Technical Mice Study
(T.A.1480 SRI)

Irrigation Management and Crop Diversification
(Sri Lanka)

PHASE II

Seasonal Report
Kirindi Oya
Maha 1991/92

October 1992

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

in association with

Irrigation Department
Department of Agriculture

Irrigation Management Division
Land Commissioner's Department

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Chapter 1

INTRODUCTION

This report describes activities and results at Kirindi Oya of the Irrigation Management and Crop Diversification Project (ADB TA 1480 **SRI)** for the 1991-92 Maha season. The report also describes plans for Yala 1992. The report is organized by the three main components:

- Main System Management.
- Tertiary System Management.
- Pilot Program for Other Field Crops (OFCs).

During the season, progress achieved on the several sub-components of the Main System Management component includes:

- Water allocation among the sub-systems was addressed by a high level committee and a draft set of recommended rules were prepared for further discussion and ratification.

- Simulation modelling work for management of the Right Bank Main Canal (RBMC) has been undertaken. Systems for measuring and communicating flow data for the RBMC were successfully established and the performance of the model was evaluated from the point of view of operators and farmers.

- **In** the water balance study **of** Ellegala Irrigation System (EIS), data collection on water deliveries, calibration of measuring devices, updating the water balance model, and analyses of the inflows/outflows were completed. Also, a decision making study was carried out as a preliminary to expanding this work to cover improvements to water management within EIS.

- For maintenance management, prioritization and selection of maintenance works were completed. **In** addition, the cost analysis of past expenditure data arid the assessment of administrative cost were done.

Under the Tertiary Manaeement Comuonent, pilot work was Carried out in DC5 of RBMC. Attempts were made to undertake pre-seasonal maintenance, introduce water sharing practices during land preparation and crop growth period, collect water delivery data and data on cultivation activities. Only partial success was achieved for various reasons.

The Pilot Program for OFCs was carried out in **DC2** of Tract **3** under the Left Bank Main Canal (LBMC). Crops were produced satisfactorily with the active participation of agency officials, although some problems remain to be solved.

Training activities included sending **25** officers from different line agencies on a three day study tour to Polonnaruwa and Kimbulwana Oya with **the** objective of exposing them to operation, maintenance, and the participatory management of irrigation systems. Also, a one and half day workshop on training skills was conducted for officers. A three day workshop on need based maintenance management was carried out for ID and IMD staff and FRs. All the resource persons were from the agencies.

Maha season accomplishments were the result of work by the implementing agencies: Irrigation Department (ID), Imgation Management Division (IMD), Department of Agriculture (DOA), and Land Commissioner's Department (LCD). During Maha, ID and IMD head office staff began to participate in SCC meetings as decided at the **first** SAC meeting. A new chairman of the OFC Program Sub-committee was selected following a change in RE(LB). Due to another 'transfer the chairman of the Main System Sub-committee will be changed. The contributions of the outgoing members are greatly appreciated.

Chapter 2

MAIN SYSTEM MANAGEMENT

The Main System Management Component of the project includes several sub-components:

- Seasonal water allocation
- Main Canal Operation
- Water balance study of the five tanks in Ellegala Irrigation System
- Maintenance management

From this season, IIMI in addition to the above started looking at the management of the Ellegala Irrigation System (EIS) as a whole in order to find ways to improve water use within EIS.

Each of these sub-components is discussed below.

2.1. Seasonal **Water Allocation**

Currently, water is allocated to the various sub-systems of Kirindi Oya by the Project Management Committee (PMC). The Senior Imgation Engineer (SIE) explains the water situation of the Lunugamvehera reservoir and the expected inflow for the months ahead and advises on the number of tracts in the new area in addition to the Ellegala systein that can possibly be irrigated.

In this process, he assumes a release of 56,000 ac.ft. to the EIS if the new area **is** not irrigated. If the new area is irrigated, then the ID assumes about 30% of water supplied to the new area comes as drainage water to the EIS and therefore, the release from Lunugamvehera will be reduced. However, the IE (Tissa) makes a request to PMC for the quantum of release to the EIS based on the previous data on water allocation to EIS and feedback from the farmer representatives of EIS. This request is usually accepted without discussion by the PMC. One major reason for this ready acceptance is insufficient data on the current utilization within EIS and on contributions from drainage and rainfall to EIS. Estimate of these quantities have only recently been available from the water balance study undertaken as part of this project.

Realizing the importance of arriving at an acceptable seasonal water allocation plan, the Central Coordinating Committee for the KOISP has constituted a 'Special Task Force' under the chairmanship of the State Secretary for Irrigation to prepare guidelines for the allocation of water from the Lunugamvehera reservoir among the different sub-systems. 'The State Secretary in turn constituted a sub-committee of which IIMI is a member.

The sub-committee has not yet made its final recommendations; however, there seems to be broad consensus among the committee members for: a) growing short-age paddy variety (3-3½ months) throughout the project area; b) starting the Maha season after the: first of October only after receiving 75 mm of rainfall; c) raising only OFCs during Yala in the new areas; and d) apportioning the new and old areas into zones to receive water for paddy and OFCs in a prescribed rotation. Rotation details are yet to be worked out,

2.1.1. Inflow Analysis

Thirty-five years of monthly flow data at the Lunugamvehera reservoir site obtained from the Irrigation Department was analyzed for trend, cyclicity, modal values of occurrence, frequency of occurrence and flow pattern through a scatter diagram.

The results indicate that the modal values of flow occurrence would be sufficient only to have:

* During maha, 100% paddy in EIS, 50% paddy in the newly developed area and OFCs in the remaining 50% of the new area.

* During yala, 80% paddy in EIS with 20% OFCs in EIS and all of the new area will be supplied with water for OFCs.

These conclusions are based on limited water-use data collected during Maha 1991/1992 and the current water use. These conclusions are to be firmed up with additional data collection.

2.2. Improvement of **Main** Canal Operation

The Right Bank Main Canal (RBMC) was selected for this sub-component. The activities undertaken under this sub-component in the RBMC included the following:

- Defining water delivery targets.
- Refining monitoring and feed back.
- Evaluation of the utility of operational targets.
- Response mechanism to contingencies.
- Reviewing decision making.

This work has been carried out in cooperation with another activity involving the creation and testing of a computer canal simulation model that is to be used for monitoring canal performance. This activity is separately funded by the Government of France.

2.2.1. Progress During Maha 1991-1992

During maha, the monitoring and feed back systems for RBMC were: refined through the data collection program for the simulation modelling project. Measurements (spindle heights) were taken at BC, DC and FC off-takes originating from RBMC. The data was collected through irrigators engaged in gate operations. Work Supervisors (WSs) supervised the data collection program and relayed the data collected at tract level to Resident Engineer's (Right Bank) RE (RB's) office. In addition, the WS exhibited the data collected in his tract on a notice board kept at his office. Once the data was relayed to the RE's office, lie put the data into the computer for the calculation of discharges made to each and every DC. The daily discharges made to DCs are exhibited in the notice board kept at RE's office for this purpose. If the discharges were above the targets, WSs were instructed to reduce the discharges.

Though this system of data collection was not new to the ID officials, they had not been able make it work in a systematic way. After the implementation **of** the simulation modelling project, it became necessary to collect data for monitoring and evaluation purposes. WSs were paid a small incentive for their special attention to the supervision of data collection and communication. The training necessary for the data collection had been given to the field level officers by ID with the collaboration of IIMI.

In order to evaluate the effects of the simulation on system operation and to prepare for adoption of the new system operation on a wider scale, IIMI Research Officers (ROs) also carried out a study of decision making practices on the RBMC.

2.2.2. Results and Achievements

* **As** a result of the implementation of a monitoring and feed back system, the system managers are now in a position to know what is actually happening in the system under their charge. The procedure used prior to the implementation of this system was to respond to farmers' complaints by making field visits. Now the system manager is in a position to have **an** idea of the canal operations with lesser number of field visits. **He** is also in a position to give the canal operators necessary instructions based on the data received from the field.

* The notice boards at the offices of WSs and RE publicly state the discharges made to BCs and DCs originating from RBMC. This helps the ID officers respond to farmers' complaints in a rational way.

* The data collected has helped the RE to review the present water issue schedule prepared by the SIE. The RE believes, based on his observations in implementing this program, that the targets are higher than the actual field requirements.

* Interviews with farmers reveal that water problems were reduced considerably this season. It is very clear that the monitoring and feedback system has contributed to this improvement.

* The monitoring and feedback system has helped the canal operators in their activities. They now know whether the target discharge has been made to the canal. The earlier system of responding to farmers requests have been changed. **As** a result, the number of operations at DC and cross regulators has been reduced.

2.3. Water Balance Study in Ellegala System

Ellegala Irrigation System (EIS) receives irrigation water from two main sources: Lunugamvehera Reservoir and run-off and drainage contributions from its own catchments. In order to use the water supply from Lunugamvehera more efficiently, Kirindi Oya managers require a good data base on run-off and drainage to EIS, water utilization for crop growth within EIS, losses, occurring in the system and operational procedures of the sub-systems. The Ellegala Water Balance Study is intended to provide a good data base as well as to develop operational procedures for the use of system managers. The main activities under this component are:

- Establishing a flow measurement and communication network.
- Development of a computer model for water balance in EIS.
- Field testing the model and determination of inflows and outflows of EIS.

2.3.1. Activities During Maha 199111992

The following activities were implemented under the EIS water balance study:

- Completing the balance work of updating system data (fixing sill levels, gate sizes etc.) and establishment of measuring points.

- Training data collectors.

- Developing and updating the computer model.

- Data analysis using the model.

Updating Tank Data: **During** the previous Yala most of the work related to updating the system details and establishing a communication network was done and the balance work was completed during this season. New data collection locations were identified during the implementation and the locations were calibrated. These works were completed by IIMI with assistance of **ID.**

Training Data Collectors: The EIS Water Balance Sub-study Committee prepared a plan for the implementation of the study at the planning workshop. According to the action plan, an orientation program for data collection was held on 13 August 1991 at the office of IE (Tissa). Members of the Sub-study Committee visited the measuring points with the data collectors and gave them field training on data collection.

After running the computer model with data collected during the first week, many discrepancies were observed in the data. Therefore, revisions were introduced in the data collection procedure and another training session was organized for the data collectors.

Developing the Computer Model: A computer model based on Lotus 1-2-3 was developed by **SIE** for computing discharges and tank balancing. The orifice equation was used for computing discharges through gates; height capacity and height **area** equations developed for individual tanks were used for the water balance. Difficulties arising from using long time intervals (15 days) were averted by using a ten-day period. Also certain problems caused by the original version of the program was overcome by modifying the program. Further development of the model is planned by the Sub-study Committee to reduce the computer time **needed.**

Data Analysis: As a test run of the model, data from 21 October 1991 to 30 January 1992 was entered and the results for the period of Maha 199111992 were obtained. This trial has shown that the model is capable of analyzing the water balance of EIS but it needs improvements in order to obtain the information in a form usable for system operation.

2.3.2. **Results and** Achievements

The results achieved under each activity are described below.

Updating Tank Data: All basic hydraulic data for EIS tanks, balancing equations and a few sluice sill levels were updated. Ceramic gauges in metric scale were fixed at 26 measuring locations taking care to measure maximum depth of water in places of measurements.

It was observed in two locations at Weerawila and Yodawewa, that the newly fixed tank water level measuring gauges were not long enough to measure the maximum water level in the tank. Therefore, measurements were made by placing a foot-ruler on the gauge temporarily. Spindle heights of the sluice or controlling gates were used for calculating the gate opening. In Tissawewa, the spindle of the sluice gate has been covtxed by a casing and could not be seen. This made it impossible to measure the gate opening directly. The ID practice was to count the number of rotations made by the gate operator and convert it to height. This was not a reliable practice as the operators are likely to make mistakes when counting the number of rotations. Therefore three measuring tape gauges were fixed to the spindle and a permanent reference point was marked in order to measure sluice gate opening. Since this tape gauge had been stolen after a few days of fixing, the earlier practice of counting the number of rotations made by the spindle was used again to calculate the gate opening.

As a result of this work, a better flow measuring system and communication network was established during this season. Despite a few errors in some places, the data collection and transmitting system arrangement worked satisfactorily.

Training Data Collectors: Permanent field laborers hired by the ID for gate operations have been entrusted with data collection while attending to the gate operations Some: elderly persons in employment lacked knowledge of the metric measuring unit system and therefore they recorded gauge reading in imperial measuring units in the data sheet without indicating the unit of measurement used. After continuous supervision and on the spot training on how to measure metric gauge reading easily and how to convert measurement!; made in imperial units to metric units and vice versa, some progress in their performances could be observed. In comparison with the first set of data, the data received at present is vastly improved due to the training given to these operators.

Developing the Computer Model: A computer model based on Lotus 1-2-3 was developed for water balancing of EIS. However, there is a practical difficulty when using the orifice equation for calculating discharge. This arises because the flow conditions -- free flow and submerged flow -- have to be noted based on the downstream water level of the orifice. Since all the tanks have barrel outlet through its dam the flow just downstream of the sluices cannot be measured. To overcome this problem, gauges have been fixed with reference to sluice sill on the open-end of the barrel outlet. When the downstream water level is more than 2/3 of upstream water level of the orifice, it is considered to be under submerged condition in our computations.

The main problem with the computer model is that it is time consuming and requires a lot of computer memory. Further improvements to the Lotus based model will be made while attempts are also made in developing a more efficient and user friendly model using Fortran.

Because of the problems of data quality caused by ineffective training of the data collectors, tremendous efforts had to be taken in scanning the data before feeding it to the computer. Presently, data analysis for the period from 21 October 1991 to 28 January 1992 has been completed.

Individual Tank Analysis: Figures 2.1 to **2.6** are graphs that report different aspects of the analysis of the data by the computer model for Weerawila, one of the EIS tanks. Figure 2.1 shows clearly how the tank level responded to rainfall. Figure 2.2 shows how inflow from the feeder canal to Weerawila responded to rainfall while Figure 2.3 shows how drainage into the tank from the KOISP new areas as well as run-off from Weerawila's own catchment responded to rainfall. These three graphs clearly show that the tank gets a major portion of its total inflow from rainfall and drainage rather than from Lunugamvehera reservoir.

Figure 2.4 shows drainage inflows and spill from Weerawila. It was noticed by many observers that the EIS tanks, particularly Weerawila, spilled quite heavily at times. Figure 2.5 shows the relation between the spill and tank water levels for Weerawila Tank. Figure 2.6 shows tank water level, inflow into and net flow through main canal from Weerawila.

The data analysis made through the computer model has made these relationships available to system managers for the first time.

Minimizing Spillage: Spilling from the EIS tanks is considered a waste of water since the same water, if not released from Lunugamvehera Reservoir to EIS, could have been used in the new areas of KOISP.

As is shown in Table **2.1,** active storage of EIS tanks is around 17,350 ac.ft. At the commencement of the Maha 1991-92 season (late September), the EIS tanks were partially filled with water from Lunugamvehera reservoir. No attention was paid to the quantity normally received in the system as local run-off from the Kirindi Oya and from the local catchments of the five EIS tanks.

Table 2.1
Storage Capabilities in Ellegala Irrigation System

TANK	TWL at #		Capacity at		Active System	
	MOL #	FSL #	MOL	FSL	Storage	A. Storage
(ft) (ft)	(acft)	(acft)	(acft)	(acft)		
RB SYSTEM						
Pannagamuwa	5	8.1	93	817	724	
Weerawila	6	12.5	3966	11083	7117	7841
LB SYSTEM						
Debara wewa	5.5	8	305	750	445	
Tissa wewa	9	15.5	479	3209	2730	
Yoda wewa	7	12.3	1769	8103	6334	9509
EIS Total:						17350

TWL = Tank Water Level
MOL = Minimum Operation Level
FSL = Full Supply Level

Table 2.2 shows that there were no water releases from Lunugamvehera Reservoir to EIS between 21 October and **28** January. But there was a considerable quantity of run-off and drainage to the feeder canal system from the areas located at higher elevations. These areas comprise: the natural catchment of the Kirindi Oya and part of newly developed area of the KOISP. Analysis of the data shows that 9697 ac.ft. (Table 2.2) of run-off water received by the feeder canal system was distributed among the five tanks in this period.

In addition, as illustrated by Figures **2.1** to **2.3** for Weerawila Tank, every tank received run-off from its own catchment area, From these tables and figures, it can be inferred that spilling of EIS tanks often occurs due to rains in the local catchments.

Table **2.3** summarizes the balances for the individual tanks in EIS. **As** is clearly evident in Figure **2.7,** spills from Pannagamuwa Tank and Tissa Tank are counted as inflow to Weerawila and Yodawewa respectively. In calculating the surplus in EIS, spillage of Debarawewa **is** also considered as drainage inflow to Tissawewa. Wastage occurs only when spilling occurs in Weerawila and Yodawewa. According to our analysis *total* outflow or wastage **in** EIS system during the period of study was 5944 ac.ft.

Table 2.2
Feeder Canal Discharges

Period		RF (mm)	Lunu.Re	Gamu.	F.Debara (acft)	F.Tissa	E.LB Total	E.RB Total	Total
						Ellegala LB			
21-Oct	30-Oct	33	0	0	62	336	399	2240	2639
31-Oct	09-Nov	121	0	24	120	144	287	0	287
10-Nov	19-Nov	153	0	3	185	570	758	68	826
20-Nov	29-Nov	10	0	165	39	66	270	0	270
30-Nov	09-Dec	4	0	155	311	70	535	6	541
10-Dec	19-Dec	210	0	197	279	1481	1958	25	1983
20-Dec	29-Dec	10	0	145	142	196	483	22	505
30-Dec	08-Jan	15	0	262	392	501	1155	72	1227
09-Jan	18-Jan	2	0	289	331	585	1205	12	1217
19-Jan	28-Jan	0	0	7	90	103	200	3	203
Total		557	0	1246	1950	4053	7250	2447	9697

RF - Rainfall
Lunu. - Release from Lunugamwehera reservoir
Gamunu - Supply to Gamunupura
F.Debara - Feeder canal supply to Deberawewa
F.Tissa - Feeder canal supply to Tissa wewa
E.LB - Total supply of Ellegala LB feeder canal
E.RB - Total supply of Ellegala RB feeder canal

This study clearly shows that the spilling of the **tanks** can be avoided and the system *can* be operated more efficiently by maintaining the minimum operation levels in the **tanks** at the commencement of the season.

Drainage Analvsis: Another important factor is brought out by the analysis of the Drainage Contribution for Unit Rainfall (DCUR) ***(see*** Table **2.4).** Ellegala Irrigation System is located at the tailmost part of the Kirindi Oya system. Run-off and drainage water originating from higher new settlement areas flow through the command area of EIS and reduces its irrigation demand. This should be considered when allocating water from Lunugamvehera Reservoir to EIS. Catchment run-off of individual **tanks** in EIS differs from each other for the reason that some catchment areas include newly developed area under Lunugamvehera. Drainage flows from these **areas** vary with irrigation supply to the new project area.

Table 2.3
Balancing of Ellegala Irrigation System

	Command	Tank Inflow		Tank Outfows				System	
	Areas (Ac)	Feeder (acft)	Drainage (acft)	M.canal (acft)	Release (acft)	Spill (acft)	Losses# (acft)	Surplus (acft)	Balance (acft)
ELLEGALA RB SYSTEM									
Pannagamuwa wewa	560	2447	1145	948	2788		-115		
Weerawila wewa	2301	2788	10765	8797		1898	-464		
Total:			14357	9745			-579	1898	3293
ELLEGALA LB SYSTEM									
Debara wewa	945	1950	5106	5647		1945	-144		
Tissa wewa	2750	4053	13397	8081	10173		-182		
Yoda wewa	3267	10173	2425	6839		4046	-642		
Total:									
EIS Total:	9823		14357	9745			-579	1898	3293

Drainage conditions to EIS vary with the following four conditions:

1) Water is issued to the entire new area.
2) Water is issued to RB Tract 1, LB Tract **1,** LB Tract **2** and LB Tract **3.**

3) Water is issued to RB Tract 2, RB Tract 5 and RB Tracts 6 and 7.
4) No water is issued to the new area.

Table 2.4
Drainage Contribution for Unit of Rainfall

Conditions: Water issue to entire New Area
Water issue to RB Tract 1, LB Tract 1, 2 and 3
Water issue to RB Tract 2, Tract 5, 6 and 7
No water issue to New Area
Result under condition (ii)

TANK	Drainage Flow Exceedance Probability (Acft/mm)		
	90%	75%	50%
Pannagamuwa wewa	4.4	6	19
Weerawila wewa	7	16	40
Debarawewa	4	9	29
Tissa wewa	5	13	46
Yoda wewa	3	9	19

In Maha 1991/92, condition one applied. The quantity of drainage received on a particular day was divided by the quantity of rainfall on the corresponding day for calculating drainage contribution for unit rainfall. These values are tested against the exceedance probabilities of 90%, 75% and 50%. The results of this analysis are shown in Table 2.4. It can be seen from the table that the drainage contribution for unit rainfall in Pannagamuwa, Debarawewa and Yodawewa are somewhat equal. This is because the catchment areas of these tanks are small compared to Weerawila and Tissawewa.

DCUR can be calculated in this way for the other conditions under the Water Balance Study and the result can be used to develop rules for the allocation of water as well as for the operation of EIS. A Pre-seasonal Allocation Plan for seasonal decision making can be based on the probable drainage contribution calculated on the basis of probable. rainfall and probable availability of water in that season. The area to be cultivated in a particular season can be decided on the basis of this analysis. The DCUR can be used as a guideline for deciding appropriate minimum operational levels for the individual tanks.

Water Duties For EIS: Analysis of water duty for the study period is given in Table 2.5. Pannagamuwa showed the lowest duty at 1.7 ac.ft./ac. for this crop growth period. This was mainly due to the location of Pannagamuwa command area. Part of this command area is benefitted from seepage water supplied to Weerawila Tank and therefore the irrigation demand of the tank is comparatively low. The second reason for the low duty is the very short canal system and good water control in this area.

The highest duty of 6.0 ac.ft./ac. was reported from Debarawewa. Though the command area under this tank is moderate (945 ac.) when compared with other tanks, it has a longer right bank main canal. In addition, re-use of drainage water too is very much less in the command area under this tank than under other tanks.

Tissawewa and Yodawewa have large command areas but duty was low. This was mainly due to high re-use of drainage water in the command areas of these tanks.

2.4. Management Aspects of Ellegala Irrigation System

A management study in the Ellegala system was undertaken as a research activity to supplement the findings of the water balance study of EIS. The main objectives were:

Table 2.5
Tank Duties for Crop Growth Period
(October 21, 1991 to January 28, 1992)

Name of System	Command Areas (Ac)	Main Canal Discharges (acft)	Tank Duty Acft/Ac
Release from Lunugamwehera		0	
ELLEGALA RB SYSTEM			
Pannagamuwa wewa	560	948	1.7
Weerawila wewa	2301	8797	3.8
ELLEGALA LB SYSTEM			
Debara wewa	945	5647	6.0
Tissa wewa	2750	8081	2.9
Yoda wewa	3267	6839	2.1
Total:	9823	30312	3.1
Irrigation Duty (Ex-sluice) for DC5 Sub. RB Tract 01:			3.2

- To understand decision making for water allocation, and system operation. This was specially required as the EIS tanks started spilling during Maha, raising the question of the effectiveness of the current management process in EIS.

- Collection of information to help prepare the Yala 1992 program for improving system management in EIS to be implemented with the participation of ID and IMD.

2.4.1. Results

The study showed the following:

* It was discovered that decision making for water allocation for EIS is not based on reliable information about needs. Instead water allocation and distribution is carried out largely on the request of EIS farmers and IE (Tissa).

