximum number of poor landless families, generate employment, and achieve self sufficiency. At this level the investment for a settlement project is partially an economic venture which brings economic returns to the national income in the long term. This objective interacts with the available resources of land and water to determine the area to be developed for a pre-determined cropping pattern which enable the settlement of the maximum possible number of landless families.

The objectives of the agency responsible for the operation of the system narrow down from the national objectives to a concern with allocating the available seasonal quantum of water among the maximum possible farmers in compliance with the basic water allocation and distribution scenarios as agreed with the farmers at the cultivation meeting and in conformity to the design and operational rules adopted by the agency. Implicit within this objective, the agency is concerned with providing reliable and equitable supply of water with simplicity of operation. These concerns with the interactions of institutional factors have given rise to the choice of the size of turnout area, field canal, capacity, size of farm turnout, etc.

The objectives of each individual farmer are somewhat in conflict with the objectives at the other levels. The individual farmer is concerned with the production of enough food for his subsistence and to maximize his income in the short run while trying to upgrade his quality and standard of living in the long run. Ideally the individual farmer prefers the most profitable crops that fit into his capability, with either a continuous delivery of water or a delivery on demand. This is a major area of conflict in objectives at his level with the other two levels. In particular the preferences of each individual farmer are not necessarily in harmony with the betterment of the entire farming community. Therefore this influences the choice of water distribution which has to ensure an equitable supply to the farming community at large.

Kirindi Oya Project: Background

The Kirindi Oya Irrigation and Settlement Project can basically be characterized by 1) the existence of an old irrigation settlement before the new reservoir project was commissioned, and 2) the limited availability of water for double cropping in the newly developed command area. These two basic characteristics have influenced the selection of cropping patterns, and apportionment of priority for water in the planning of the project. Though the irrigation system has been designed to cater for rice irrigation in both yala and maha seasons, the seasonal operation of the system is confronted with two basic challenges in order to conform with the basic project objectives. These are:

1. selection and implementation of an appropriate cropping pattern to make use of the limited supply of water to best achieve the objective of the project; and
2. selection of appropriate operational scenarios which do not jeopardize the water rights of the old system settlers and the equitable benefits to the new settlers, while achieving reliability and adequacy of water supply.

The second Appraisal Report prepared for the project (ADB:1982) envisaged a 200 percent cropping intensity with a mixture of rice and non-rice crops. The third Appraisal Report prepared for Phase II (ADB: 1986) envisaged through a simulation study a 170 percent cropping intensity (100 percent in maha and 70 percent on an average during yala) with a mixture of rice and other field crops. More recently, the water management consultants have proposed as the "most feasible" scenario a mixture of rice and other field crops on lowland areas, and irrigated and rainfed crops on upland areas (Water Management Consultants 1987: volume 1).

The Irrigation Department recently proposed a 'cluster system' for allocation of water. In this proposal water is to be issued first to head-end tracts of the new area and the drainage water coming from the new tracts has to be utilized to fill the tanks of the old Ellegala system, to enable the old settlers to make the best use of drainage water from upper areas of the new system. This, on paper, appears to be a feasible and appropriate strategy in order to ensure the overall water use efficiency of the water-short Kirindi Oya system. However, the old settlers collectively resisted the proposal and rejected it on the grounds that the new proposal would jeopardize their traditional water use rights.

The degree of success in canal operation depends upon the reliability, adequacy and equity of water supply. Examining these parameters involves many issues which can be broadly divided into two categories: technical and non-technical. The technical issues address the basic design assumptions made at planning and designing of the project as well as the subsequent operation of the system. The non-technical issues embrace the operational, institutional and organizational assumptions and procedures which are complementary to the technical issues.

The treatment of design-management interactions in Kirindi Oya should address one fundamental question: whether the irrigation system design has enough capability to meet the crop water requirements at the farm level with a reliable, adequate and equitable supply. This is considered the number one requirement that must be satisfied to certify that the irrigation system is capable of functioning satisfactorily. If not, one can investigate the technical reasons why such a conformity between the design and operational capacity does not exist. If the system is capable of delivering the supplies as planned or designed, and in actual practice this does not happen, then one can look into the operational procedures and organizational structures and their implications to identify the constraints, and possible improvements necessary to close the gap between actual and intended performance.

PROCEDURES FOR ESTIMATION OF WATER DEMAND

Technical Note no. 6 of the Irrigation Department (Irrigation Department 1981) describes the procedures to be adopted in determining the crop water requirements for rice and subsidiary food crops. The basic elements of the computational procedures and the assumed parameters are presented below.