* No irrigation schedules are prepared for either individual tanks or the total EIS system. As a result, there is no way to determine issues for individual tanks. The system manager has to fill the tanks on the demand of the farmers. This practice is an incentive for EIS farmers to waste water. This is true not only in respect of water issues to individual tanks but also for issues to DCs under EIS tanks.

* The physical system (canals, structures, etc.) are dilapidated. This is likely to create problems for implementing rotations in these systems.

* Since the commissioning of KOISP, EIS farmers have enjoyed 200% cropping intensity. Not all EIS farmers could achieve 200% cropping intensity prior to the construction of Lunugamvehera. EIS farmers are womed that this privilege will be withdrawn in future. Any attempt to change the present practices should be considered with utmost care or else there will be tremendous resistance from them.

* Prior to the construction of Lunugamvehera, EIS farmers started Maha cultivation in mid October and Yala cultivation in March after the beginning of Maha and Yala rains respectively. It is possible to make maximum use of the rain in the local catchment if the management decided to go back to this practice. Tank spilling too could perhaps be avoided by this practice.

2.4.2. Maintenance Management

The maintenance management sub-component is intended to induce improvements in maintenance. When the distributary systems are handed over to the farmers, the conveyance efficiency and reliability of water supply in the main systems need to be maintained at high standard to build confidence among farmers. Therefore system managers have to pay special attention to maintaining the system at a reasonably high level within the given resources, constraints, procedures, practices, and traditions. The ISM project in Polonnaruwa systems has realized the importance of this aspect and a similar work plan has been drawn up in view of addressing maintenance problems during the post rehabilitation period. Unlike ISMP, the maintenance management system introduced under **this** sub-component has an in-built monitoring and feed back mechanism.

Table 2.6
Distribution of Allocation (IMD) for Operation and Maintenance 1992

Scheme	Com.Area Acres	Maintenance Rupees	Operation Rupees	Total Rupees	Main/Acre Rupees	Oper/Acre Rupees	O&M/Acre Rupees	1991 Alloca. Rupees
Hambantota	14906	665000	540000	1205000	44.61	36.23	80.84	940800
Tissa	10433	575000	335000	910000	55.11	32.11	87.22	704872
Badagiriya	2100	98000	52500	150500	46.67	25.00	71.67	120344
Right Bank	10408	340000	221000	561000	32.67	21.23	53.90	479175
Left Bank	4856	160000	104000	264000	32.95	21.42	54.37	236012
Southern Range	42703	1838000	1252500	3090500	43.04	29.33	72.37	2481203
Uda Walawe	29640	4675000		4675000	157.73			

The salaries of WSs from ID vote = Rs. 532,850 - 12.48 per acre
The salaries of TOAs from ID vote = Rs.1,427,150 - 33.42 per acre
The salaries of TOAs of Walawe = Rs.1,350,000 - 45.55 per acre

There are two main activities under this study component:

- Development and implementation of maintenance procedures.

- Evaluation of impact of maintenance on system performance.

During the Yala 1991, this sub-component has focussed on developing maintenance procedures and has started work on expenditure analysis.

The following items of work were identified as the work plan for Maha 1991/92:

- Completion of prioritization and preparation of final estimates.

- Completion of maintenance cost analysis and assessment of the administrative cost.

- Providing training and awareness on maintenance management for TAs, WSs, IOs, and FRs.

- Preparation of an annual work plan for maintenance.

- Calibration of selected locations in the main canal to evaluate the impact on hydraulic performance due to maintenance work.

- Implementation of maintenance work.

Work was continued on the Weerawila main canal as the pilot area.

2.5. Progress During Maha 1991-1992

2.5.1 Progress During Maha 1991-1992

The work plan was successfully carried out during the season. This program has introduced a number of ID officers to need based maintenance. ID officers also used the diagnostic walk through and farmer consultation to determine maintenance needs .in sub-systems outside of the pilot area. It is clear that this method is replicable and there is a positive response from the system operators.

Allocations for Maintenance: Maintenance allocations to the ID in Kirindi. Oya are quite low.. These allocations are part of a total allocation for operations and maintenance provided through the IMD. The O&M allocation to Tissa Division made available :at beginning of the year was Rs466,110; it was later increased to Rs575,000. Since the total extent of irrigable lands under this division is **10,433** acs, the allocation is about Rs55 per acre. **As** is shown in Table 2.6, the allocations to the other parts of Kirindi Oya are even lower. For the Southern Range as a whole there was a 16% increase in O&M allocations for 1992 from Rs3,090,500 to Rs2,660,000. However, within the Range, O&M allocations range from Rs53 per acre to Rs87 per acre. Old systems like Tissa and Hambantota are the most favored because it is felt that new systems like KOISP need less maintenance. Also comparatively higher allocations were made to Tissa Division to cover its high overhead costs.

The O&M allocation does not cover the salaries of the maintenance staff; these salaries are covered from other ID allocations. The O&M allocation covers the salaries of casual staff (typists, peons, watchers, drivers, etc.), travelling and subsistence of staff, vehicle repairs, etc. Theoretically the cost should be more or less uniform across systems unless there are some inherent difficulties in system operations which demand increased travelling, human effort, machinery, etc. Some of the differences among divisions may be clue to a fixed number of casual staff attached to these divisions irrespective of the work load.

In comparison, the amount allocated by the Mahaweli Economic Authority (MEA) for the maintenance of about 30,000 acres of the Uda Walawe Project is Rs4,670,000 about Rs156 per acre. **At** Uda Walawe, unlike Kirindi Oya, the operation and maintenance of the headworks is funded separately. In addition, **MEA** allocations for maintenance of roads, premises, buildings, and vehicles are much higher than ID allocations for the same items. **An** analysis of the maintenance allocation to the Southern Range of ID through IMD and the total allocation of Uda Walawe Project through **MEA** is given in Table 2.6.

These figures show that the maintenance expenditure in Uda Walawe from MEA is **2.82** times that of ID. It is necessary to evaluate the performance of the physical system and also the effort required in operation activities to determine the significance of this difference. In case of Mahaweli, the operation cost as defined by IMD cannot be easily separated in their budget. The overhead cost of Mahaweli system includes only the salaries of the irrigators - about Rs46 per acre. The comparable figure for the Irrigation Department is about Rs33 per acre. On the other hand the salaries of WSs provided by the ID works out to Rs12 per acre.

If lack of expenditure on maintenance is the major reason behind the need for rehabilitation at close intervals then the most of Mahaweli systems should have a longer life compared than ID systems. In fact, the need for rehabilitation does not depend solely on maintenance levels. Other factors contributing to shorter rehabilitation cycles are: quality of original construction work, compatibility of the designs and the operation of the irrigation network, farmer participation, etc. Proper maintenance with active farmer participation has resulted in long lasting irrigation infrastructures in some schemes. Therefore the appropriate level of maintenance investments should be established considering both the economic and management aspects. Also close monitoring of maintenance should be established.

In deciding the expenditure level it **is** also appropriate to pay attention to: work needed considering the size, the nature, and the age of the system; the quality of inputs (skill, salaries of the implementing staff); and the level of farmer participation. In this analysis it is necessary to evaluate the maintenance efforts of the agencies. The expenditure policies for **O&M** should be studied thoroughly with due considerations to above **mentioned** facts with the goal of bringing expenditures to appropriate levels.

Preparation of Estimates: The final estimate for repairs **needed** on the Weerawila main canal is shown in Table **2.7.**

This estimate was submitted to the DDI for his actions as prescribed in the new procedure. The final estimate was Rs285,000 but the allocation originally made available for this work item was only Rs40,000. Thereafter ID received an additional allocation from the IMD for Tissa Division. The expected increase for the Weerawila system will be between **Rs25,000** and Rs30,000.

Weerawila sub-system has been allocated only a fraction of the sum actually required for maintenance. This clearly indicates a substantial budget deficit. Ways and **means** to overcome this situation are under study. Part will be overcome by farmers doing Shramadana work. The Irrigation Engineer has proposed mobilizing the maintenance labor gang for certain items; the expected savings from this activity is Rs59,925.

The DDI set the priorities for implementation after consulting the Irrigation Engineer. Desilting **has** received the lowest priority not because it consumes lot of money, but because the most essential items for conveyance of water are the weeding, repairs to structures and other **earthwork** for the safety of the system. The first three items (Priorities 1,2, and **3)** will

Table 2.7.
Estimate of the Expense Necessary to be Incurred for Physical Maintenance Estimate for Weerawila Main Canal in Canal

Sub-Items	Qty.	Units	Items	Rate Rs. Cts.	Total Rs. Cts.	Priority
1	149.80	sqs.	Water Weeding (WBD) in m/c. (2/Year)	8.00	1198.40	1
2	435.70	sqs.	Water Weeding (WBL) in m/c. (2/Year)	5.35	2330.99	1
3	294.40	sqs.	Water Weeding (WBD) in m/c bund (2 Year)	8.00	2355.20	1
4	1442.35	sqs.	Water Weeding (WBL) in m/c bund (1 Year)	5.35	7716.57	1
5	189.00	sqs.	Water Weeding (WBD) in m/c Road (1 Year)	4.00	756.00	1
6	1090.20	sqs.	Water Weeding (WBL) in m/c Road (1 Year)	3.20	3488.64	1
7	38.33	sqs.	0.5" Thick ct. plastering 1:3 ct. motar	517.00	19816.61	2
8	32.09	cu.	E/E from borrow & back fill around structure	337.25	10822.35	2
9	32.09	cu.	Placing and Compacting fill material	45.50	1460.09	2
10	1.78	cu.	R/R Masonary in 1:5 ct. motar	4085.00	7271.30	2
11	0.40	sqs.	9" thick rubble pitching in 1:5 ct. motar	3028.00	1211.20	2
12	0.88	cu.	1:3:6 (1.5") ct. concrete mc form work	7082.00	6232.16	2
13	1833.44	cu.	Desilting along the main canal	106.75	195719.72	4
14	54.91	cu.	E/E from borrow and filling washed - ways	337.25	18518.39	3
15	54.91	cu.	Placing and Compacting fill material	45.50	2498.40	3
16	Item	allow.	Contingencies	Sum	3603.98	
					285000.00	

Cost for priority 1	= 17845.80
Cost for priority 1 & 2	= 64659.51
Cost for priority 1,2 & 3	= 85676.30
Cost for priority 1,2,3 & 4	=281396.02

be dealt with during this year.

The ID staff argue that the desilting may be avoided if the canal banks are raised to bring the canal capacity up to its requirement. If desilting is selected but postponed due to lack of funds, the water level of the main canal will rise above the current full supply level. This may allow the main canal offtakes to draw more water. Therefore repair of the control mechanisms at these offtakes is required to deliver the required quantity of water. Bank raising can be done in selected *areas* where the capacity is inadequate. Generally, desilting changes the hydraulic regime conditions in a canal but there is a tendency to revert to the original condition that brought on the need for desilting. Therefore it may be advantageous to improve the canal capacities by raising selected banks rather than undertaking expensive and recurrent desilting. This approach can be considered for implementation.

<u>Cost Analysis:</u> Analysis of the costs of maintenance has two parts: reviewing past expenditure records and assessing overhead costs. In this analysis, expenditures on O&M were split among administrative, operations, and maintenance costs. In doing so, it was necessary to go into the details of each paid document to verify the nature of the spending. The analysis was completed for the years 1980, 1989, 1990, 1991 and the summarized results are tabulated in Table 2.8.

Table 2.9 makes it very clear that administrative expenditures were incurred at the expense of maintenance work. For instance, in 1991 the ratio of the administrative expenditure and the allocation provided for the same is as high as **4.21** compared to 0.85 and 2.10 in previous years. There is a trend to spend a greater portion of the available funds on administration. This has certainly had a detrimental effect on the maintenance of the system.

Table 2.10 shows that in some years the expenditures on physical maintenance work in different sub-systems are not uniform. Tissawewa, Weerawila and Pannegamuwa tanks were favored as compared to the others while the Ellegala headworks was given very little attention. These allocations **are** meant for routine type of work like desilting, weeding, and small structural repairs. If these items are neglected then it will endanger the safety of the system as well as reduce the conveyance capacity. Except under special conditions (flood damages, breaches, etc.) there is little justification for nonuniformity in these allocations.

Table 2.8
Allocation and Expenditure Data of Tissa Division

Year	Administration		Maintenance		Total		ID Opera.		Total O&M		Expendi./Acre
	Alloca. Rs.	Expendi. Rs.	Alloca. Rs.	Expendi Rs.	Alloca. Rs.	Expendi. Rs.	Alloca. Rs.	Expendi. Rs	Alloca. Rs.	Expendi. Rs.	Rs.
1987	406466	296216	704096	776062	1110562	1072278	339000	357844	1449562	1430122	120
1988	358650	249926	486850	673627	845500	923553	550400	506288	1395900	1429841	117
1989	290000	247501	585000	591102	875000	838603	318000	402644	1193000	1241246	104
1990	276026	578559	673556	407285	949582	985844	332894	408836	1282476	1394680	117
1991	250920	1056621	408460	147400	659380	1204021	388500	119539	1047880	1323560	128

The detailed analysis shown in Table 2.11 of administrative costs for Tissa Division showed that expenditure should be Rs511,200 per year. This is more than the 30% of funding for physical work recommended by Sheladia Associates for ISMP and more than the 40% recommended by the IMD. The subsistence rates of the government officers were increased substantially after the analysis and this change will be included in the next report. A large portion of the administrative cost (49%) is the salaries of the casual staff. The best possibility of reducing the costs therefore lies in the possibilities of cutting down the number of staff. The other areas where reductions can be effected are travelling expenses (13%) and maintenance of vehicles (17%).

Table 2.9
The Ratios of Expenditure and Allocation of Maintenance Budget Expend

Year	Adminis.	Maitenan.	Total	ID Oper.	Tot.O&M
1987	0.73	1.10	0.97	1.06	0.99
1988	0.70	1.38	1.09	0.92	1.02
1989	0.85	1.01	0.96	1.27	1.04
1990	2.10	0.60	1.04	1.23	1.09
1991	4.21	0.36	1.83	0.31	1.26

If IMD overhead standards are used, it appears that maintaining a separate division for EIS is not economically justifiable. The recent amalgamation of EIS with the Left Bank office will improve the situation but will not resolve it.

Consider the three calculations:

* If the maintenance work of the LB and of EIS is funded at present levels, the total allocation for administration based **on** IMD norms will be Rs336,832 (4856 acres ***55** Rs/ac *.4+ Rs575,000*.4).

* With amalgamation, the total requirement might increase. Taking the analysis in Table 2.11 as a base, the increased requirement could be estimated on an increased area basis. On this basis, the estimated administrative costs of the new division would be Rs 749,136 (511,200/10,433*15,289).

* As indicated in Table **2.6,** the allocation for operations provided by the IMD for Tissa and Left **Bank** divisions were Rs335,000 and Rs104,000 respectively After

amalgamation the total available amount is Rs409,000. The estimated administrative cost for Tissa Division alone (Rs511,200) is higher than this allocation.

Table 2.10
The Ratios of Actual Expenditure and Allocation of Maintenance Budget of Sub-Systems

Systems	1987	1988	1989	1990	1991	Expend
Tissa	0.91	1.17	0.77	0.74	0.21	
Yoda wewa	0.74	1.13	0.74	0.51	0.34	565345.4
W'wila	1.14	1.76	0.92	0.92	0.84	382494.8
D'wewa	1.00	0.79	0.69	0.26	0.09	290274.4
P'gamuwa	1.90	2.91	2.40	0.88	0.06	31496.57
G'pura	0.93	0.41	0.61	0.00	0.23	23709.76
Ellegala	0.87	0.99	0.00	1.17	0.00	9259.20

It appears therefore, that this new division is still not of feasible size.

Determination of the feasible size of a maintenance division requires attention. At current funding rates, these figures suggest that an economically feasible division should serve at least 24,000 acres (Rs511,200/Rs55 per acre/.4=23,236 acres). However, the calculation of the administrative cost.of the division shown in Table 2.11 was made considering the minimal possible staff and other facilities. It is quite possible that more area can be managed with this staff and facilities. Therefore a proper estimation of the actual requirements **needs** to be made. Another possible conclusion is that the norm for divisions below 24,000 acres is rather low,. **A** detailed analysis of these figures is required and will be done during the course of this study.

The above computation suggests that KOISP **needs** only one irrigation division. Divisions of the comparable size exist elsewhere, Parakrama Samudra is a good example. However, because the system is new and suffers from water short conditions, it may not be advisable to consolidate all of KOISP under one division until the system :reaches stability. Of course, a short term solution is to have part of this cost borne by construction or rehabilitation works. If political or administrative reasons dictate maintenance of smaller divisions, the norms for administrative costs may need to be revised.

<u>Training for Officers and Farmer Representatives</u>: Training was given in three separate one day sessions on 9th, 10th and 11th of January 1992 at the Weerawila District Training Center. The objectives of the program were:

- to make field level officers and farmers aware of the concept of need based maintenance;

- to motivate farmer participation in maintenance work;

- to mobilize and make effective use of resources.

The resource persons were from ID, IMD and IIMI. ID staff arranged this,program; IIMI provided financial assistance. On the first day the TAs and the WSs of both the systems attended and their supervisors attended as observers and resource persons. The attendance and the participation of all categories of staff were very good. The subjects discussed and resource persons were as follows,

Table 2.11
Quantity Sheet for Administration of Tissa Division

S.I.	Description	Unit Rs.	Qty.	Rate Rs.	Frc. Rs.	Amount	Sub-Tot.	Percentage
1.	Salaries							
1.1	Watchers(3*22days)	days	66	88.95	1	5870.70		
1.2	Drivers(2*30)	days	60	83.00	1	4980.00		
1.3	Operators(20days)	days	20	93.85	1	1877.00		
1.4	Casual Typist(2*23days)	days	46	88.95	1	4091.70		
1.5	Casual Draughtman(23days)	days	23	88.95	1	2045.85		
1.6	Storeman and Peon(2)	month	2	2040.00	0.5	2040.00	20905.25	49.07
2	Subsistance for Field Staff							
2.1	Irrigation Engineer	days	5	200.00	0.3	300.00		
2.2	Divisional Assistant	days	4	200.00	0.3	240.00		
2.3	Technical Assistants(4*4days)	days	16	150.00	0.3	720.00		
2.4	Work Supervisors(4*4days)	days	16	150.00	0.3	720.00		
2.5	Drivers(2*10days)	days	20	150.00	0.3	900.00		
2.6	Operators	days	5	150.00	0.3	225.00	3105.00	7.29
3	Travelling for Field Staff							
3.1	Irrigation Engineer	Miles	200	10.00	0.5	1000.00		
3.2	Divisional Assistant	Miles	150	10.00	0.5	750.00		
3.3	Technical Assistants(3*150Mls.)	Miles	450	10.00	0.5	2250.00		
3.4	Technical Assistant	Miles	300	1.25	0.5	187.50		
3.5	Work Supervisors(4*300Mls.)	Miles	1200	1.25	1	1500.00	5687.50	13.35
4	Overtime for Office Staff							
4.1	Clerks(4*40Hrs.)	Hours	160	7.50	0.5	600.00		
4.2	Draughtmen(2*40Hrs.)	Hours	80	7.50	0.5	300.00		
4.3	Store Keeper	Hours	40	7.50	0.5	150.00		
4.4	Typist	Hours	40	7.50	0.5	150.00		
4.5	Peons(2*40Hrs.)	Hours	80	7.50	0.5	300.00	1500.00	3.52
5	Vehicals							
5.1	Tyres-Nissan (3sets/year)	sets	3	9400.00	0.6	1410.00		
5.2	Tyres-Daihatsu(3sets/year)	sets	3	8000.00	0.6	1200.00		
5.3	Fuel and Lubricants	Item	1	7500.00	0.6	4500.00	7110.00	16.69
6	Telephone Bills	Item	1	4000.00	0.5	2000.00	2000.00	4.69
7	Electricity Bills	Item	1	2500.00	0.5	1250.00	1250.00	2.93
8	Stationary	Item	1	2000.00	0.5	1000.00	1000.00	2.35
9	Rounding off					42.25	42.25	
	Total per month					42600.00	42600.00	
	Total for year					511200.00		

* Sources, limitations and relationships of maintenance allocations: S.A.P. Samarasinghe.

* Importanceof farmer participation in maintenance work: U.M. Liyanage.

* Strategies to overcome resource 'deficits: H.A. Karunasena.

* How to determine the norms for maintenance work: **D.K.A.** De Silva.

'The next program was conducted for Institutional Organizers (IOs) and the attendance of the training program was somewhat good. The subject matter was different from the first day:

* Small scale contract management and the responsibilities of each party: D.K.A. De Silva.

* Duties of farmer organizations in maintenance work: S.A.G. Thilakasiri.

* Strategies **to** overcome resource deficits: H.A. Karunasena.

* Maintenance process: R.A. Dharmasena.

For the last program, the target group was Weerawila Farmer Representatives. Due to poor communication attendance was rather poor. Some FRs from Yodawewa also attended. The subject matter and resource persons were the same as in the second program.

A questionnaire was administered to the trainees at the end of each session to evaluate the training. The responses were:

1. According to the participants the general arrangements of the training were good and the theme was timely. They stated that this training will help the turnover program. All agreed that the training was comprehensive.

2. There were divergent views on the taking over of O&M responsibilities by the farmer organization. None of the organizations were ready to take over full O&M responsibilities. According to 80% of the FRs, they can not take over till the DCs are properly rehabilitated. IOs too agreed that the DCOs are not strong enough to take the responsibility at this stage. Most of the organizations were recently formed and need more training and exposure to the program according to them.

3. Except for three field officers of ID, all officers said that the proposed maintenance program is good and is likely to solve farmer problems. The three officers who opposed this view said that they will have to do a lot of additional work if the program is implemented.

4. DC leaders and IOs generally complained that they do not receive the necessary assistance from ID when they handle contracts. They suggested that ID should make timely payments for contract work done by DCOs.

An assessment of the impact of training as well as of the progress of the maintenance program was attempted towards the end of Maha season. A questionnaire was adlministered to the DC leaders for this purpose. However, none of the DC leaders interviewed were aware of these programs and their impact. Therefore eight FRs from Weerawila tank were interviewed in detail for information on their views on the existing arrangements for maintenance in their system. The issues that emerged at these interviews are listed below:

* Out of the 8 FRs interviewed, only three had attended the training program. Even those who attended knew nothing about the proposed maintenance program.

* The FRs did not know that certain activities, for example main canal cleaning done by FOs on Shramadana and deployment of TOAs for maintenance activities, were done under the pilot maintenance program. Most of the activities done under the program had been identified as work organized and done by IE (Tissa).

* The FRs were of the view that main canal maintenance is the responsibility of ID. They can participate in identifying the maintenance **needs** at main canal level. The DC level is maintained by the DCOs at present with or without funds from ID

* There existed a seemingly unresolvable conflict between the leaders of the four head reach DCs and the leaders of the tail end DCs. The tail-end DC leaders complained that four head-reach DC leaders are favored by the IE. They stressed the necessity of maintaining equity in the allocation of maintenance funds to the DCOs before attempting to make any intervention. The DCO leaders in the tail end DCs identified their organizations with IMD while the leaders of head reach DCOs showed a close relation with IE.

* Some tail-end DC leaders were of the view that they do not have a voice in the Sub-Project Management Committee because of the pressure exercised by a certain farmer group in the process of taking decisions on maintenance, etc. Also, according to them, they are not well represented at the PMC. They proposed the formation of tank committees or Wewa Sabha to bring an end to the problems mentioned above and also for implementing the proposed intervention as well.