1. The evapotranspiration (ET) of the reference crop is computed by the Modified Penman's method for the climatic variables at Mahalluppallama. This is considered to be representative for projects in the dry zone and intermediate zones of Sri Lanka. The 75 percent exceedence probability evapotranspiration values at Mahalluppallama are recommended and adopted for the design. These reference ET values are compared with the values computed by modified Penman's method on the basis of meteorological data from Hambantota and pan evaporation observations at Tissamaharama. The 75 percent probability evapotranspiration values at Angunukolapellessa are used for the preparation of water delivery schedules of the Irrigation Department. The pan-evaporation data at Weerawila monitored by IIMI, is provided in Table 4.01.

A summary of the seasonal total reference crop evapotranspiration deducted from Table 4.01 is as follows:

	<u>Reference crop ET (mm)</u>	
	<u>Maha season</u>	<u>Yala season</u>
Mahalluppallama	786	1060
Hambantota	1033	1083
Angunukolapellessa	856	982
Weerawila(tract 5)	905	1252

This table indicates that the crop water requirements during any typical yala season can be higher than the assumed values by 27 percent for the operational schedules, implying the importance of monitoring climatic variables in the project area.

Table 4.01. Comparison of monthly reference crop ET values at Mahalluppallama, Hambantota and Weerawila* (* project area right bank tract 5)

Month	Maha season (Oct - March)						Yala season (April - August)					
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
M. Illuppallama												
mm	157	109	117	119	127	157	150	162	175	190	193	190
mm/day	5.1	3.6	3.8	3.8	4.8	5.1	5.0	5.2	5.8	6.1	6.2	6.3
Hambantota ^a												
mm	173	154	150	177	180	200	183	183	174	185	181	177
mm/day	5.5	5.1	4.8	5.7	6.4	6.4	6.1	5.2	5.8	5.9	6.2	5.9
Angunukolapellesa ^b												
mm	149	103	116	149	155	184	149	160	155	175	165	178
mm/day	4.8	3.4	3.8	4.8	5.5	5.9	5.0	5.2	5.2	5.6	5.3	5.9
Weerawila ^c												
mm	216	165	161	93	134	136	168	201	234	186	229	234
mm/day	6.0	5.5	5.2	3.0	4.8	4.4	5.6	6.5	7.8	6.0	7.4	7.5

- a. Based on the meteorological data at Hambantota and pan evaporation observation at Tissamaharama for a time series of 26 years.
- b. Based on the meteorological data at Angunukolapellesa agriculture research station.
- c. Based on pan-evaporation observations in right bank Tract 5 by IIMI for one year.

2. The growth of the crop from sowing to maturity is considered in four stages, namely initial (sowing and seedling growth), development (vegetative growth), mid (reproductive growth) and late (ripening). The evapotranspiration of the crop differs for each crop growth stage and this difference is accounted for by multiplying the reference crop ET by a crop factor (Kc) for each growth stage. The growth stages and their respective Kc values for the crops common in Sri Lanka are shown in Annex 4.01.
3. The irrigation requirement is the amount of water to be delivered to the farm for land preparation and crop growth, when the effective rainfall is insufficient to meet such requirements.
4. The amount of water and the number of applications required for land soaking and land tillage (land preparation) which typically includes first ploughing, second ploughing and puddling vary considerably with the type of soils. For rice in the clay or heavy soils generally encountered in the lowland forms (LHG soils), the design procedure recommends two applications of water: first application of 100 mm in 5 days (2.31 l/s per ha) for land soaking and 75 mm in 10 days (0.87 l/s per ha) for land tillage, totalling 175 mm spread out over 15 days (1.35 l/s per ha). When transplanting is done instead of broadcasting it is further recommended that the land tillage requirement may be provided in two applications of 45 mm for land tillage and 30 mm prior to transplanting. These recommendations implicitly assume a land preparation period of 2 weeks for a typical farm allotment, which allows 5 days for land soaking and 10 days for land tillage. However, when rice is cultivated on upland soils consisting of well-drained Reddish Brown Earth (RBE), the corresponding land soaking and land tillage requirements are obviously high. The design procedures for the estimation of irrigation requirements do not recommend any corresponding values for RBE soils.