Preoaration of Annual Maintenance Plans: Maintenance work needs to be planned to ensure that the different activities are completed on time and to monitor progress. Most irrigation managers do not prepare annual maintenance plans because of the low priority given to maintenance, as compared to construction. Since **1986,** the participation of farmers in irrigation activities has exerted heavy pressure on the irrigation agency with respect to the deteriorated irrigation infrastructure. Thus there is substantial improvement in INMAS areas where maintenance work is being carried out on a more or less need based manner with farmer involvement.

According to the research design, identification, prioritization and decision making on the maintenance requirements must be done with the active participation of farmers. In the pilot area, farmers participated to some extent but farmer participation in each stage of the process **needs** further improvement. The attempts made by the Irrigation Engineer of Tissa Division is remarkable in the preparation of the work plan. Even though this procedure was not sufficiently field tested for replication he prepared detailed work plans for the other systems also.

The Annexure shows the **1992** overall maintenance plan. Firstly an annual program was prepared for the permanent maintenance gang and they were assigned **equal** sections of the main canal. This program was prepared for both periods - canal closure and water issue. The period of canal closure **is** utilized for the heavy cleaning work inside the conveyance section of the canal. The TOAs are assigned **175** feet of canal length **per** day to cover the weeding in the first four miles of the MC. During water issues they **are assigned** different sections **so** as to cover the entire main canal and the norm is to weed ***85*** feet a day along with their water distribution duties. Table **2.12** is an example of a TOA assignment.

Table 2.12
Allocation of Duties of TOAs
TOA 1

Date	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
01	0.85	1M+17.50	17.75	27.85	44.85	1M+8.85	1M+25.85	1M+17.50	1M+35.00	1M+42.85	2M+8.85	2M+2.85
02	1.70	19.25	18.70	28.70	45.70	9.70	26.70	19.25	36.75	43.70	9.70	26.70
03	2.55	21.00	19.55	29.55	46.55	10.55	27.55	21.00	38.50	44.55	10.55	27.55
04	3.40	22.75	20.40	30.40	47.40	11.40	28.40	22.75	40.25	45.40	11.40	28.40
05	4.25	24.50	21.25	31.25	48.25	12.25	29.25	24.50	42.00	46.25	12.25	29.25
06	5.10	26.25	22.10	32.10	49.10	13.10	30.10	26.25	43.75	47.10	13.10	30.10
07	5.95	28.00	22.95	32.95	49.95	13.95	30.95	28.00	45.50	47.95	13.95	30.95
08	6.80	29.75	23.80	33.80	50.80	14.80	31.80	29.75	47.25	48.90	14.80	31.80
09	7.65	31.50	24.65	34.65	51.65	15.65	32.65	31.50	49.00	49.65	15.65	32.65
10	08.50	33.25	25.50	35.50	1M+8CH	16.50	33.50	33.25	50.75	50.50	16.50	33.50
11	9.35	35.00	26.35	36.35	17.35	34.35	52.50	51.35	17.35	34.35		
12	10.20	36.75	27.00	37.20	18.20	35.20	2M+00CH	2M+8CH	18,20	35.20		
13	11.05	38.50	38.05	19.05	36.05				19.05	36.05		
14	11.90	40.25	38.90	19.90	36.90				19.90	36.90		
15	12.75	42.00	39.70	20.75	37.75				20.75	307.75		
16	13.60	43.75	40.60	21.60	38.60				21.60	38.60		
17	14.45	45.50	41.45	22.45	39.45				22.45	38.60		
18	15.30	47.25	42.30	23.30	40.30				23.30	39.45		
19	16.15	49.00	43.15	24.10	41.15				24.15	40.30		
20	17.00	50.75	44.00	25.00	42.00				25.00	41.15		
21		52.50								2M+42.0		
22		2M+00CH										
23												
24												
25												
26												
27												
28												
29												
30												
31												

The plan for the identified work was not completed due to the administrative changes in the division and for want of approved estimate. This work plan will be completed according to the availability of funds and implemented by involving farmers.

Calibration for Hydraulic Performance (Impact) Evaluation: The impact of maintenance must be measured by comparing hydraulic performance over time. The basic parameters that have been selected are the main canal water profile, quantity of water flow through control sections and the travel time between control sections. Sensitivity of these parameters *to* the maintenance differs according to the intensity of the maintenance work. In order to observe a reasonable change in these parameters, maintenance work should make substantial improvement to hydraulic performance of the reach. We intend to observe the hydraulic performance of the Weerawila main canal before and after the maintenance activities.

Implementation of the Maintenance Work The closure season between the 1991,192 Maha and 1992 Yala was very short because both farmers and officers felt that it was advisable to start the Yala cultivation using the residual soil moisture. The first water issue was made on the 1st March and maintenance work was possible only during the month **of** February. Even though the canal was closed on the 29th January it was not possible to work inside the canal due to stagnant water. In most of the sections the cleaning work started around the 10th of

February. The first four miles of the canal was distributed among six Turn Out Attendants (TOAs) and the details of the assignments and their progress are given below:

2.5.2. Lessons Learned and Findings

The lessons learned and the findings of the work done up to end of Maha 1991/1992 are summarized below:

1. The suggested maintenance procedure and methods **used** in each stage of the process are implementable within the framework of ID and IMD.

2. There exists a substantial difference in per acre allocations for maintenance between Mahaweli systems and ID/IMD systems; allocations for Mahaweli systems are three times higher than those for the ID/IMD systems.

3. Administrative overhead of maintenance work for ID **is** high compared with the physical work; the costs are covered by using the funds given for physical work.

4. ID could reorganize its O&M divisions by bringing more command area under each division in order to maximize the man power utilization; at the same time the **per** acre maintenance overhead cost could be reduced.

5. Recurrence of rehabilitation at closer intervals ***can*** be minimized by effective utilization of allotted funds.

6. The preparation of work plans for maintenance were done in a satisfactory manner and the implementation during the closure season is quite successful. Further improvements in this regard could be done at the end of this year.

7. Norms and standards for different kinds of maintenance activities need to be revised after analyzing the progress of each activity.

8. The preparation of work estimates on the basis of needs is well accepted by the agencies and farmers; mechanisms for farmer participation in this process need to be revised in view of getting their active involvement.

9. There is very high potential for getting farmers' contribution in bridging the gap of resources; every effort should be taken to motivate and mobilize them through training and awareness.

10. Establishing hydraulic performance parameters and using them in impact evaluation should **be** given high **priority.**

11. It was noticed that the training provided for different groups had not yielded substantial impact; this was due to very poor communication between the farmers and farmer representatives. Therefore it is suggested to implement an awareness program for the farmers at the DC level so that it will help the main system.

2.5.4. Work Plan for Yala 1992

The following work will be carried out during the season:

- Further improvements to the model.
- Verification of drainage contributions to EIS and water consumption within EIS.
- Implementation of a systematic operation of EIS using the **feed** back of the model.
- Introduction of sub-system operations based on crop water requirements.
- Implementation of an on-farm water management program.

These work items will be implementation with active participation of ID and' IMD.

Under seasonal planning, the following work items are identified for 'Yala 1992:

- Inflow analysis of Lunugamvehera reservoir.
- Development of allocation rules for different inflow regimes and climatic conditions.
- Study on institutional issues for seasonal planning.

The above mentioned activities will be done in close collaboration with the ID and IMD.

The following work items will be carried out with active participation of ID and IMD.

- Continuation of the maintenance implementation program with modifications.
- Continuation of the expenditure data collection for the periods of 1987, 1998.
- Revision of the maintenance procedures based on the feedback.
- Monitoring of the hydraulic performance.
- Impact evaluation of the total program.

The following activities are planned for Yala 1992:

- preparation of irrigation schedules at least for three larger tanks
- awareness program for farmers and officers for implementing the schedule
- providing inputs to the **task** force on seasonal allocation

ANNEXURE

Maintenance Program of Weerawila Wewa for 1992

ALLOCATION

HEAD 300
HEAD 301

TRACT NO:
IRRIGABLE AREA:

	YALA	MAHA
FIRST DATE OF WATER ISSUE	10.03.92	15.09.92
LAST DATE OF WATER ISSUE	10.07.92	15.01.93

NAME OF T.A. : R.A. DHARMASENA
NAME OF W.S. : B.G. WIJETUNGA

NO. OF POSSIBLE MAN DAYS 1280 RANGE SOUTHERN DIVISION TISSA

ITEM	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
HEAD WORKS												
WEEDING/CLEARING SLOPES AND RESERVATIONS REMOVAL OF ANT - HILLS	********	**	****	********	********	********	****		****	********	********	********
MAIN CHL.												
WEEDING CANAL BED WATER PLANTS		******	****				****	********	****			
WEEDING CANAL SLOPES AND ROAD RESERVATION.	********	**	****	********	********	********	****		****	********	********	********
REPAIRS TO STRUCTURE.		******	****				****	********	****			
GREASING AND OILING CONTROL MECHANISMS.									****			
APPLICATION OF PAINT/ EMULSIONS TO STRUCT/ CONTROL GATES.									****			

Weerawila Tank Water level & Rainfall

1991/1992 Maha season

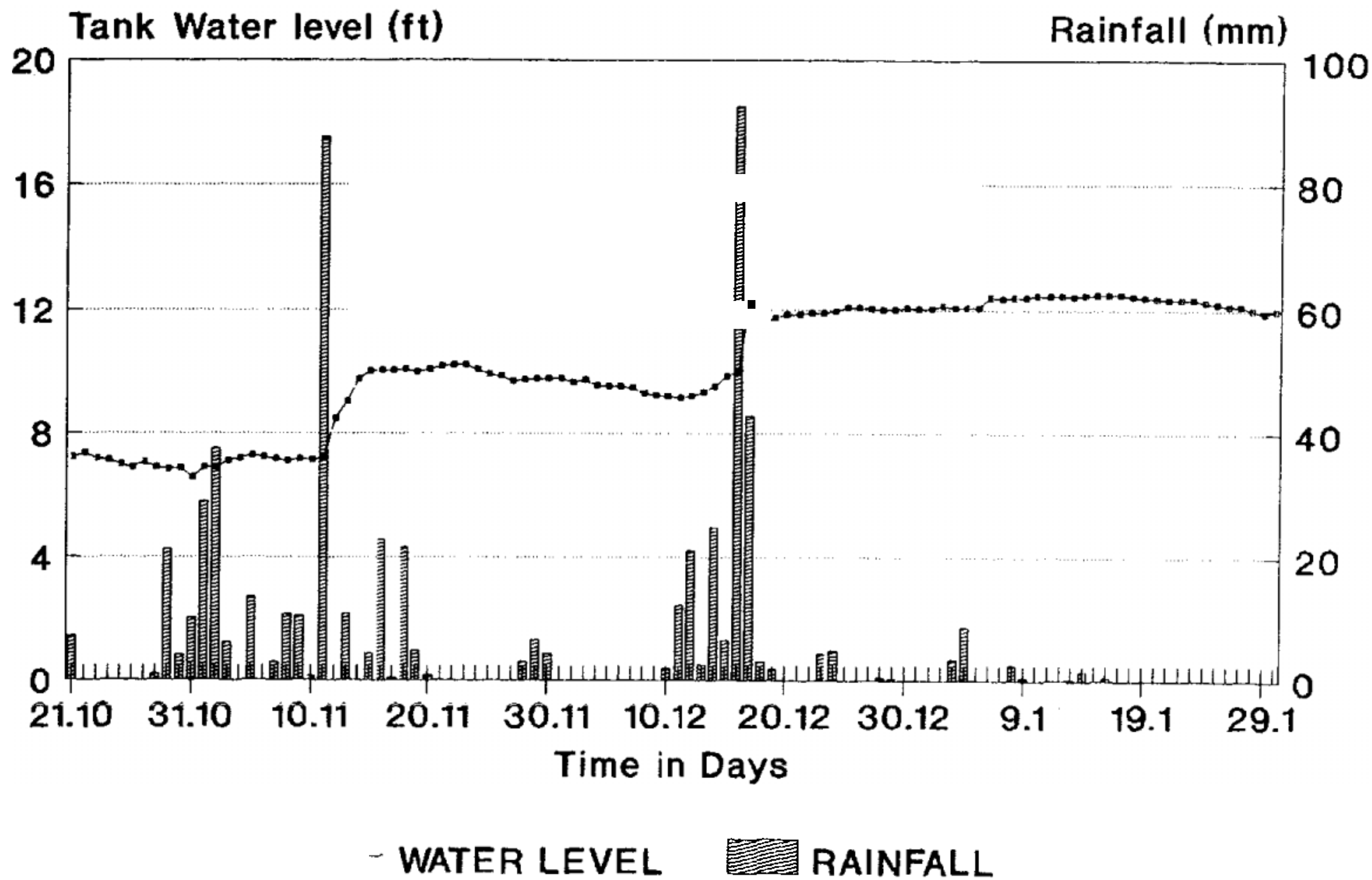


Figure 2

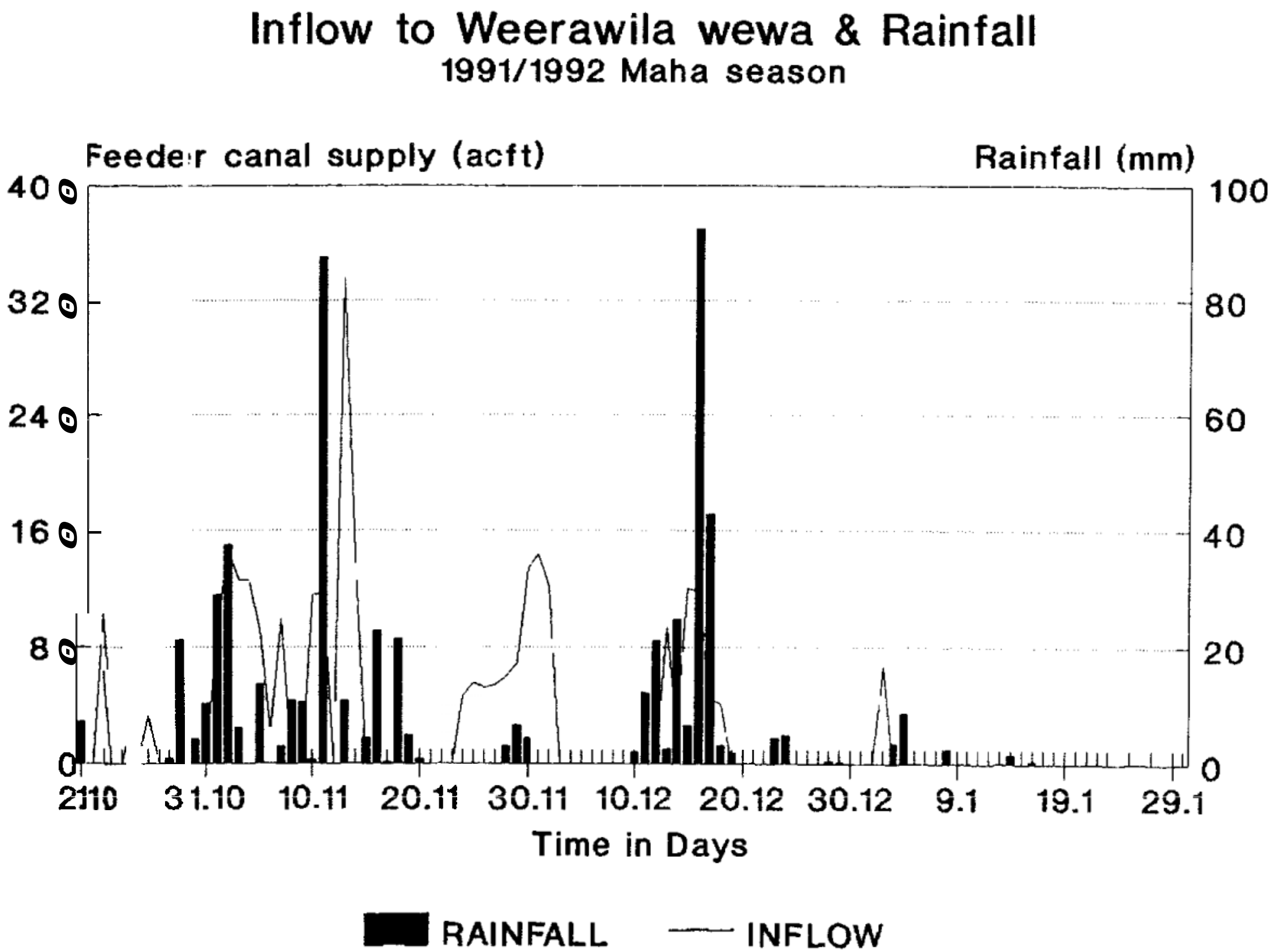

Inflow to Weerawila wewa & Rainfall
1991/1992 Maha season
Feeder canal supply (acft)
Rainfall (mm)
400
320
240
160
80
0
100
80
60
40
20
0
21.10
31.10
10.11
20.11
30.11
10.12
20.12
30.12
9.1
19.1
29.1
Time in Days
RAINFALL
INFLOW

Figure 2.2

Rainfall and Drainage with Runoff
1991/1992 Maha season

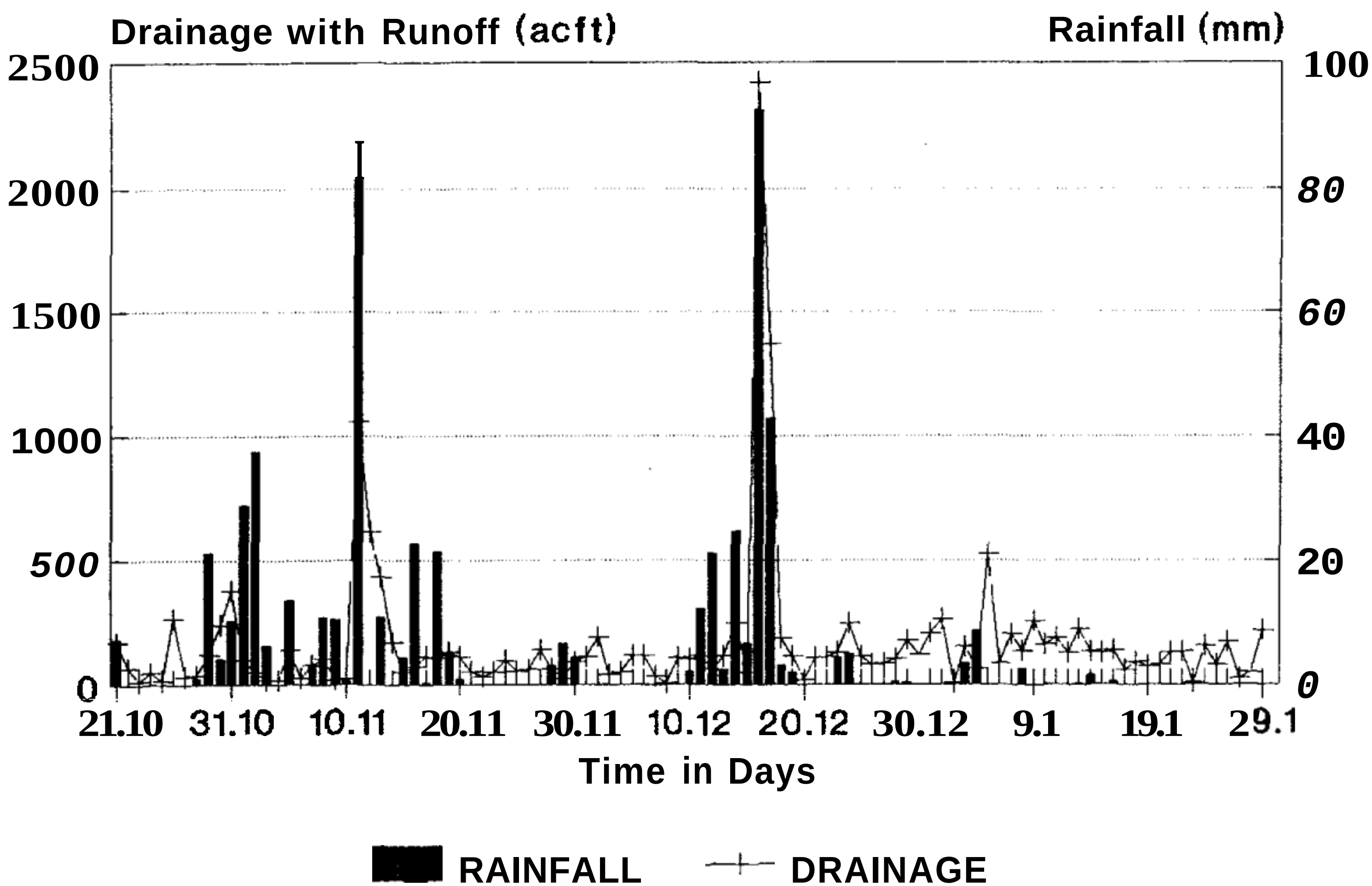


Figure 2.3

Surplus Drainage with Runoff

199111992 Maha season

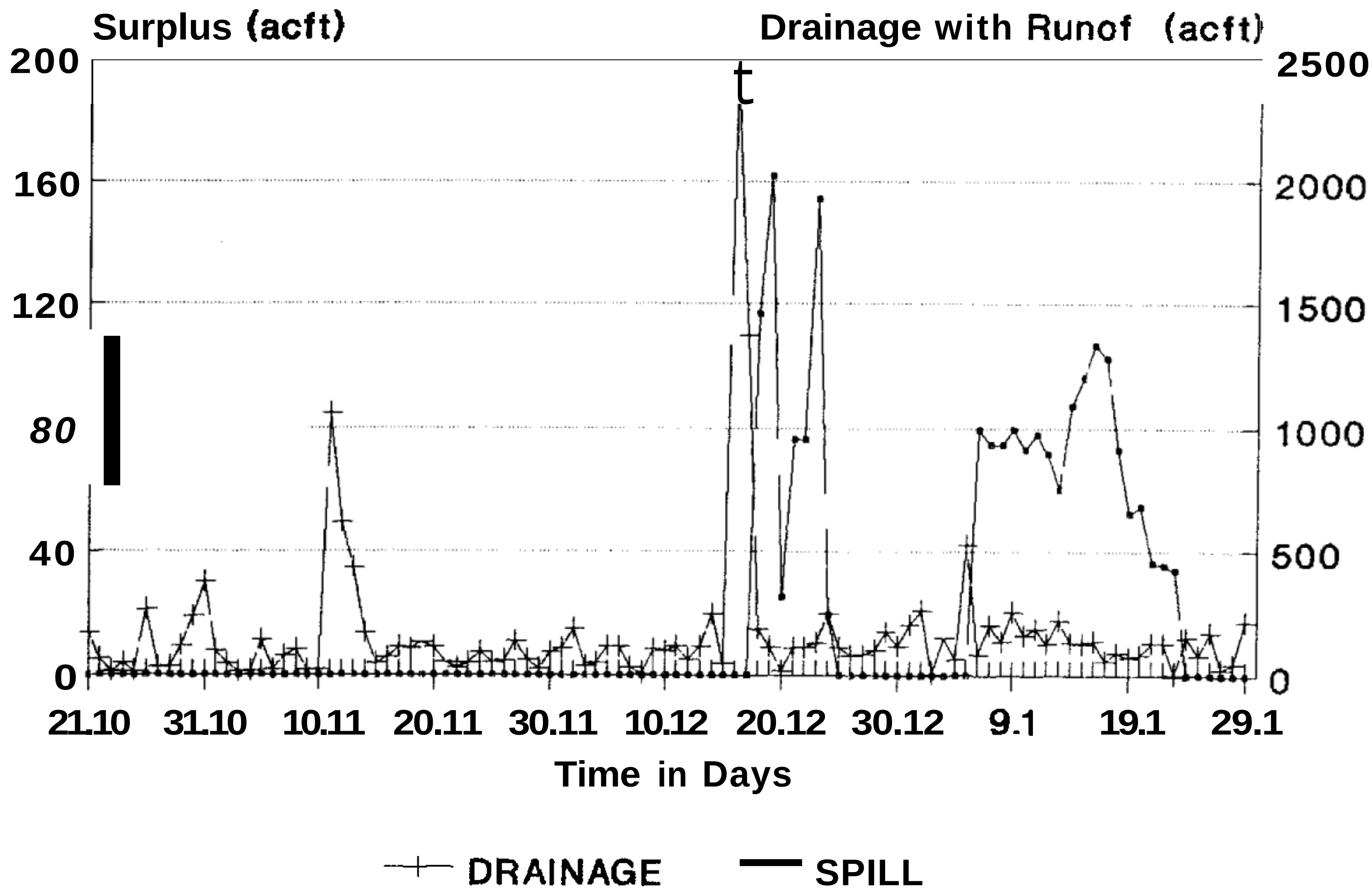


Figure 2.4

Surplus and Tank Water level
1991/1992 Maha season

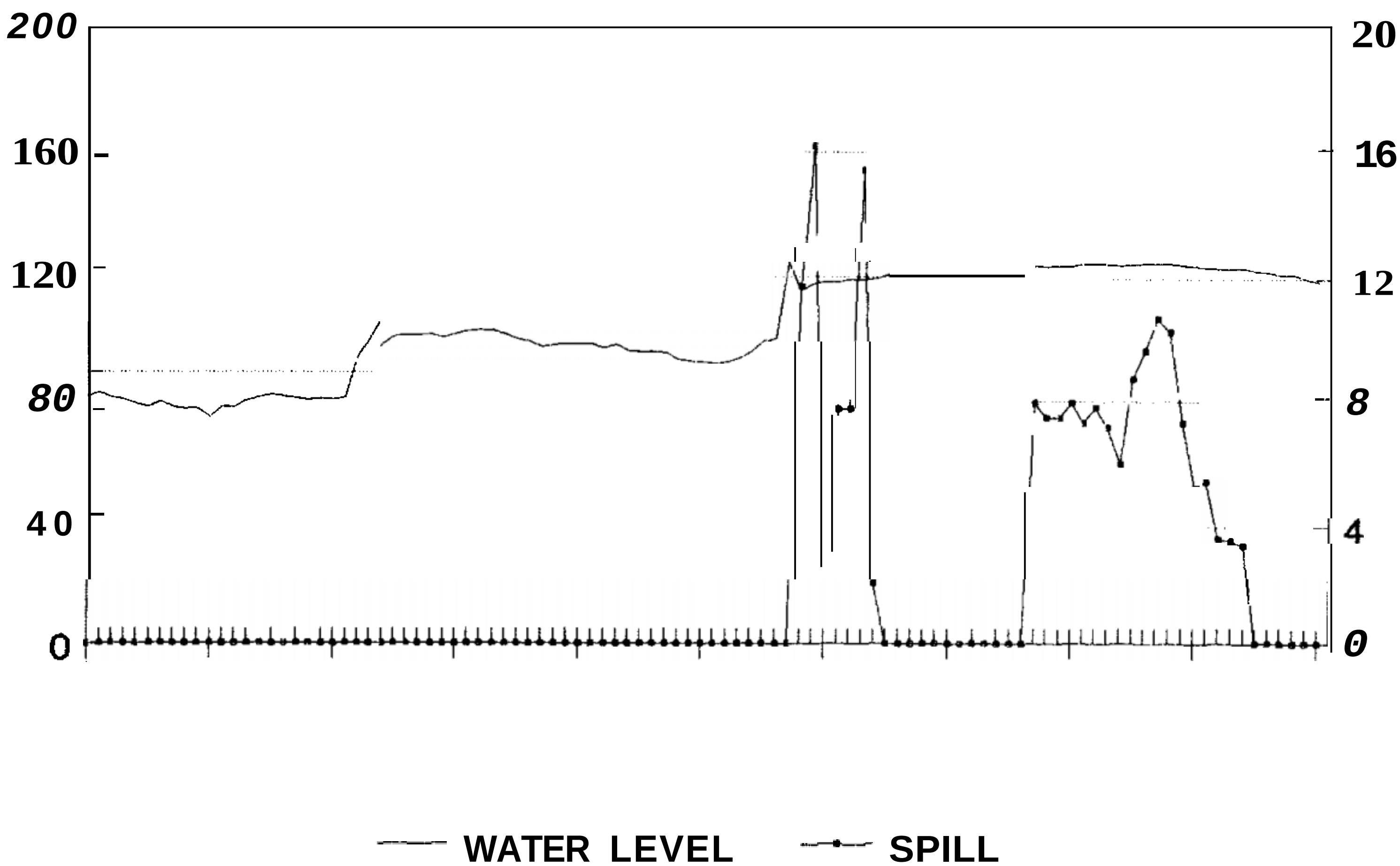
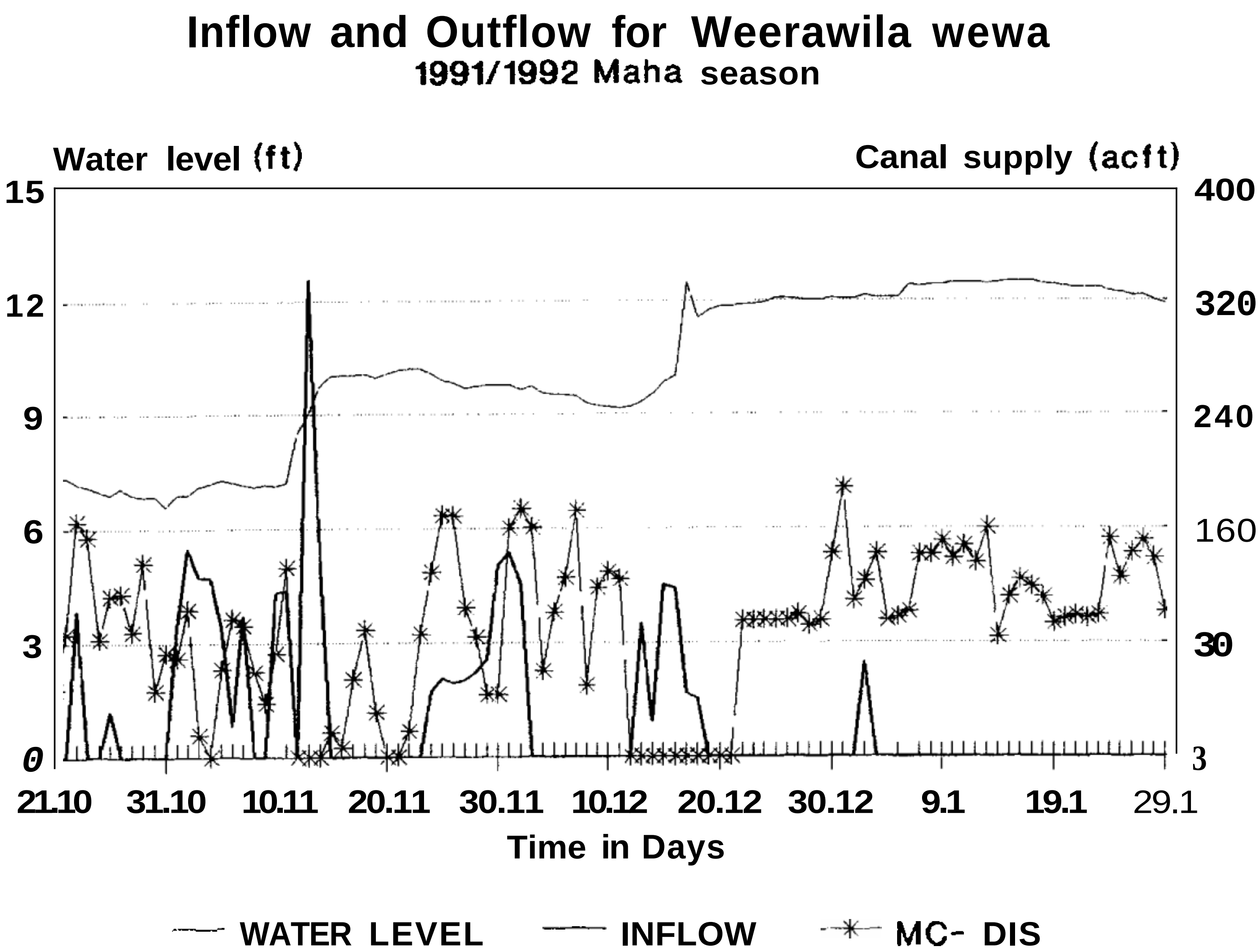


Figure 2.5



Inflow and Outflow for Weerawila wewa
1991/1992 Maha season
Water level (ft)
Canal supply (acft)
15
12
9
6
3
0
400
320
240
160
30
3
21.10
31.10
10.11
20.11
30.11
10.12
20.12
30.12
9.1
19.1
29.1
Time in Days
WATER LEVEL
INFLOW
MC- DIS

Figure 2.6

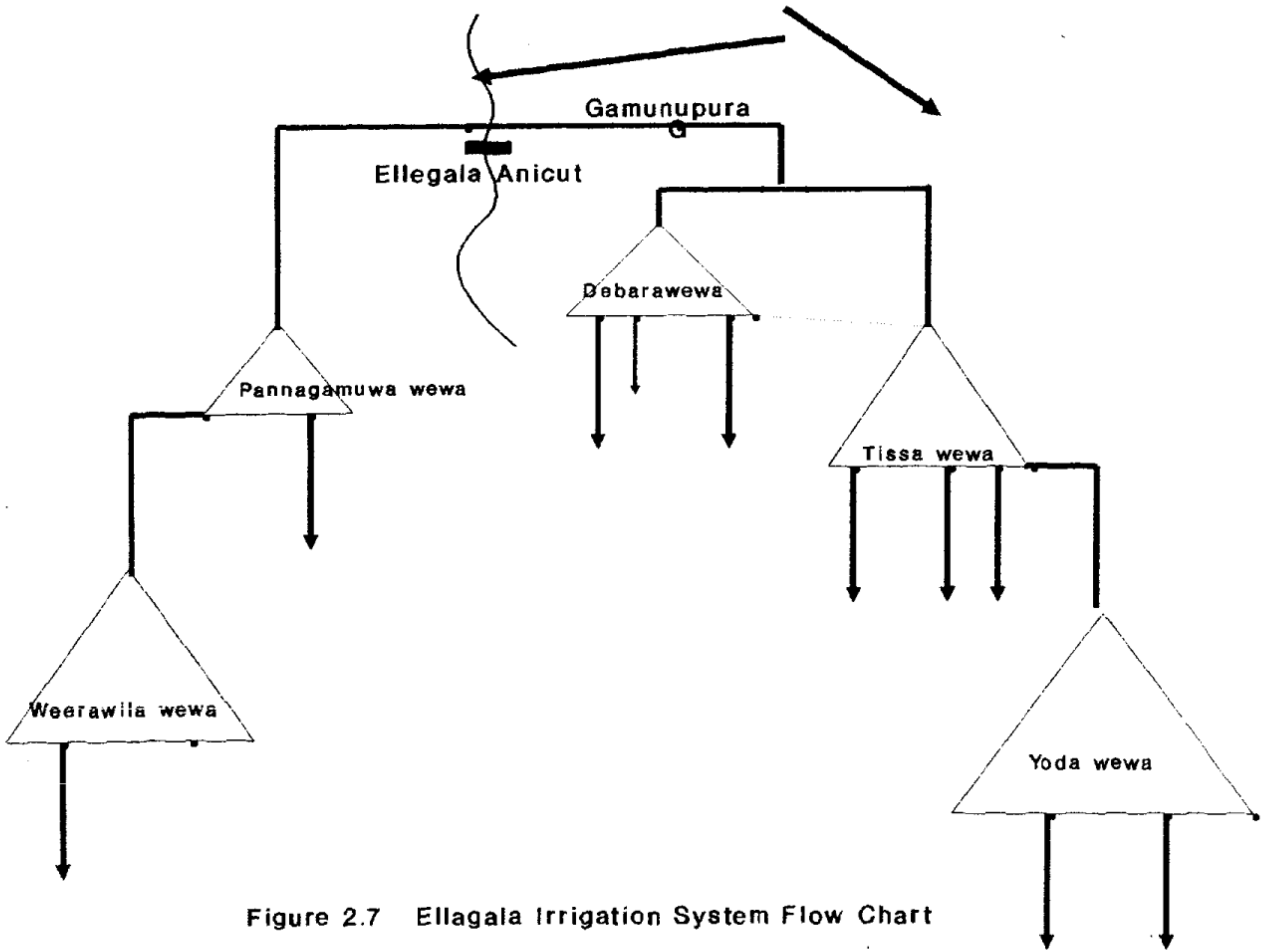


Figure 2.7 Ellagala Irrigation System Flow Chart

Chapter 3

TERTIARY MANAGEMENT

3.1. Introduction

The main objectives of this research component are:

1. To'develop and field test management innovations for farmers and officers for improving the planning, coordination and implementation of water management and agricultural plans at the distributary channel (DC) level.

2. To develop and test processes for institutional strengthening and for turning over more O&M responsibilities to the DC organizations.

3. To explore the possibilities of operationalizing the tested management innovation in the system.

The activities proposed to achieve the above objectives were:

a. institutional strengthening;
b. tertiary maintenance management;
c. seasonal planning and coordinated acquisition of agricultural inputs;
d. operation during land preparation and crop growth periods.

3.1.1. Sample Area Selected for Maha 1991/1992

The sample selected for Maha 1991/92 study was Sub 1/DC5 in tract 1 of the Right Bank (RB) system. Initially, some members of the Sub-Study Committee on tertiary system management, especially those representing ID and IMD, did not agree with the selection of this DC for study and proposed the selection of a DC from the Left Bank (LB) system. The ID officers felt that the proposed DCO was very strong when compared with the other DCOs in RB system and therefore was not representative. The other objection raised by the ID officials was that Sub 1/DC5 was a lined canal unlike others in the system. However, canal lining work started only after research work had begun in DC5. IMD was not in favor of the selection because the president of the DCO was not acting as they felt he should under the INMAS programme. However, since IIMI had selected RB system for its study on main canal management and simulation modelling research projects, the final decision was to select RB Sub 1/DC5.

The sample Sub DC consists of four FCs with a total command area of 61 Ihectares. The entire command area under the canal is considered as low land for the preparation of the irrigation schedule. However, as shown in Table **3.1,** IIMI estimates that the command area consists of **74.2%**LHG soils and 25.8% of RBE soils.

Table 3.1
Classification of Command Area

Canal	Command Area ha	Soil RBE ha	LHG ha	RBE %	LHG %
FC 51	16.00	6.00	10.00	37.5	62.5
FC 48	6.00	1.25	4.75	20.8	79.2
FC 49	24.00	3.50	18.50	22.9	77.1
FC 60	15.00	3.00	12.00	20.0	80.0
SUB:	61.00	15.75	45.25	25.8	74.2

(Based on eye estimation by IIMI staff)

3.2. Tertiary Maintenance Management

3.2.1. DC Maintenance

By the time initial training programs for farmers and Farmer Representatives in DC5 were started, pre-seasonal maintenance activities on the DC had been done on contract by the DCO. However, in the one day training program for Farmer Representatives, the procedure to be followed in the planning and implementation of pre-seasonal maintenance was explained to them. The procedure includes an initial meeting of the DCO with the participation of ID officers at least two months prior to the commencement of cultivation season. The meeting would discuss the funds allocated for maintenance work in the DC. Thereafter a diagnostic walk-through the DC area is made by the FRs and TA to identify the maintenance needs. After the ID prepares estimates for the identified items, prioritizing of the maintenance items is carried out jointly by the FRs and ID officials. In addition, the training emphasized the need for cleaning and desilting the FCs prior to the season.

As the pre-seasonal maintenance work had been partly done by the DCO, the proposed pre-seasonal maintenance programme in the DC could not be implemented this **season.** However, the following shortcomings were observed in the maintenance work done by the DCO.

- The leadership of the DCO had taken to doing things without consulting the DCO committee members. Thus, without consultation, the president hired **34** farmers as wage laborers to clean and desilt of the DC with the money allocated by ID for this purpose. In previous seasons, the DCO organized Shramadanas to complete the work and the payment made for the canal maintenance work was deposited in the DCO account for the use of the organization. This season, because the ID funds were not sufficient to pay for the labor necessary to complete for the pre-seasonal maintenance work in the entire canal, a part of the DC remained uncleaned even by the first day of water issue.

- The DCO officers were very busy at this time with a contract for lining the canal and did not pay much attention to the pre-seasonal maintenance work.

- To the farmers, the' DCO leaders acted like labor bosses and not like Farmer Representatives accountable to the farmer community. They were accused by farmers of hiring their own favorites as wage laborers. Since the leaders had hired **some** farmers as wage laborers, there was a reluctance in the part of other farmers to do Shramadana to complete the desilting and cleaning of the DC.

- The relationship between the president, the secretary and the treasurer of the DCO and IMD was not amicable. The DCO leaders looked at the IO as an enemy since he tried to bring the other DCO committee members into the contract work programme handled by the DCO leaders. The attempt by IMD to systematize account keeping of the DCO was also seen as an attempt to find fault with the way that the DCO leaders handled the contract work. In addition, the DCO leaders understood that IMD had launched a reorganizing programme with the aim of changing the leaders who had served for two years or more. This conflict made it impossible for the IO to convince the leaders to complete maintenance work in the DC before water issues. Because of these decisions and IMD's campaign, the DCO leaders were replaced by the DCO committee before the beginning of the season.

As maintenance work had not been completed by the first day of water issue:, most of the farmers, especially those who have lands in Sub 1/DC5 and other FCs below it had serious water problems. The IIMI RO discussed this problem with the line agency officers at the Sub-Study Committee meeting on tertiary system management held on 19 September. The RE made a field visit on the same day and explained to the farmers and the newly elected DCO leaders the necessity of attending to weeding and desilting work in the DC as well as FCs to minimize water problems. The IO was requested to organize a DC level meeting to encourage farmers to do canal cleaning and desilting. A DC meeting attended by the farmers and ID and IMD officers was held on 20 September. A Shramadana as organized on 21 September with the participation of about 150 farmers to clean the distributary canal. The participation in this Shramadana was successful because most of the farmers had been affected by the water shortage; they could not prepare their land without sufficient water in the DC and FCs. Water problems in DC5 were reduced'because of this intervention.

3.2.2. FC Maintenance

No systematic FC maintenance was observed in the four FCs of Sub 1/DC5 - FCs 48, 49, 50 and 51 - this season in spite of the initial training on pre-seasonal maintenance.. Nearly half of the farmers in the four FCs had completed weeding by the day of water issues hut only about 10% had attended to desilting. They had done the cleaning to avoid blame: by other farmers or the FR and not to ensure efficient conveyance of water in the FC. As a result of inadequate FC maintenance, tail end farmers of FCs 49, 50 and 51 had problems with water at the beginning of the season.

Several attempts by the IO to organize FC group meetings failed. Finally, meetings with the farmers of FCs 49 and 50 were held to motivate them to do FC cleaning work. The meeting of the farmer group of FC50 was arranged by the IO to select a FR for the canal because the FR of the canal had served more than two years and therefore, according to IMD norms, should be changed. The other meeting was arranged by the IO with the farmers of **FC49** at night as most of the farmers in the canal are wage laborers and were not available during the day. At these meetings, the proposed pre-seasonal maintenance programme was explained lo the farmers and the maintenance work was completed.

Meetings could not be arranged with the farmers of FCs 48 and 51. The leaders in these two canals did not show enthusiasm for organizing meetings. Both complained that they have leased out their lands and are engaged in other activities: one in a small business and the other in mining and paddy cultivation outside the project area. Pre-seasonal maintenance work in these two FCs remained very unsatisfactory. Some farmers cleaned the canal several days after water issues began only when the RE(RB) made a field visit and explained that their water problems are due to non-attendance to FC maintenance work. Even then these farmers did only weeding and not desilting.

3.2.3. Other DC Improvement Work

Though the improvement work started in the DC area at this time was beyond the scope of the research, IIMI took an interest in documenting this process. The DCO handled canal lining work in the head reach area of the DC. The contract work was carried out by the president, the secretary and the treasurer of the organization who hired farmers in the DC area as wage laborers. However, there were many allegations against the president for hiring his favorites for work, and for misappropriating funds and materials such as cement and rubble. In the eyes of some officers, the quality of the work too was poorer that work previously handled by the DCO. As there was a problem related to account keeping, PM (IMD) attended the DCO meeting personally to discuss the matter with the committee members and to update the accounts. Some FC leaders criticized the president at this meeting for handling the contract work as if it were his own contract and not that of the organization. The way the contract work was carried out by the leaders lacked the participatory spirit.

In addition to the contract work in the head reach of the DC, another contract had been offered to a private contractor for concrete lining of the Sub 1/DC5. The farmers in the DC were not aware that their canal was going to be concrete lined and that a private contractor had been offered the contract. The president of the DCO said that he was aware of the contract being offered to a private party. However, when ID inquired whether the DCO was in a position to handle the contract, he turned it down because he knew there were other parties interested in the contract and he did not want to offend them. However, farmers in the DCO said that they could have done a better job if the contract had been taken by the DCO. This case represents the loss of an opportunity to strengthen the DCO and to strengthen the farmers' feeling of ownership of the system both of which would help to increase the probability of success of turnover of O&M responsibilities to the farmers' organization.

FC road construction work had also been started in FCs 44, 46, 46A, 49, 50 and 52 by the time the study was begun in the DC5 area. The DCO handled the contract work in FCs 46, 46A and 52. The other FC road construction work was handled by private contractors; as the DCO leadership felt they could not accept the contract for lack of financial and other resources. The Farmer Representative of FCs 46 and 46A had disputes with the DCO leaders because the DCO leaders felt that the road construction work was not satisfactory.

3.2.4. Impact

IIMI carried out a household survey on a sample of 25 farmers at the end of the Maha 1991/92 to evaluate the impact of the action research programme on the maintenance of the tertiary system. The survey results showed:

- Sixty percent of the sample farmers (60%) were not satisfied with the way their FCs had been cleaned.

- Survey respondents said that majority of farmers cleaned FCs only after water issues and not before.

- There were water problems as a result of inadequate DC maintenance. However, farmers said that ID and IMD intervention after water issues solved these problems.

The limited impact of the interventions can be traced primarily to the following causes:

- The study intervention was limited to one day training to Farmer Representatives.

- Most of the trained Farmer Representatives were changed after the training but prior to the commencement of the cultivation season.

- A significant number of farmers - **48%** in the sample but more than a 60% in the actual population - had leased out their lands because of financial constraints and could not take part.

3.3. Input Coordination

One goal of the research is training farmers to manage the tertiary system themselves. Therefore it was felt necessary to train them to collect data on input **needs** so that the data could be used for coordinating input supplies. At the beginning of the season even though it was too late to use the data for input coordination, each FR was provided with a format **(see** Annex 3.1) and trained to collect the data. However, the farmer representatives did not fill out the forms and information had to be collected through IIMI Field Assistants.

Collection of data through the farmer representatives failed for several reasons:

- The major reason was that three out of the four FRs were not full time cultivators. Two out of them had leased out their lands. The other was a **full** time employee of the Imgation Department and had no time to spend.

- The other reason was that the FRs considered this as an additional burden on them for others' benefit.

3.3.1. Problem with Inputs

The time **ADB** Phase I study identified a lack of coordination mechanism at DC level as a major input supply constraint. With the exception of tractors, all inputs could be obtained without much difficulty by better coordination and planning. Farmers were eligible for credits from the state banks. The major credit problem was a delay in issuing loans on the part of the local branch of the bank because of insufficient staff. This situation has now changed. The household survey carried out at the end of Maha 1991/92 shows different trends with regard to input supply problems.

a) Credit Out of the 25 settler farmers surveyed, only 12 (48%) farmers cultivated their allotments in the season. The rest leased out their lands. Only seven farmers (28%) were eligible for credit from the banks. Except for one, the rest of the farmers who cultivated have become defaulters due to poor yields, scarcity of water to underiake either paddy or OFCs in many Yala seasons, and lack of other income generating activities or employment opportunities.