The Operation and Maintenance Manual (O&M Manual) prepared by the Water Management Consultants (1989) recommends that 50 mm is sufficient for land soaking if the land soaking is performed in a week. This would mean a requirement of 7 mm/day (0.81 l/s per ha). It also recommends that puddling can be performed with a layer of approximately 50 mm of water on the field. This would mean a land tillage requirement of 7 mm/day (0.81 l/s per ha), if land preparation is performed in one week, or 3.5 mm/day (0.40 l/s per ha) if the land preparation is spread out over two weeks (Water Management Consultants; 1989: Section IV4, pp.22-23),

The values recommended by the design guidelines and the values recommended by the water management consultants for the operation of the system are compared with the observed values in Distributary Canal 2 (DC2) of Branch Canal No. 2 (BC2) of right bank tract 5 in yala 1989 season in Table 4.02.

Table 4.02. Land soaking and land preparation periods, and irrigation water requirements in Kirindi Oya

	Design Guideline	Operation Guideline	Observed Values DC 2*
<u>Land Soaking</u>			
Period (days)	5	7	8
Requirement (mm)	100	50	400
(mm/day)	20	7	50
(l/s per ha)	2.31	0.81	5.78
<u>Land Preparation</u>			
Period (days)	10	14	30
Requirement (mm)	75	50	430
(mm/day)	7.5	3.5	16.0
(l/s per ha)	0.87	0.40	01.85
<u>Total</u>			
Period (days)	15	21	38
Requirement (mm)	175	100	880
(mm/day)	11.7	4.76	23.2
(l/s per ha)	01.35	0.55	02.68

* These figures indicate the actual water use, not the requirement.

The table shows the large difference between the assumed land preparation requirements and the actual water used by a typical farmer in Kirindi Oya (in DC2 of right bank tract 5). This indicates that what is actually happening in the field is different from what **has** been assumed in the design and operation models. A rough estimate of the amount of water being used by the farmer for the land soaking and preparation *can* be computed as follows:

a. Land soaking water (in week 1)

1 m depth of soil with porosity 35 percent with antecedent moisture content of 25 percent at the time land soaking begins.

Hence additional water required for completed saturation	=	100 mm
Topping up (ponding) water	=	100 mm
Seepage and Percolation losses in a week		
	7 x 10 mm/day	= 70 mm
Evaporation losses	7 x 5 mm/day	= 35 mm

	Total	□ 305 mm
		=====

b. Land preparation (in week 2 and 3)

The requirement is only to allow for S&P losses \square 140 mm

Thus the total water requirement for land preparation of a typical farm can be as high as 445 mm spread over a period of three weeks.

When non-rice crops are cultivated on RBE soils, land soaking is not separately provided for. The Irrigation Department design recommends one combined application of about 40 mm for land tillage at any pre-determined time in the land preparation period of 15 days. Some research conducted elsewhere recommends 40 to 70 mm (Dimantha, S. 1987).

5. The seepage and percolation losses (S&P) are assumed as 3 mm/day for maha and 5 mm/day for yala for lowland farms typically consisting of LHG soils. When rice is cultivated on upland farms consisting of RBE and intermediate soils, the corresponding S&P values should be higher than that of LHG soils. However, no recommended values are found in the design procedures and guidelines. When non-rice crops are cultivated for the purpose of computing the irrigation water requirements at farm level, the land soaking and preparation activities are assumed to commence in staggers. The design guidelines recommend three staggers in such a way that water issues and farm operations are to be carried out on 1/3 of the command area at any given time. This means that the cropped area is divided into three equal staggers with a time lag of two weeks between the commencement of each successive stagger.

For the purpose of scheduling irrigation, the O&M manual recommends a somewhat different stagger. It suggests a distribution of 20, 60 and 20 percent of the command area for staggers 1 to 3 respectively with a time lag of only one week between each successive stagger.

6. Technical note No. 6 recommends the following values to be considered as effective rainfall (Re) in the estimation of irrigation water requirements for design purposes.

For rice Re = 0.67 (R-25.4) subject to a maximum value of 225 mm and zero when actual rainfall (R) is 25 mm or lower.

For non-rice crops Re = 0.67 (R-0.25) subject to a maximum value of 75 mm or zero when R is 6 mm or lower.

The actual rainfall to be considered for estimating the effective rainfall is the 75 percent exceedence probability rainfall at the required location. However, the operation and maintenance manual recommends the adoption of the 70 percent of the 80 percent probability of exceedence rainfall as the effective rainfall in the preparation of water delivery schedules and planning water deliveries.

Based on the 80 percent probability rainfall at Tissamaharama, deduced from the data from more than 50 years, the two recommendations on effective rainfall compare as shown in Table 4.03.