   All of the seven eligible farmers obtained bank loans and cultivated their lands. Since the bank loans were not sufficient to meet the production costs, six of the seven farmers borrowed additional money from other sources while the other used his own money in addition to the bank loan. Contrary to the notion that farmers lease out their lands because they have better income opportunities, this data indicates that these farmers have had to lease out their lands because of the very hard conditions.

   The five owner operators not eligible for credit from the state bank borrowed money from friends, relatives, and private money lenders. One farmer was provided with credit by Sarvodaya, a non-government organization.

   There has been no delay in loans to the farmers entitled to bank loans. The farmers were able to obtain loans in time because of the improved coordinating mechanism through the PMC, the efforts of the PM **(IMD)** and a decrease in the number of farmers eligible for credit which reduced the work-loads of bank employees.

b) Tractors **A** tractor shortage was one of the most serious problems contributing to delay in land preparation during the **ADB** Phase I study. Now, purchase of tractors by farmers with loans provided under **ADB** assistance and hire of tractors from other areas outside the project have reduced the problem. Only 3 farmers (12%) complained of tractor problems this season. Normally, farmers hire the same tractor for first, second and third plougings. Three farmers faced tractor problems during second plowing because the tractor owner who did the first plowing had undertaken work @lowing) in a large number of allotments. This problem was not due to a tractor shortage according to these farmers.

c) Labor Only three farmers (12%) reported labor problems during the season. They faced a labor shortage when cutting their ridges. The farmers' view is that labor problems occur when water issues are made to several tracts in the RB system and EIS together. This is because they hire farmers from their own hamlets or from the adjoining hamlets as wage laborers. However, during the Phase I study it was noted that many farmers bring wage laborers from their original villages in Matara and other districts. This migrant labor is now virtually absent from the area. It may be because many farmers have become wage laborers due to serious economic problems during the past few years.

d) Fertilizer Only one farmer **(4%)** reported shortage of fertilizer. He tried to purchase fertilizer from the cooperative stores with a voucher issued to the cooperative by the bank. The farmer would not have had this problem if he had purchased from a private trader as many farmers do now.

In spite of the fact that there was no shortage of fertilizer, only six farmers (24%) claimed to have used the recommended quantities of fertilizer. Three out of this six were non-owner operators. Fifteen farmers (60%) said that they did not have the funds to use the recommended quantity. Two farmers (8%) were of the view that they need :not apply the recommended quantity as the new land is fertile. Another two farmers (8%) said that they do not use the recommended quantity because their land is affected by salinity and could yield only a poor harvest.

e) Weedicide and Pesticide A shortage of weedicide and pesticide was a problem faced by farmers in previous seasons. This time, farmers did not complain of a shortage of weedicide and pesticide in the market. Many farmers now buy their requirements from private traders rather than from Agrarian Service Centers. However, those who obtained bank loans complained that the loans do not include an amount for pesticide.

f) Seeds Six farmers (24%), all of them owner operators, complained of shortage of ***seed.*** They had not informed the DOA of their seed requirements in time to enable the Department to supply the seed requirements. The other farmers too, though had not informed DOA, had been able find **seed** from the area. Though DOA is not in a position to supply **seed** to all the farmers, they can supply seed to some of them if requirements are informed beforehand. It should be stressed, however, that the number of farmers who are likely to face shortage of ***seed*** paddy would be more if all the settler farmers do the cultivate for themselves. Seed paddy was less of a problem this season because the majority of cultivators were renters better equipped with inputs.

3.3.2. Impact of the Intervention

All except one of the farmers was of the opinion that the DCO had no plan for the acquisition of inputs in time. The organization can intervene in this sphere only if the farmers have financial resources, credit, etc. Since the farmers lack this, the FRs were of the opinion that intervention **in** this sphere is not possible.

3.4. Water Management During **Land** Preparation

Though the FRs have been trained to prepare a rotational plan for water distribution within FCs, they were still using a rotation plan which they have been using for the last few years. Farmers in FC49 followed three hour rotations but there were deviations at times Farmers in FCs 50 and 51 followed 6 hour rotations while the farmers in FC48, with only six allotments under the canal, did simultaneous sharing. When the number of allotments under a FC was more than **14,** the farmers tended to follow some rotation even during the lancl preparation period in order to overcome water problems.

Very dry weather conditions prevailed in the area for about two and half months prior to and after the first water issue on 15 September 1991. Farmers found it very difficult to soak the land within six hours. The land soaking requirement seemed very high. IIMI verified the high requirement at allotment No.742 under FC51 on 23rd September 1991.

Table 3.2 shows the results obtained.

Table 3.2
Measuring Land Soaking Requirement

Irrigating started	= 08:45 am
Irrigation stopped	= 20:00 pm
Water supply rate	= 23.26 l/sec
Area soaked	= 0.55 ha
Allotment size	= 1.13 ha
Time taken for irrigation	= 11.75 hr
% of area soaked	= 48,67 %
Water height in liyadda	= 180 mm

The difficulty experienced by farmers in irrigating the allotments within a short period could be understood by looking at the climatic data for this period. The weekly rainfall and evaporation data based on Weerawila Agriculture Research Station for the period from 15th September 1991 to 22 January 1992 is given in the Figure 3.1, During the first four weeks in which farmers are supposed to do land preparation, weekly evaporation values were higher than weekly rainfall values. In this period farmers had to depend entirely on irrigation water for land preparation as shown in Figure 3.2.

When the farmers realized that they needed at least 12 hours to irrigate the entire allotment, they started borrowing the turns of other farmers who were not ready to irrigate when their turns came, with the promise of returning the turn when they were ready. But when it came to the second plowing the farmers found it difficult to continue their work as they had to return the turns they had borrowed. They needed assistance.

On the request of the FR of FC49, IIMI initiated a discussion on water sharing during land preparation and discussed with them a rotational plan developed by IIMI in collaboration with ID. Farmers agreed to follow this rotation. This rotation plan involved the following steps (it is assumed that a FC has a maximum of 24 allotments).

a) Twenty-four farmers group themselves in four groups of *6* farmers each.

b) From the first day, each farmer of the first group receives water for a period of 12 hours. It takes **3** days for this group to complete land soaking in the 6 allotments.

c) On the fourth day, each farmer of the same group receives water for a period of four hours *to* continue with second plowing and related activities. One day is required for this operation.

d) On the fifth day, the second group starts land soaking and completes it within three days.

e) On the eighth and ninth days, all six farmers of the first and second groups respectively receive **an** issue on the basis of four hours each.

This procedure is followed until all four groups complete land soaking. All the farmers can complete the first plowing within **18** days and continue with other work by following this rotational plan even in a very dry period. It becomes much easier in a wet period.

3.4.1. Impact **of the** Intervention

Several indicators are used here for the analysis of the impact of this intervention:

* Water sharing practices and reduction of water problems.
* Time taken for land preparation.
* Water use during land preparation.

<u>Water Sharing Practices and Reduction of Water Problems</u>: Data collected on water sharing within FCs shown in Table 3.3 shows that there were rotations implemented in FCs **49,** 50 and **51** in the study area. However, there had not been any rotation in the **FC48** which has only ***6*** allotments under it. It should be understood that the rotation adopted by the farmers is not the one introduced by the Sub-Study Committee on tertiary system management. It was a combination of the rotation previously adopted in the canal and the one proposed by us.

Table 3.3
Total Water Use for Land Preparation Period

Date	Week	RF	ET	SUB	FC 51	FC 48	FC 49	FC 50
15-Sep	1	0.00	55.40	58.40	99.11	116.06	25.40	41.04
22-Sep	2	3.20	56.20	115.80	126.16	109.96	88.73	132.96
29-Sep	3	18.10	33.10	108.36	133.67	137.06	87.12	106.69
06-Oct	4	4.10	45.40	111.85	141.43	116.12	84.71	106.74
13-Oct	5	59.40	23.30	70.48	77.27	43.57	54.13	79.27
20-Oct	6	40.00	35.00	72.38	58.58	79.44	62.01	58.58
27-Oct	7	103.10	8.30	39.54	47.51	42.48	37.11	35.31
Duty	mm	227.90	256.70	576.81	735.96	644.68	439.21	560.60
Duty	acft	0.75	0.84	1.89	2.42	2.12	1.44	1.84

The household survey data too indicates that a rotation had been practiced by 19 farmers **(76%)**in the sample in the previous Maha season and by **18** farmers **(72%)**in **this** season.

However none in FC48 followed rotation in either season. Only 6 farmers (30%) were satisfied with the rotation. However, 14 (56%) farmers were of the opinion that rotations should be implemented in LP period to minimize water problems and delay in land preparation. However the rest did not favor the implementation of rotations during LP period.

Ten farmers (40%) complained of water problems in spite of the implementation of rotations in the canals. Nine of these ten farmers mentioned unreliable supply as their water problem. The unreliable supply was mainly due to the operation of FC gates by the farmers to get more water to their canals. These ten farmers (40%) claimed that water problems had delayed their land preparation.

Time Taken for Land Preparation: The time required for land preparation is considered to be 4 weeks in the irrigation schedule. However, a continuous issues are made to the canal even during the fifth week to meet the farmers requirement for "isnam", a practice of irrigating the allotment for several hours after few days from sowing and draining off of water after some time. The rotational issues for crop growth period **starts** in the sixth week from the commencement of water issues.

As shown in Figure 3.3 (land preparation progress) a period of six weeks have been taken to complete the LP work in 90% of the command area under the canal. The studies carried out in the same distributary in Maha 1989/90 shows same results (Final Report - Vol. II, page 220). The time taken for the completion of the LP work in the entire command area of the Sub 1/DC5 is seven weeks. Since there are no complaints from the cultivators regarding the supply of other inputs in this season, the delay can be attributed to water problems.

The period of six week for land preparation in FC48 is very high compared to the number of farmers in other FCs with more than 16 allotments. In fact they could have completed it within the first three weeks. Completion of LP in FC51 which is the head most FC of the Sub DC, within 5.5 weeks is the best performance. The tail end canals like FC49 had undergone severe water shortages and therefore it took a longer time. However, there is a high potential to improve the LP performance by introducing a systematic water sharing. It requires good pre-seasonal standard maintenance to minimize water shortage at the commencement of a season to achieve this (Reference - Figure 3.3).

Water Use During Land Preparation: Relative Water supply (RWS) is used here as **an** indicator to measure the adequacy of irrigation supply to the sample sub-system. The RWS for land preparation period is defined as:

$$\frac{\text{Water Supply}}{\text{Water Requirement}} = \frac{IW + RF}{Eo + S\&P + \text{Land soaking and ponded water.}}$$

IW = Irrigation water delivery in mm
RF = Rain fall in mm
Eo = Open pan evaporation in mm
S&P = Weighted S&P value for canal to represent in soil groups.

If RWS = 1 in any given week at the level of **a** typical farm allotmenl, this means that the combined supply by the system and the rain-fall in that week exactly match the actual requirement. For the purpose of our analysis, the conveyance efficiency in a typical field canal or distributary was assumed as 93%, the value adopted in the water delivery schedule prepared by ID. This results in necessary RWS values of 1.07 and 1.15 at the head of a typical field canal and a distributary canal respectively to achieve RWS values of 1.0 at the field.

A comparison of weekly RWS values in the sample sub-system for Maha 1991/92 with the critical RWS values as shown in Figure 3.4 indicates that there had been **an** undersupply to the field canals except FC50 during the first week of land preparation. It can be seen however by examining the irrigation supply graphs in Figure 3.9 that all the FCs other than FC49 received a supply of more than 100 mm per week during land preparation. FC49 received a supply of 80 mm per week. The tail end farmers of FC49 resorted to blocking the main drain to irrigate their allotments because they could not irrigate their allotments from the FC. The drought conditions that prevailed in the area increased the water requirements for soil saturation and also created water problems which contributed much to the delay in land preparation in this season.

In addition, the Table 3.4 indicates that FCs 49 and 50 (the tail most FCs) did not receive water for a period of one day and two days respectively. This was due to the pre-seasonal maintenance problem at DC level. The irrigation supply to the canals had been stopped in the fifth and seventh weeks for two days and three days respectively. The area had experienced a considerable rain-fall only in the fifth week after the commencement of land preparation activities in the field. However, the total consumption during LP is below the ID's design values. These values should be updated.

Water Duty for Land Preparation: Water duty can be used as **an** indicator to measure the success of the intervention. The irrigation duty at the head of each FC in the sub-system is shown in Table No.3.7. The table clearly indicates that the FCs in the head reach of the Sub DC - FC51 and FC48 - have used more water than those in the tail. FC49, the canal with a command area of 24 ha had the lowest duty: 439.21 mm. It should be noted however that the tail end farmers of FC49 used drainage water for land soaking and most LP work. FC51, the head-end canal, reports of the highest duty of 735.96 mm. The water duty at the Sub DC level was 576.81 mm in this season against the 880 mm reported in DC2 in RB Tract 5 in Yala 1989. Therefore, there appears to have been a drop in duty.

The question now is whether the reduction of water duty is due to the intervention. The rain received in the fifth week of the season, the soil stabilization which has occurred during the past few **years,** rectifications of construction defects, development of skills in farmers as well as of the system operators, the monitoring programme implemented at the main system level might have contributed along with the intervention, much to the reduction of water duty in this season.

3.5. Water Management During the Crop **Growth** Period

3.5.1. Rotations

The Irrigation Department (ID) had plans to implement rotations within DCs from the begiinning of the sixth week.

Table **3.5** shows the schedule prepared for the sample study area by the Water Management Unit of ID.

Table 3.4
Number of Days Without Flow Per Week

DATE	SUB	FC 51	FC 48	FC 49	FC 50
15 Sep.	-	-	-	1	2
22 Sep.	-	-	-	-	-
29 Sep.	-	-	-	-	-
06 Sep.	-	-	-	-	-
13 Oct.	2	2	2	2	2
20 Oct.	-	-	-	-	-
27 Oct.	3	3	3	3	3
03 Nov.	-	-	-	-	-
10 Nov.	4	4	4	4	4
17 Nov.	4	4	4	4	4
24 Nov.	-	-	-	-	-
01 Dec.	-	-	-	-	-
08 Dec.	2	2	2	2	2
15 Dec.	6	6	6	6	6
22 Dec.	1	1	1	1	1
29 Dec.	-	-	-	-	-
05 Jan.	1	1	1	1	1
12 Jan.	3	3	3	3	3

However, the schedule was not implemerited. There were continuous issues to the four FCs during the period. Instead **of** rotating the canal, the ID closed the canal during rainy days. When the canals are closed after rain, it became difficult to implement rotations within FCs and within the DC. Only farmers in FC49 could be induced to follow rotations to overcome water problems. As some farmers in FC50 started closing the turnout FC49, the FC leader collected some money from the members of the canal and put a padlock on the gate to keep the canal gate fully open. The canal remained fully open till the end of the season and farmers in the FC were very happy. Not even ID interfered in this matter. The implementation of rotations during the crop growth period thus could be described as a total failure.

Table 3.5
Schedule for Crop Growth Period 1991/92 Maha

Canal	Upland ha	Lowland ha	Flow time days	Open day	Open time	Close day	Close time	1 Mon	2 Tue	3 Wed	4 Thu l/s	5 Fri	6 Sat	7 Sun
Sub-DC			7.0					113	82	113	113	113	113	113
FC51	0	15.2	6.5	3	6am	2	6pm	30	15	30	30	30	30	30
FC48	0	6.1	2.5	2	6pm	5	6am	0	15	30	30	0	0	0
FC49	0	27.3	7.0	5	6am	5	6am	48	48	48	48	48	48	48
FC50	0	10.1	4.0	5	6am	2	6am	30	0	0	0	30	30	30

3.5.2. Results

* Water Sharing Practices and Reduction **of** Water Problems

According to IIMI's observations and survey findings only the farmers in FC49 practiced rotations during the crop growth period. The rotation followed in FC49 was not a newly introduced one. It had first been introduced by the former FR. All the farmers in FC51 complained that they did not receive an adequate supply during crop growth period. Farmers in FC50 complained of shortage and unpredictable supply at night. This may be due to the intervention by the farmers of FCs 51 and 48. The majority of farmers (6 cut of ten) in FC49 complained of shortage of water in spite of the fact that their canal was fully open during the crop growth period.'

* Relative Water Supply and Water Duty During Crop Growth Period

RWS during the crop growth period is calculated by:

$$RWS = (IW + RF)/(ET\ crop + S\&P)$$

As can be seen from the Figures 3.5 to 3.7, the RWS values are rather low during the crop growth period. They should be around 1.2 - 1.5. It is only the rainy weeks that represent values above 1. These low values clearly indicates that the farmers complaints over shortage of water are reasonable and rational.

The Figure 3.8 (Mean Relative Water Supply) shows that the irrigation agency has been successful in maintaining substantially reasonable equity in the sub-system under study.

As a response to the heavy rainfall during the crop growth period, the canal was kept closed on many days as shown in Table 3.4. This closure contributed tremendously to the reduction of wzter duty during the crop growth period. The canal duty varied from 1044.9 mm - 1571.2 mm during the crop growth period as shown in Table 3.6.

Table 3.6
Total Water Use for Crop Growth Period

03-Nov	8	43.70	15.10	80.54	91.21	98.81	79.10	59.10
10-Nov	9	126.00	21.80	37.16	43.67	30.07	35.98	43.33
17-Nov	10	27.40	18.80	34.61	37.89	13.10	25.53	37.86
24-Nov	11	13.80	23.90	97.72	101.55	96.00	73.38	101.37
01-Dec	12	0.00	36.10	96.77	127.09	60.92	81.29	90.50
08-Dec	13	62.60	8.50	56.10	71.95	36.29	52.08	45.94
15-Dec	14	146.30	18.10	4.41	6.05	6.60	4.35	1.87
22-Dec	15	9.60	23.60	61.69	84.29	97.51	54.56	30.39
29-Dec	16	12.30	23.30	89.11	97.75	62.53	78.23	91.64
05-Jan	17	3.00	28.00	69.94	81.43	89.87	56.78	52.64
12-Jan	18	2.10	24.00	53.10	64.57	67.31	43.68	36.00
19-Jan	19	0.00	22.20	29.34	27.84	46.52	20.74	41.98
Duty	mm	446.80	263.40	710.48	835.29	705.52	605.70	632.94
Duty	acft	1.47	0.86	2.33	2.74	2.32	1.99	2.08
Total for Maha Season								
Duty	mm	674.70	520.10	1287.29	1571.25	1350.20	1044.91	1193.53
Duty	acft	2.21	1.71	4.22	5.16	4.43	3.43	3.92

3.6. Institutional Development

At the inception of this action research it was assumed that the strengthening of farmer organization could be achieved through the implementation of four activities with the participation of the farmers: pre-seasonal maintenance, input coordination, and water management during the crop growth and land preparation periods. The assumption was that the intervention would offer them benefits. In addition it was believed that the farmer organizations formed by IMD were functioning and could be further strengthened through this type of an action research program. However, by working with the farmer population in this season, it became clear thet there are serious economic and other constraints which stand as a barrier to institutional development. Therefore, this section is devoted to the analysis of these constraints in order to change approaches and strategies in future interventions.

3.6.1. Institutional Functioning

The DC5 farmer organization was once regarded by both IMD and ID as one of the strong farmer organizations in the RB system. It was the first organization to take over improvement work such as concrete lining work in the canal and pre-seasonal maintenance work. This was the only organization of the project which took over full operation responsibilities on a pilot basis. The leaders were forced by its members to hand these responsibilities back, to the ID a few weeks after take over because of the water problems faced by the farmers. When research activities started under Phase I project in Tract 1 area, both IMD and ID had a high regard for the organization. At the time of the implementation of the Phase II action research, IMD had lost hopes for its top leadership and were planning to launch a program to change them. ID officers still considered the organization to be most effective one until the leadership was changed on the initiative of IMD.

The main argument of IMD was that the leaders had become corrupt, had developed bureaucratic tendencies and were not accountable to the farmers. The IMD believer, that leaders may not get corrupted or may not act as bureaucrats if they serve only for a period of two years or less. However, the main question why the top leadership move away from the members of the farmer organization and develop bureaucratic tendencies can not be explained this way. In IIMI's view, farmers and other FRs must participate in organization activities. When farmers and FRs are not actively involved in the organization activities, the DCO leaders tend to develop bureaucratic tendencies.

The above argument holds true not only for the DC5 farmer organization but also for many other farmer organizations in both RB and LB systems. The lack of participation of farmers in organization activities, meetings, etc, is a problem in the new area of the project. This problem is closely linked with the economy and economic activities.

3.6.2. Economic Activities of DC5 Farmers

As explained earlier, 52% of the farmers in the sample had leased out their lands and were engaged in activities which fall outside the domain of the DCO. Interviews with the farmers and the household survey conducted towards the end of the season showed that they do not depend on the allotments to make a living. Even if they do, it is not their main occupation.

Table 3.7 illustrates the problem.

A major cause of the situation is the scarcity of water to engage in irrigated agriculture in both seasons. Farmers cultivated the imgated allotments only in 7 seasons since the first water issues in Yala 1986. They have missed four seasons due to scarcity of water. It should be mentioned that in Yala 1990, OFCs were cultivated only in an area of 103.90 acres and therefore only a very few farmers could reap the benefits of cultivation.

Table 3.7
Sources of Income

Occupation	Rank 1 Number of farmers		Rank 2 Number of farmers	
1990/91 Maha				
Irrigated agriculture	8	32%	9	36%
Chena cultivation	7	28%	3	12%
Wage labor	9	36%	2	8%
Other	1	4%	0	0%
991 Yala				
Irrigated agriculture	4*	16%	0	0%
Chena cultivation	1	4%	0	0%
Wage labor	4	16%	0	0%
Other	0	0%	0	0%
No employment	16	64%	0	0%
1991/92 Maha				
Irrigated agriculture	12	48%	3	12%
Chena cultivation	3+	12%	4	16%
Wage labor	8	32%	0	0%
Other	2	8%	0	0%

* water issues were not made. Illegal OFC in irrigated allotment.

\+ number of chena cultivators reduced because of the restriction on encroaching the reservoir area formerly occupied by this community.

3.6.3. Economic Returns

Based on the survey conducted in the DC5, net returns for an owner operator range from a minimum of Rs1,826 to a maximum of Rs17,962. The average return is Rs9,432. Based on net returns the 12 owner operators can be grouped as follows:

a) Earning less than Rs5,000 = 2
b) Earning between Rs5,000 to Rs10,000 = 1
c) Earning above Rs10,000 = 9

Nine out of the 13 farmers who had leased out lands had received Rs5,000 or more as land rent Two farmers had received a rent exceeding Rs10,000. The farmers are of the view that they can barely manage if they can cultivate in both seasons. However, the position of the non-owner operators who used wage labor, paid land rent and spent an average of Rs2,428 for fertilizer should receive attention. They reported a maximum income of Rs6,380 and a maximum loss of Rs20,563. The average income of the non-owner operators was a loss of Rs930. Six out of the 12 non-owner operators reported losses.

The average yield in the area is 3000 kg per ha; the minimum is 865 kg while the maximum is 4200 **kg.** Salinity and low fertilizer application can be regarded as the main reasons for low yields. Owner operators spent an average of Rs1,731 for fertilizer though '75% claimed that they did not use the recommended quantity of fertilizer. **A** relationship between the yield and the location of allotment could not be observed from the analysis of yield data.

The farmers in DC5 area have no employment opportunities other than wage 'labor at peak periods of agricultural seasons. There were only two farmers fortunate enough to find regular employment. One worked as a driver in Colombo while his wife looked after the land. The family was not permanently settled. The other employed person was the FK of FC49, an adhoc laborer attached to ID. Formerly they had access to chena land in Bogahawewa, an area which came under the reservoir. Now the authorities are trying to keep them away from this area. This too had affected them severely as chena cultivation was the main source of their income even after coming to the settlement. All these factors have contributed to the pauperization of the majority of farmers in the sample area. The extreme form of this pauperization is **expressed** by four farmers in the sample who have leased out their land to non-owner operators and now work on the same allotments as share croppers. These economic conditions are not in favor for building farmer level institutions because the farmer organization program does not offer solutions to these problems.

Table 3.7 above indicates that a significant number of farmers (32%) make their living by working as wage laborers. This makes it impossible for them to participate at FC and DCO activities. Both the newly selected secretary and president of the DCO too have leased out their lands and work as wage laborers.

3.6.4. Evaluations of the DCO

All the farmers in the sample accept that they are members of the DCO. With the exception of one farmer all claimed to know their FR. The FR had been selected by the farmers' consensus according to them. Seventeen farmers (68% of the sample) were satisfied with the performance of their FR. However, those who were not satisfied claimed that the FR did not try to distribute water and arrange FC cleaning. The majority of the unsatisfied were from FC51. They said that the FR had leased out his land and was not in the hamlet during the cultivation season. Out of the four FRs in the Sub DC, the FRs of FCs 48 and 51 had leased out their lands. Since FC48 was a small one with only six allotments, the farmers had no water problems and therefore did not find fault with the FR. In addition four allotments on the canal had been leased out. In case of FC50, the situation was very different. Farmers needed the assistance of the FR but he was not available in the hamlet as he was gemming elsewhere.

Only 4 farmers (16%) in the sample said that their FR tried to solve their problems. Nine farmers (36%) said that they did not know whether he tried to solve their irrigation problems. Twelve farmers (48%) said that the FR did not do anything to solve their problems. The farmers were not confident that their leaders can resolve conflict among the members of the FC group.

Seventeen farmers (68%) had met their IO and knew his role. Those who had not met the IO were those who had leased out their land and had engaged in wage labor. Those who had met the IO were of the view that his service was useful but the rest said they do not know whether his service was useful or not. Twenty farmers (80%) had attended DC meetings and 19 farmers (76%) had attended FC meetings and knew the functions of the organizations. Twelve farmers (48%) reported that attendance at FC meeting and participation at FC activities are satisfactory while the rest denied it.

When asked whether the DCO had been successful in solving their irrigation and agriculture related problems, 15 farmers (60%) gave positive replies. This is because the DCO had been able to do concrete lining of the canal and solve some irrigation problems of the farmers. However only 8 farmers (32%) were satisfied with the performance of their FC groups.

The farmers in the sample did not understand the decision making process for the seasonal agricultural plan. They denied that they have a role in the matter. They did not know that it is the PMC that takes the final decision regarding cultivation and said that the GA and officers take the decision. They were denied of the roles of FRs or farmers.

Though IMD has been successful in forming farmer organizations, the economic problems raced by the farmers have become a serious obstacle to institutional development. A large section of the community does not benefit from participation as they do not cultivate the land. As a result of lack of farmer participation in various organizational activities, some leaders get de-motivated. Some leaders take the opportunity to use organization resources For their own benefit. This process can be ended only by bringing back farmers to cultivate their allotments. Whether this is possible under the present circumstances is not clear.

Rainfall and Evaporation
Weerawila Agricultural Research Station
Maha 1991/92

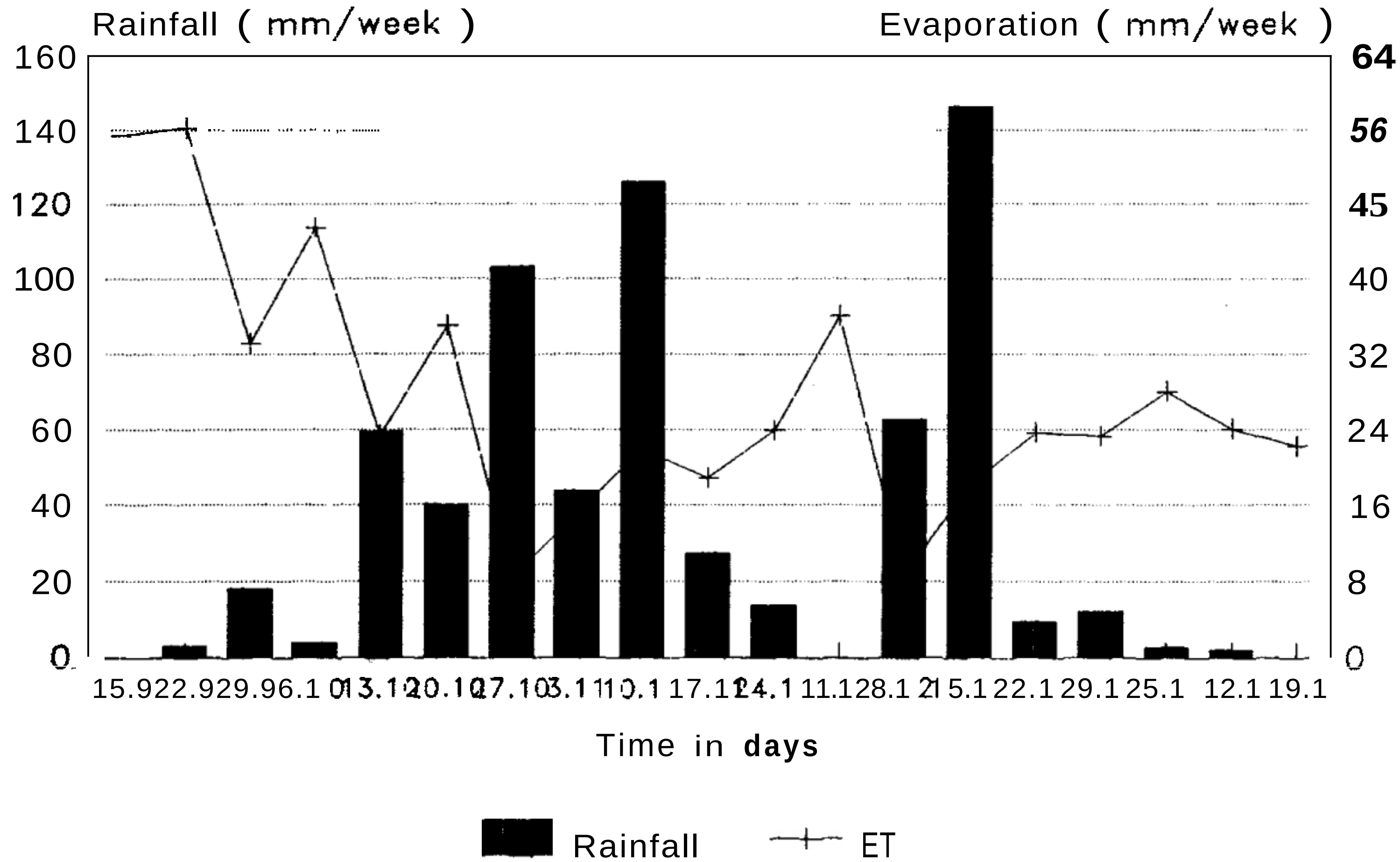


figure 3.1

Rainfall and Irrigation Supply

RB Tract 01 DC 5 Sub Canal

Maha 1991/92

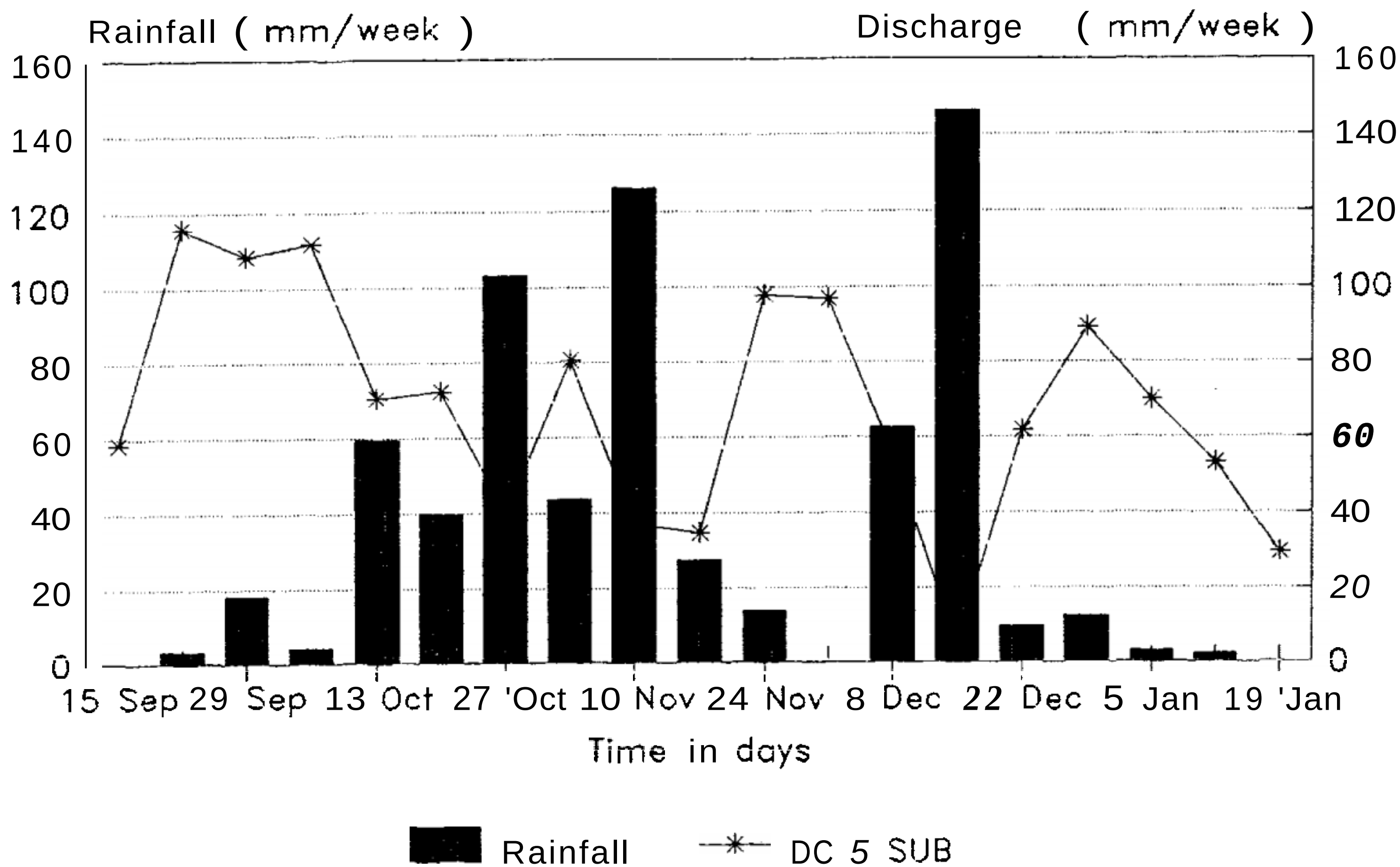


figure 3.2

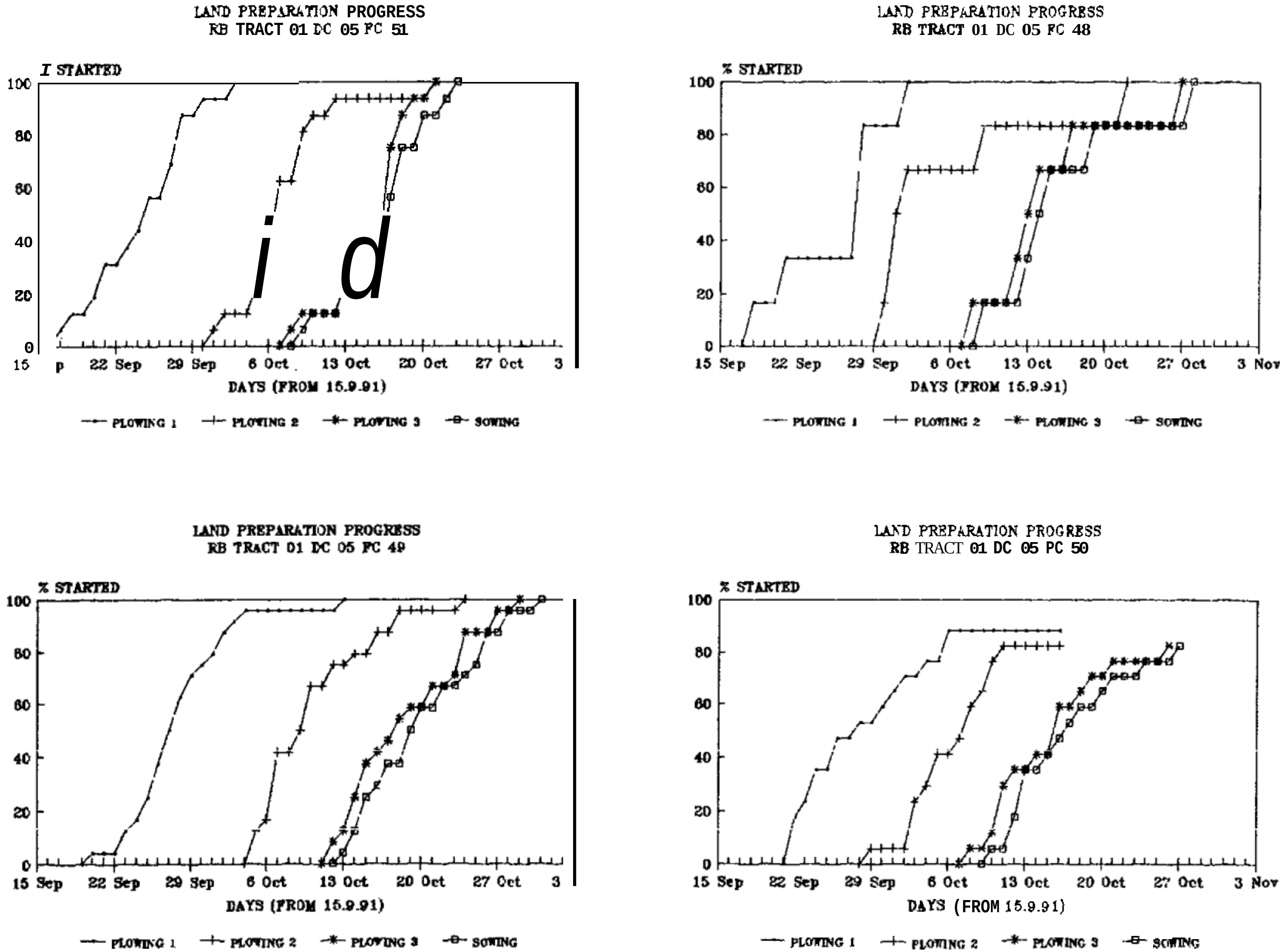

LAND PREPARATION PROGRESS
RB TRACT 01 DC 05 FC 51
% STARTED
100
80
60
40
20
0
15 Sep
22 Sep
29 Sep
6 Oct
13 Oct
20 Oct
27 Oct
3
DAYS (FROM 15.9.91)
PLOWING 1
PLOWING 2
PLOWING 3
SOWING
LAND PREPARATION PROGRESS
RB TRACT 01 DC 05 FC 48
% STARTED
15 Sep
22 Sep
29 Sep
6 Oct
13 Oct
20 Oct
27 Oct
3 Nov
DAYS (FROM 15.9.91)
PLOWING 1
PLOWING 2
PLOWING 3
SOWING
LAND PREPARATION PROGRESS
RB TRACT 01 DC 05 FC 49
% STARTED
15 Sep
22 Sep
29 Sep
6 Oct
13 Oct
20 Oct
27 Oct
3
DAYS (FROM 15.9.91)
PLOWING 1
PLOWING 2
PLOWING 3
SOWING
LAND PREPARATION PROGRESS
RB TRACT 01 DC 05 PC 50
% STARTED
15 Sep
22 Sep
29 Sep
6 Oct
13 Oct
20 Oct
27 Oct
3 Nov
DAYS (FROM 15.9.91)
PLOWING 1
PLOWING 2
PLOWING 3
SOWING

Figure 3.3

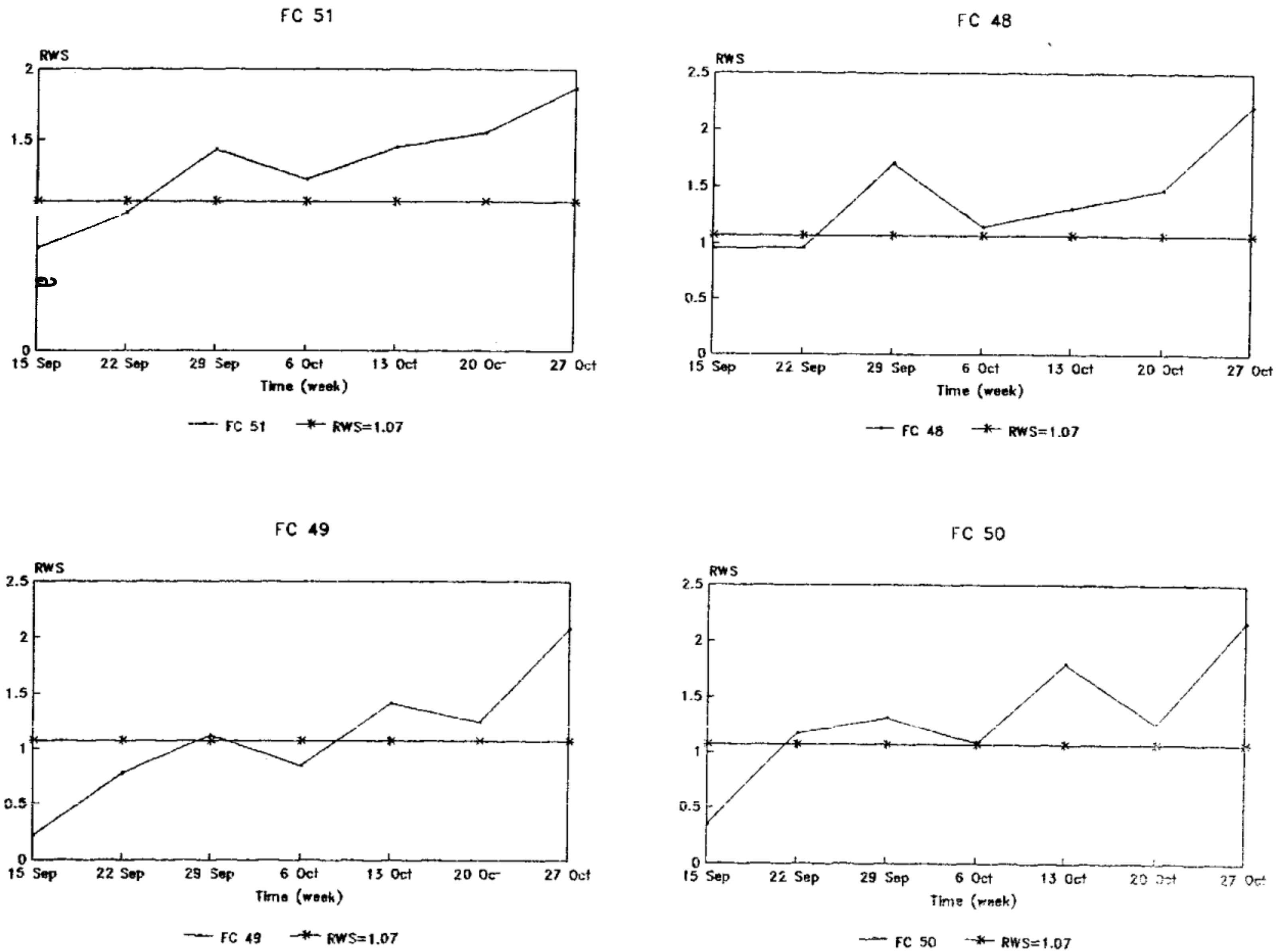
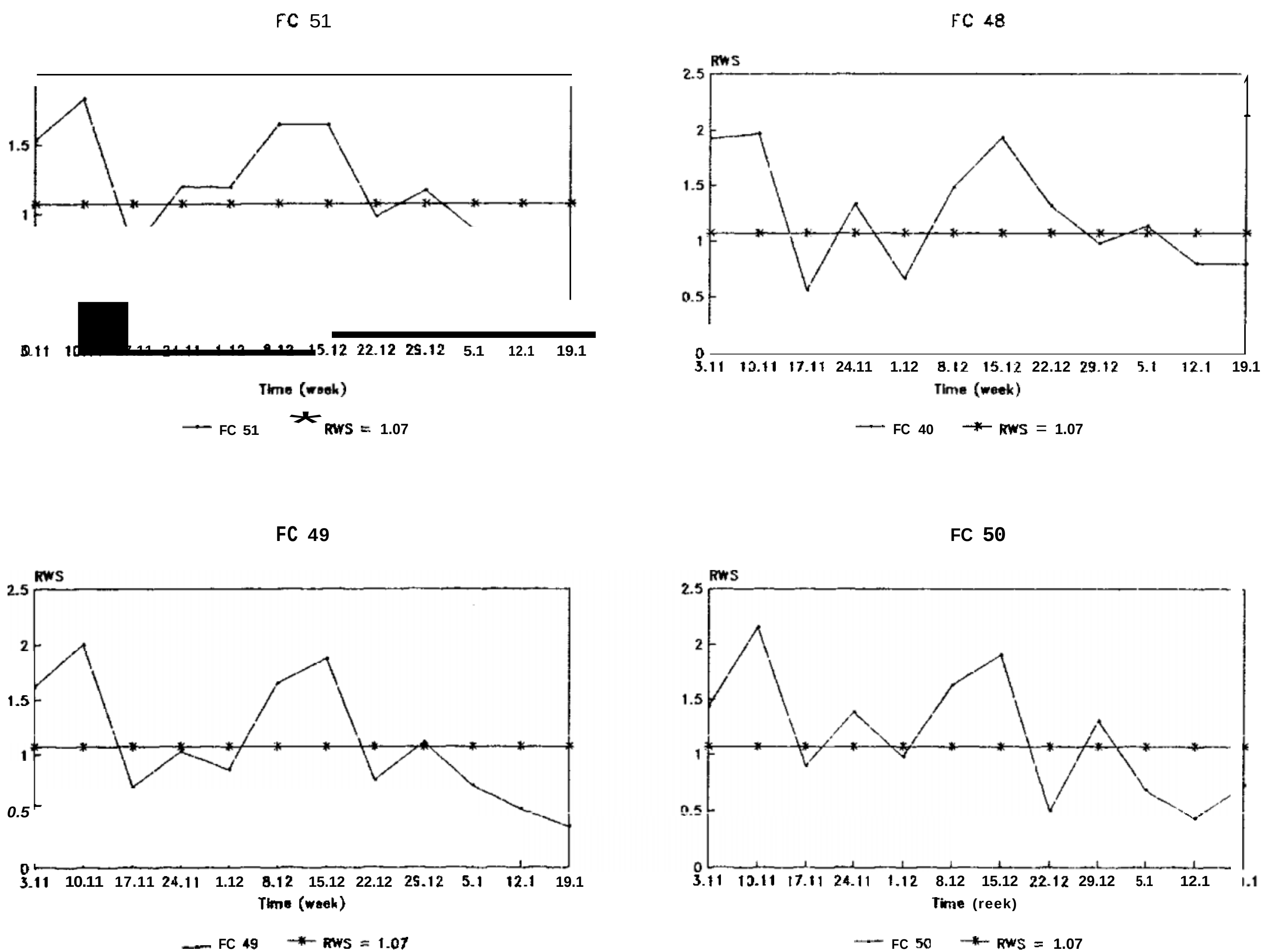


Figure 3.4 RWS for Land Preparation Period



Fgure 3.5 **RWS** for Crop Growth Period

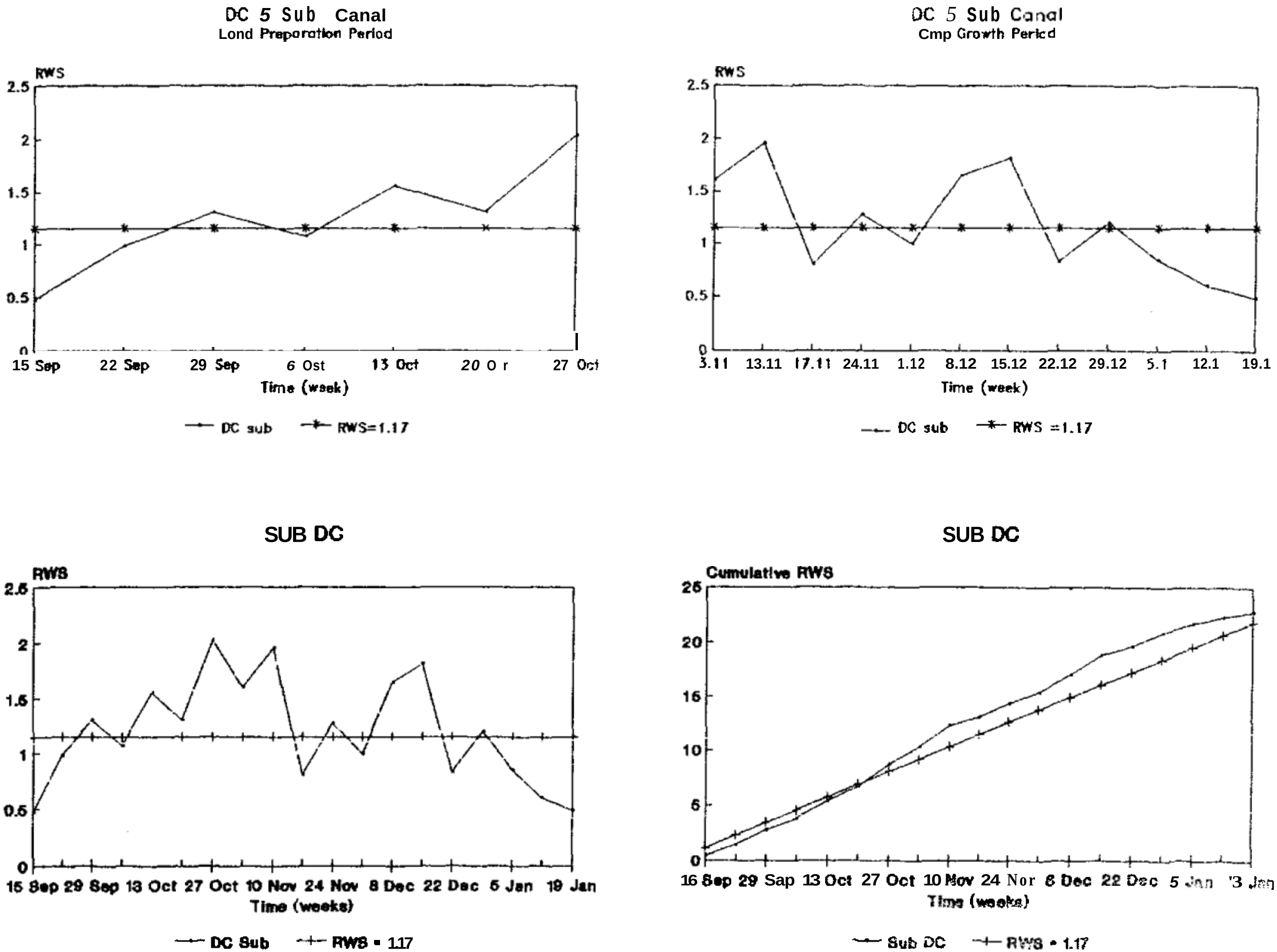


Figure 3.6 RWS for DC 5 Sub Canal

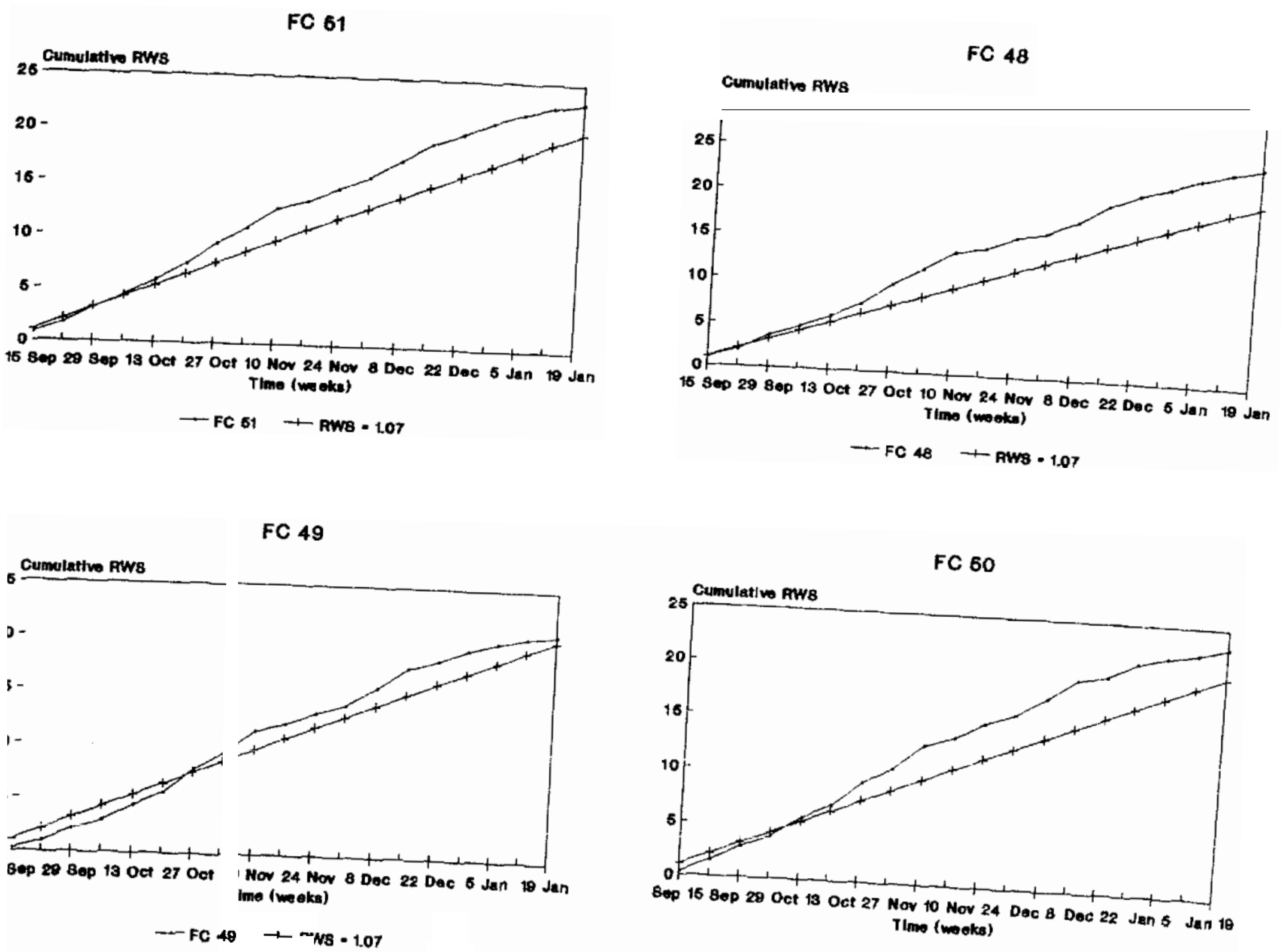


Figure 3 7 Cumulative RWS for Field

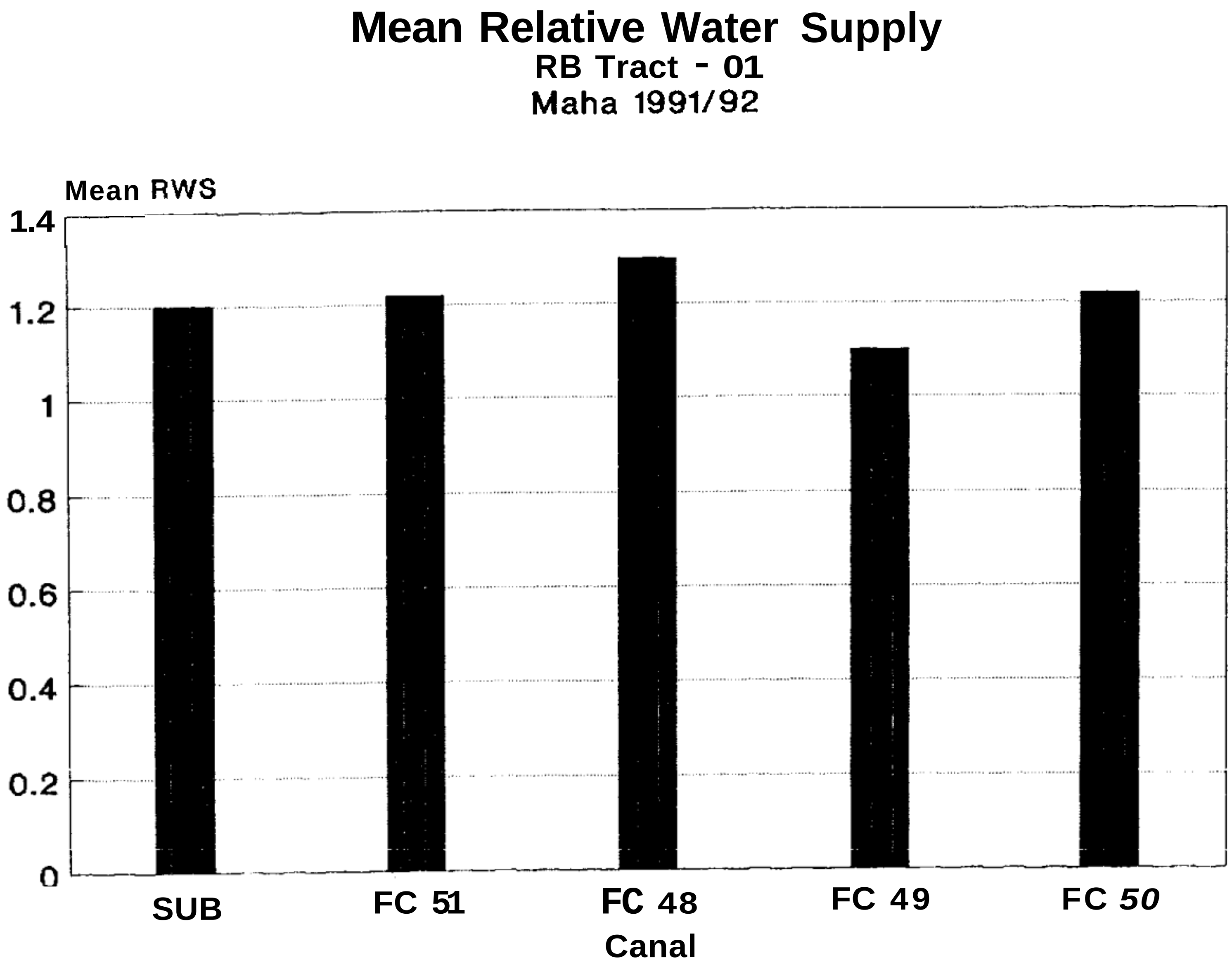

Mean Relative Water Supply
RB Tract - 01
Maha 1991/92
Mean RWS
1.4
1.2
1
0.8
0.6
0.4
0.2
0
SUB
FC 51
FC 48
FC 49
FC 50
Canal

Figure 3.8

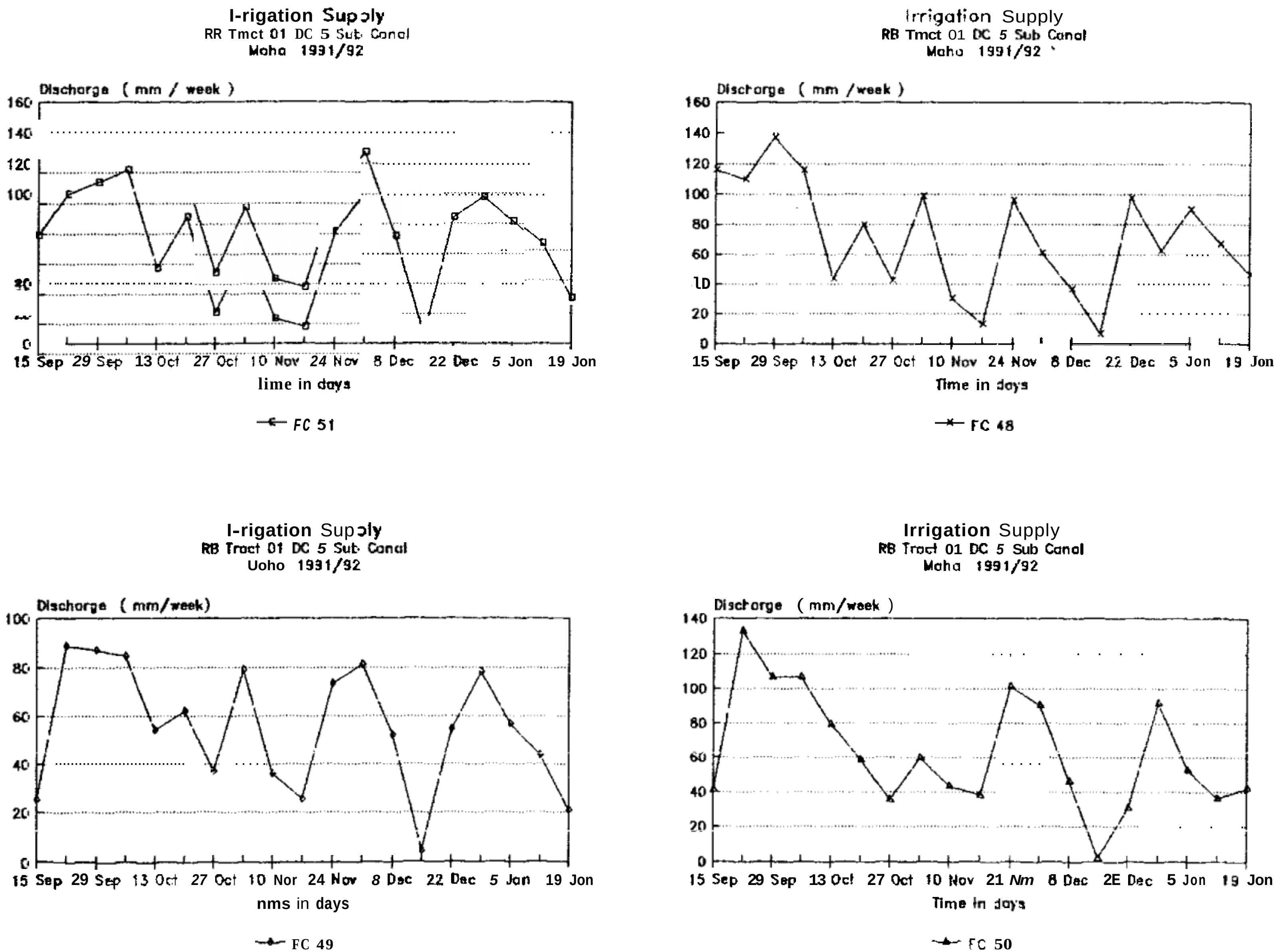
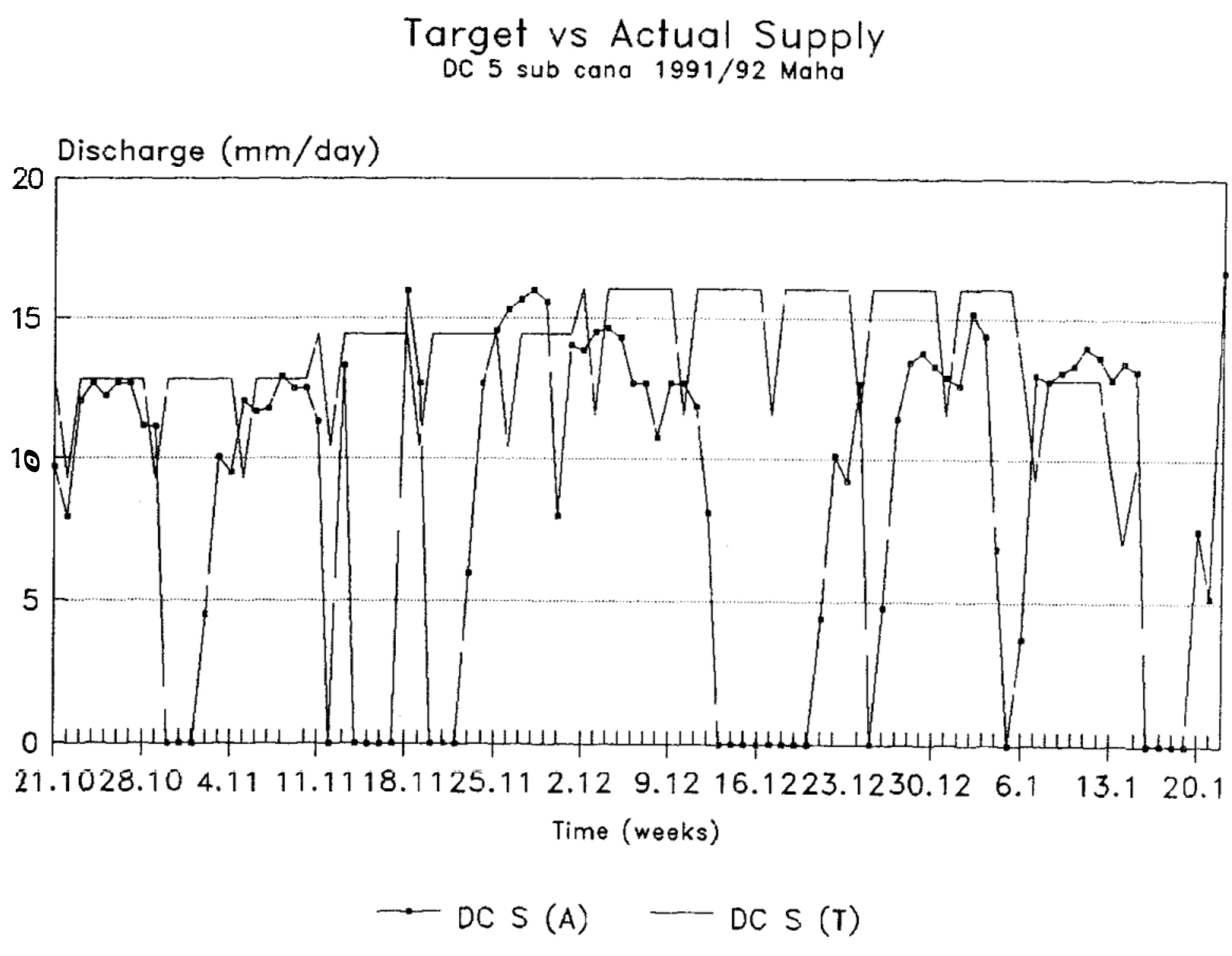

I-rigation Supply
RR Tmct 01 DC 5 Sub Canal
Moha 1991/92
Discharge (mm / week)
lime in days
FC 51
Irrigation Supply
RB Tmct 01 DC 5 Sub Canal
Maha 1991/92
Discharge (mm /week)
Time in days
FC 48
I-rigation Supply
RB Tract 01 DC 5 Sub Canal
Uoho 1991/92
Discharge (mm/week)
nms in days
FC 49
Irrigation Supply
RB Tract 01 DC 5 Sub Canal
Maha 1991/92
Discharge (mm/week)
Time in days
FC 50
15 Sep 29 Sep 13 Oct 27 Oct 10 Nov 24 Nov 8 Dec 22 Dec 5 Jan 19 Jan

Figure 3.9



Target vs Actual Supply
DC 5 sub cana 1991/92 Maha
Discharge (mm/day)
20
15
10
5
0
21.10
28.10
4.11
11.11
18.11
25.11
2.12
9.12
16.12
23.12
30.12
6.1
13.1
20.1
Time (weeks)
DC S (A)
DC S (T)

Figure 3.10

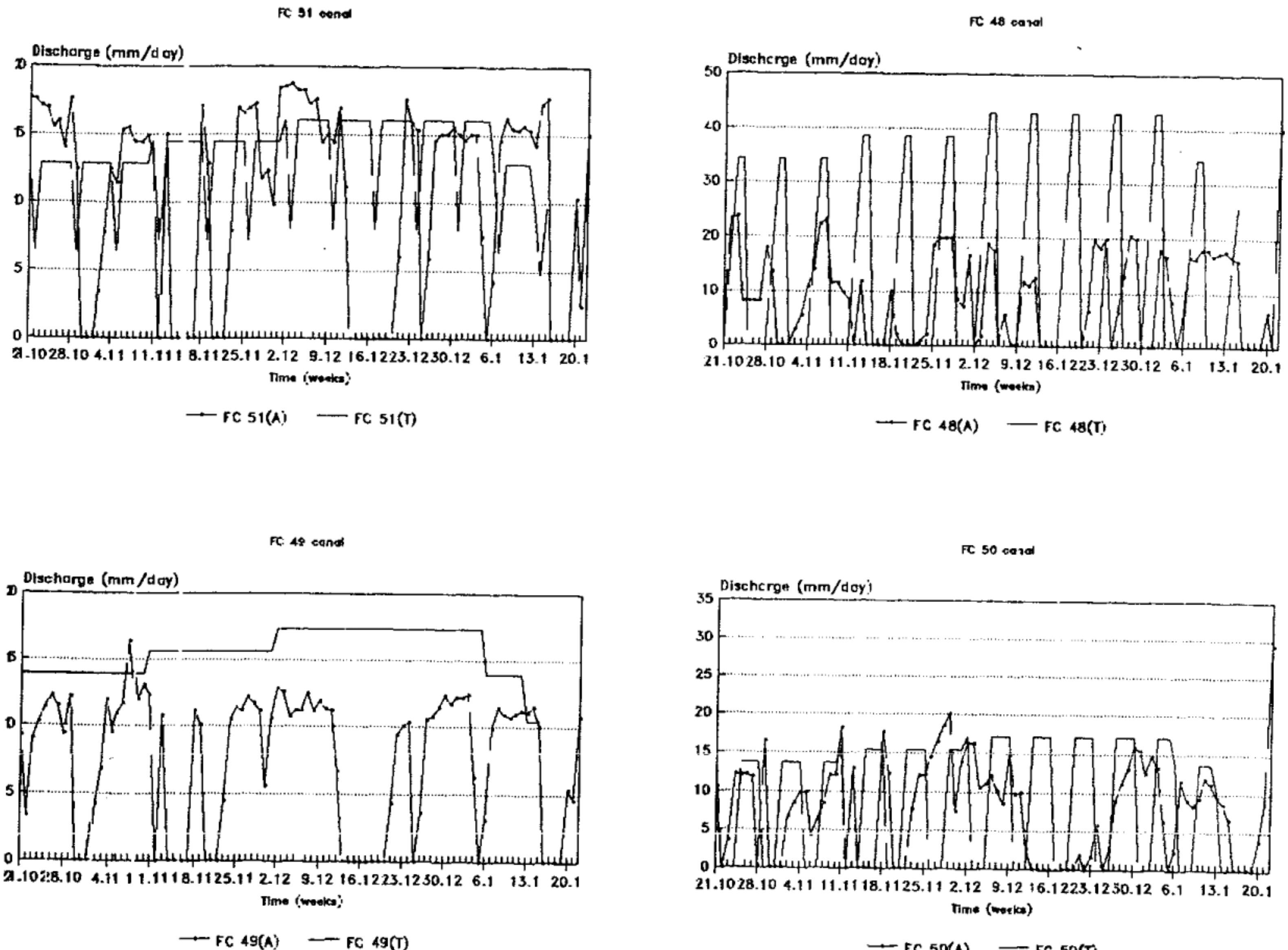


Figure 3.11 Target vs Actual Supply (1991/92 Maha)

Chapter 4

PILOT PROGRAM FOR OTHER FIELD CROPS

4.1. Introduction

This section discusses the history of Other Field Crop cultivation and the objectives of our study.

Kirindi Oya Imgation Settlement Project (KOISP) has been originally planned for both paddy and other field crops (OFCs) cultivation. According to the original plan, during Maha season paddy should be the crop in poorly drained soils (LHG soils) and other field crops should be cultivated in well and moderately drained soils (RBE soils) and during Yala season paddy should be grown in only 50% of LHG soils and OFCs in RBE, intermediate soils and 50% of LHG soils. The main reason for suggesting this cropping pattern is to solve the water short situation. However it has not been possible to adhere to this cropping pattern and in general, paddy had been grown in both seasons on all soils. In 1987/88 Maha, the first attempt was made to introduce OFCs in the project by implementing a OFC demonstration in selected farmers fields. This program was continued. OFCs cultivated in KOISP are shown in Table 4.1.

Table 4.1
Cultivation of Other Field Crops (in ha) in Kirindi Oya

Crop	1988/89 Maha	1989 Yala	1989/90 Maha	1990 Yala	1990/91 Maha	1991 Yala	1991/92 Maha
Chili	44	15	-	12	92	115	08
Greengram	106	2	-	19	1200	18	-
Cowpea	75	-	-	40	392	11	114
Groundnut	30	-	-	140	95	7	49
Maize	41	-	-	-	-	-	11
Gingerly	7	-	-	1	50	-	-
Onion	-	-	-	1	9	28	239
Vegetables	-	47	-	54	105	44	-
Total:	303	64	-	231	1943	223	431

In 1990, the State Secretary of Irrigation submitted a report to the Secretary to the Ministry of Lands, Irrigation and Mahaweli Development suggesting remedial measures to overcome the problems in KOISP. Implementing OFC cultivation has been given as one of the remedial measures to overcome the water problem. According to his report the following have been identified as reasons for failures to implement OFC cultivation:

1. The farmer organizations are not strong and effective enough to take collective decisions.

2. Lack of farmer participation in the decision making process, especially in relation to selection of cropping patterns.

3. Ineffective extension services and lack of proper institutional arrangements for overall management of the system and sub-systems.

4. Farmers are not sufficiently motivated to change from their traditional paddy cultivation.

5. Lack of adequate marketing facilities.

6. Lack of the strong leadership essential during the first few years of change.

7. Difficulty in obtaining credit and insurance facilities

In his report, a pilot project was proposed to test the possibility of cultivating OFCs during both Maha and Yala seasons in the project area. The main idea behind this experiment was to demonstrate to all the farmers the profitability and practicability of cultivating OFCs. For this purpose tract 3 of the Left Bank was selected. This tract has about 320 ha of irrigated land which is distributed among 400 farm families; each holds approximately 0.81 ha. The land selected for the OFC demonstration is from a tract which was originally designed for paddy cultivation in Maha and OFC cultivation in Yala. The proposal suggests the following composition for the Management Team of this experiment:

- Project Manager (Chairman).
- Resident Engineer of the Left Bank.
- Colonization Officer from Land Commissioner's Department.
- Agricultural Instructor.
- Farmer representatives.

The responsibility of this team was to make necessary arrangements regarding credit, seed, farm power, fertilizer, extension services, marketing and other related aspects. It was also the responsibility of this team to ensure that relevant officers from the line departments are brought in as necessary.

IIMI's role was to document the process of this experiment, provide guidance and analyze the progress of the pilot experiment. A Sub-Committee was appointed to review the progress and to co-ordinate IIMI's activities in this program. Due to the resource constraints, two field canals of DC2 namely FC3 made up of 19 allotments, and FC4 with 14 allotments were selected for monitoring of OFC cultivation. Field canal 3 contains about 84 percent of well drained lands and FC4 has about 95 percent well drained lands. Roughly ninety-five percent of the land in FCs 3 and 4 has RBE soils.

The first cultivation of OFC in the pilot area was started during the Maha 1991/92. One hundred and sixty one farmers from DC2 and DC3 were organized to cultivate OFCs during this season.

The research program included the following activities:

1. Documenting and evaluating seasonal planning.

2. Documenting and evaluating different land preparation methods for OFCs.

3. Documenting and evaluating irrigation scheduling, water distribution and water use for OFCs.

4. Evaluating economic performance of different OFCs.

5. Documenting other activities such as credit arrangements, marketing arrangements and training.

4.2. Results

4.2.1. Seasonal Planning

Seasonal planning includes determination of the dates to commence the cultivation, crop selection, irrigation schedules and provision of other services such as supply of **seeds,** credit and barbed wire, etc. This activity takes into consideration utilization of rainfall for land soaking and preparation, so as to minimize the use of irrigation water.

The OFC Sub-Committee decided that water issues should commence after receiving sufficient rainfall (about 70 mm of cumulative rainfall; normally expected in mid October) to start the cultivation. Farmers were consulted to get their views by interviewing several farmers. The other reason for this schedule was to give sufficient time for farmers to complete the highland cultivation on their 1.21 ha homestead allotments after the start of rain. The Agriculture Department recommended suitable crops based on economic and environmental factors. However, considering the water short situation, chili cultivation was recommended only for 0.50 acres (0.2 ha). These proposals were discussed with the farmers at the seasonal meeting (Kanna meeting). The Land Commissioner's Department agreed to supply barbed-wire and water deliveries by bowser for chili nurseries. Arrangements were made by the IMD to issue credit to farmers through a bank. The Department of Agriculture planned a series of training classes on land preparation and other agricultural practices. The **DOA** also planned to conduct an OFC demonstration on farmers fields. The aim of this demonstration was to show the farmers how to cultivate OFCs under irrigated conditions. For this purpose, they selected 13 allotments from FC3. One acre from each allotment came under this program. The department provided **seeds**, fertilizer, and chemicals free of charge.

Beginning irrigated OFC cultivation in the Maha season after receiving about 70 mm of cumulative rainfall proved acceptable. This gave sufficient time for farmers to complete their highland rain-fed cultivations so that there is no competition for labor between highland cultivation and irrigated cultivation. Figure 4.1 shows that the majority started work in irrigated land after crop establishment in highland. However, farmers took longer than scheduled for land preparation and crop establishment. The scheduled period was from **25** October to 11 November. The main reason was that farmers depend solely on family labor for these activities. Also, this was the first cultivation season and therefore, they took more time to do the work.

Chili (0.2 ha), greengram, soya, ground-nut and cowpea were the recommended crops for this season. Crops cultivated are given in the Table 4.2. In the demonstration area farmers had to follow the cropping pattern suggested by the DOA. Farmers had the freedom to select their own crops for other areas. The major crop cultivated in the farmers fields was chili. Ground-nut was the second major crop. Greengram and onion extents were very low. Other crops such as cowpea and vegetables were grown in small extents. Many farmers cultivated more than the recommended 0.2 ha of chili. The main reason for farmers preference to chili is that it is the most income generating crop. Almost all farmers said that they expected to keep the chili crop for a long period utilizing rains expected during March to May, so that they could get a higher income. The majority of farmers planted a local chili variety (Vanni miris) because the seed of the improved variety was not available. Many farmers said that they can get an income for a longer period from the local chili variety. Ground-nut cultivation was restricted due to unavailability of seeds. Farmers who cultivated ground-nut said that they chose ground-nut cultivation because soils in their farms are not suitable for chili cultivation due to poor drainage conditions. A few farmers planted onions in a small extent on experimental basis. Paddy cultivation was allowed in some field canals because OFC cultivation is not possible due to poor drainage condition and unsuitable soil conditions. About six percent of the land (0.95 ha) was not cultivated in FCs 3 and 4 due to poor drainage conditions. Many farmers cultivating at the bottom of the FCs faced crop damages (3.4 ha) due to poor drainage. Damages occurred during the heavy rains received in December. One farmer in FC3 (allotment 51) attempted to cultivate paddy and abandoned it later thinking that the number of irrigation issues allocated was not sufficient for paddy.

Table 4.2.
Land Utilization Pattern in FC 3 and FC 4

Crop	FC 3				FC 4	
	Demonstration	Farmers' own	Total	%	Farmers' own	%
Chili	1.62	4.55	6.17	40.12	5.57	46.26
Greengram	2.73	0.23	2.96	19.24	0.20	1.66
Soya	1.42	0	1.42	9.23	-	-
Cowpea	0	0.20	0.20	1.30	-	-
Groundnut	0	0.24	0.24	1.56	1.21	10.05
Onion	0	0.04	0.04	0.26	-	-
Others	0	-	-	-	0.10	0.83
Not cultivated	-	-	0.95	6.18	1.52	12.62
Cultivated and abandoned	0.20	-	3.40	22.10	3.44	28.57
Total:	5.97	-	15.38	100.00	2.04	100.00

4.2.2. Testing Different Land Shaping and Land Preparation Methods

Two different land shaping methods were proposed. One method is to construct terraces at a gradient of 0.2% along the contour, while the other method is to terrace without a grade. In the second method, bunds are constructed on contours. Individual terraces are sub-divided in to 30'x 30' basins in both methods. The two types of irrigation layouts that were tested are shown in Figure **4.2.** In the first method, an irrigation ditch is laid above the ground level along the bund and a leader ditch along the main slope in each terrace. The second method has a ditch in the middle of the terrace and a main ditch along the main slope. Different land preparation methods for different crops were recommended by the Department of Agriculture. The recommended methods were raised bed for chili and corrugated for greengram, soybean and cowpea.

It was observed that farmers adopted different irrigation layouts including the recommended ones. However, the extent of land prepared under the recommended layout was low. Three farmers prepared their lands for chili crop according to the first method, and **13** farmers prepared their lands for chili according to the second method. However, all these farmers were not able to prepare their entire 2 acre extent using any of these methods. Greater extent of lands in FCs **3** and **4** was prepared using other methods or had minimum land preparation. The main reasons were lack of family labor and lack of sufficient cash to hire labor for this operation. Another reason was that basic land shaping had not been done in some of the allotments.

Table **4.3** shows the different land preparation methods for different crops practiced by sample farmers. **In** demonstration plots, all farmers followed the recommended method for chili. Eight farmers followed the recommended method for greengram and soybeans. Others planted geengram and soybeans in flat basins. In the farmers' own fields, the majority did not follow the recommended land preparation methods.

Table 4.3
Land Preparation Methods Practiced for Different Crops

Crop	Number of farmers prepared land			
	Raised beds	Small furrows	Flat basins	No land preparation
Demonstration:				
Chili	16	-	-	-
Greengram	-[illegible]	7	8	-
Soybean	-	1	13	-
Farmers own:				
Chili	2	-	9	23
Greengram	-	-	3	-
Soybean	-	-	-	-
Groundnut	-	-	2	4

According to the survey, the following reasons were given for not practicing proper land preparation methods:

1. In sufficient time.
2. High cost.
3. Lands are not shaped.
4. Lack of cash in hand.
5. Lack of knowledge.

It was observed that the first method requires more labor than the second method, **(75** man days per ha. vs. 57 man days per ha.). In the first method, it was also observed that farmers had difficulty in maintaining the farm ditch laid along the terrace. This ditch tends to break frequently when water is flowing in the canal.

Uneven land levelling caused two major problems in several farmers' fields. One was difficulty in distribution of irrigation water evenly within a basin. As a result, there was over irrigation in some parts of the land and farmers took more time to irrigate their crops.

The other problem was water logging. These problems resulted in poor growth and poor yields.

4.2.3. Irrigation Practices **for OFCs**

The imgation Department is responsible for conveying water from the reservoir to the head of a field canal. Considering the water requirement for OFCs and (expectedrainfall during Maha season, ID officers planned the following pattern of water issues:

Land preparation	:	70 mm in two issues
Crop growth period	:	November, one issue
	:	December, one issue
	:	January, three issues
	:	February, three issues

This arrangement was discussed with farmers at the seasonal (Kanna) meeting. However, the farmers in a field canal were given the freedom to request water issues whenever they required water upto the planned number of issues. **A** rotational water sharing practice in FCs was implemented from the second water issue for the crop growth period. Farmers were asked to make use of one cusec flow for six hours. The field canal representative should arrange the rotation for every water issue.

Water issues for land preparation **started** on the 25th of October and continued till the 11th of November. Cumulative rainfall received during the period of 1st October to 25th October was about 110 mm. Issuing water after receiving 110 mm of cumulative rain saved water during the land preparation period. Water issues for the crop growth period started on 28th November. A considerable amount of rain (237 mm) was received between 11th November and **27th** November.

Water use during the cropping period in FCs 3 and 4 is shown in the Table 4.4. Nine water issues were made during the five-month crop growth period. Seven irrigations out of a planned eight, were issued before the end of February. The balance irrigation was given in March. Nevertheless, farmers requested an additional irrigation for the chili crop and received one in March. Table 4.5 shows the on-farm water use in selected farms in FC3. Starting from the second issue, the duration of a water issue was reduced from **5** days to **2-3** days by implementing rotational water sharing within a field canal. The total water received by FCs **3** and 4 were 1,912 mm and 1,824 mm respectively. The theoretical water requirement for OFCs was calculated by using the FAO method so that the actual water use values could be evaluated. The actual water use values in FCs 3 and **4** are quite close to the theoretical values. Analyzing the data more closely, it was observed that the area imgated in each rotation was less than the total area cultivated in each field canal. In many cases, farmers in lower reaches did not irrigate their lands because soils in these allotments had sufficient moisture and some allotments were waterlogged. This may have been caused by poor drainage facilities and over irrigation by farmers in upper areas.

Table 4.4
Water Consumption and Area Irrigated (ha) in FC 3 and FC 4 During Crop Growth Period

Period	Water Supply to FC3 (mm)					Water supply to FC4 (mm)				
	Rainfall	Irrigation	Total	E_o mm	Area irrig. ha	Rainfall	Irrigation	Total	E_o mm	Area irriga. ha
November'91	305	28	333	96	14.6	305	57	362	96	10.5
December'91	270	129	399	98	13.8	270	58	328	98	5.7
January'92	28	269			2.3	28	298			0.5
		210	507	164	6.1		174	500	164	2.7
February'92	-	122			5.6		127			2.9
		139			5.1		130			4.3
		128	389	198	5.2		108	365	198	5.1
March'92	-	157			5.8		137			6.2
		127	284	228	5.9		132	269	228	5.8
Total:	603	1,309	1,912	784		603	1,212	1,824	784	

Note: Total cultivated extent: ha in FC 3 and 15.38 ha in FC4 12.04 ha. E_o is pan evaporation.

Water issues were made on the farmers' request. Whenever farmers felt that the soil was dry, they asked the FRs to request water. The FRs then inform the Work Supervisor or meet the Irrigation Engineer. The problem observed in this method was that while the farmers in the (ail-end needed water at long intervals, the top-end farmers **needed** water at a shorter intervals. Farmers willingly accepted the rotational sharing but did not like to irrigate crops at night. However, farmers were compelled to irrigate at night since it was difficult to **keep** the FC turnouts closed at night.

Fluctuations of the flow in FCs were observed in every water issue as shown in Figures **4.3** and **4.4. As** a result farmers had difficulties in irrigating their allotments within six hours each. Fluctuations of the flow in the FCs occured during night due to illegal operations of the main canal regulators in Tracts 1 and 2. However, this did not become a very serious problem to farmers because many farmers in the lower reaches did not take water to some **parts** of their farms and some also managed to irrigate their plots within less than six hours.

Table 4.5
On-farm Water Use for Crop Growth (in mm per ha), 1991/92 Yala

Rotation	1	2	3	4	5	6	7	8	9	Total
Allotment										
45	19.9	na	41.2	28.8	89.0	75.2	44.5	na	108.2	406.8
55	52.1	na	58.7	69.9	86.4	49.1	51.7	na	47.6	415.5
47	151.6	na	94.2	23.1	39.4	49.1	48.5	73.9	51.4	531.2
53	11.7	na	154.3	76.9	45.8	79.2	98.2	57.5	71.3	549.1

Allotments are arranged according to the top sequence.
na: not available.

The major problem identified in the irrigation of OFCs was over irrigation in most of the allotments. **As** a result.

farmers in the bottom area received much seepage from the top area which caused drainage problems in the lower parts of FCs. This condition was aggravated due many farmers could not imgate the entire land (0.81 ha) within the allocated time of six hours.

Table 4.6
Labor Use (Labor days per ha) in Other Field Crops Cultivation in FC 3 and FC4, Left Bank Tract 3

	Chili		Greengram		Groundnut	
	days	%	days	%	days	%
Demonstration plots						
Family	477	73	88	62	116	89
Hired	180	27	53	38	13	11
Total:	657	100	141	100	129	100
Farmers' own cultivations						
Family	159	64	72	86	65	71
Hired	88	36	12	14	27	29
Total:	247	100	83	100	92	100

4.3. Economic Performance of Other Field Crops

Cost and returns data for **34** sample farmers from FCs 3 and 4 was collected to analyze the economic performance of different crops. The analysis of crop performance was also done, considering different drainage classes.

To measure the economic performance of other field crops cultivated in the pilot area, the average income to the :farmer (average net returns), gross value added and labor productivity were calculated. Return to a unit of water was calculated for different crops to compare water productivity. Cost and returns data of the OFC demonstration plots was analyzed separately so that a comparison could be done with crop performance in farmers fields.

Gross value added is the income generated to land, labor (family and hired) and fixed capital. Net return is the farmer's income. Operator's surplus is defined as return to land and management. Costs of factor inputs are given as factor payments. If :factor inputs are self-supplied they are valued at their market prices. Factor payment to labor is considered as an income to the society. In the case of an individual farmer, income is returns **to** family labor, land and management. Gross return to water was calculated by estimating water productivity. This indicator was used to compare water productivity of different crops and with paddy.

Labor requirements: Most other field crops require more labor than rice. Labor use for OFCs in the sample area is given in the Table **4.6.** Labor used for OFCs in demonstration plots was higher than that of in farmers' own fields. This is mainly because farmers put more effort to the demonstration plots. However, the labor input for chili is much higher than that for other crops. The data shows that farmers mainly depend on family labor. This may be due to unavailability of cash to hire labor. No labor shortage was observed during this season. However, it is quite likely that cultivation of chili in larger extent in the system could create a labor shortage.

Capital requirements: Capital use for OFCs is shown in Tables 4.7 and 4.9. Capital requirement for greengram and soya are similar to that for paddy. Chili needs much more capital, nearly five times more than needed for legumes. However, capital may not be a problem if credit is provided without restrictions.

Table 4.7
Yields, Labor Requirements, and Costs and Returns of Other Field Crops Under Irrigated Conditions in OFC Demonstration, Left Bank Tract 3

		Chili	Greengram	Soybean
Average yield (green chili kg/ha)		4,884	511	458
Maximum yield (kg/ha)		9,544	840	1,245
Price (Rs/kg)		21.35	22.14	20
Potential yield (kg/ha) (on farmers' fields)		10,000	1,250	2,000
Gross revenue (Rs/ha)		104,266	11,320	9,160
Factor costs (Rs./ha)				
Current inputs:				
	Seed	679	988	1,383
	Fertilizer	10,059	2,470	2,470
	Chemical	11,779	1,688	948
	Sub-total:	21,779	5,146	4,802
Fixed capital		355	406	165
Labor:	Family	59,151	12,666	15,069
	Hired	16,412	4,893	1,644
	Total:	75,564	17,559	16,714
Value added (Rs/ha)		82,487	6,174	4,340
Farmers' income (Rs/ha)		65,720	875	2,531
Land and surplus		6,569	-11,790	-12,538
Labor productivity (Rs)		159	80	70
Water productivity (Rs/M³)		6.70	1.24	1.00
Water requirement M³		15,600	9,130	9,130

Value added = Gross revenue - Cost of current inputs.
Farmers' income = Gross return - (Cost of current inputs + Fixed capital + cost hired labor).
Land and surplus = Gross return - (Total factor costs).
Labor productivity = Gross revenue/Total labor.
Water productivity = Gross revenue/Total water requirement.

Yield performance: In Table 4 the eld of various OFCs and ec nom perfoımance t are shown for the OFC plots in FC3. All values are given in current prices. Table 4 presents similar indicators ti f a C demonstration conducted in 1989 Yala in the Right Bank canal Chili was the most profitable crop among all th OFCs tested. The average green chili i was 4,884 kg per hectare. Th average yield is a little less than the average ie c in 1987/88 demonstration (kg/ha). Chili i (green chili equi t) in th districts range from 4,800 ha t 6,400 kg/ha. Greengram and b crops gave quite poor ld However, e soyb yield is higher than the yield in 1989 Y l season. Yi of th crops in KOISP seems well below the potential yield of t p 1 kg/ha and 2,500 kg/ha for greengram and t respectively.

Table 4.9 shows the yield f of the crops 1 out side the e on area. Chili d i the demonstration area was y three times g than that in farmers ow ti This was mainly because th majority of chili in farmers' own fields were c l et Analyzing the yield data more closely reveals that ti in crop yields was very . I hi t chili yield was 44 kg/ha. The highest greengram and soybean y were 840 kg/ha and 1,245 kg/ha respectively; these are also below potential yields. The farmer c d ai d the i hili yield had spent more on fertilizer d i l His land (allotment 47) i in the middle of the field canal. Six farmer obtained chili yields above 000 1 t pt one, had their ts i the upper part of the field canal. y of p by diff soil category is given in the bl 4.10. The average yields of chili and greengram r well d lands were t than those in poorly dra and intermediate But soybean gave h yields in poorly drained and intermediate lands.

Table 4.8
Yields, and Costs and Returns of Other Field Crops Under Irrigated Conditions in OFC Demonstration in 1989 Yala

	Chili	Greengram	Soy
Average yield (green-chili kg/ha)	1,250	650	180
Price (Rs/kg)	67.37	27.89	7.50
Gross revenue (Rs/ha)	85,330	18,190	1,350
Factor costs (Rs./ha)			
Current inputs:			
Seed	560	2,890	500
Fertilizer	3,220	0	0
Chemical	2,680	480	230
Fuel	360	370	180
Sub-total:	6,820	3,740	920
Fixed capital	1,960	1,400	770
Labor:			
Family	21,760	6,480	2,230
Hired	14,520	6,840	5,180
Total:	36,280	13,320	7,410
Value added (Rs/ha)	78,510	14,460	430
Farmers' income (Rs/ha)	62,030	6,210	-5,510
Land and surplus (Rs/ha)	40,720	-260	-7,740
Labor productivity (Rs/day)	117	67	9

The following factors resulted in poor yields:

1. Water logging conditions due to lack of drainage facilities.
2. Poor land levelling.
3. Pests and diseases.
4. Lack of proper land preparation.
5. Damages caused by wild animals.
6. Removal of top soil.
7. High rainfall received in December.
8. Delayed crop establishment.
9. Low fertilizer application.

Economic **returns:** Comparing input requirement for different crops, it was observed that chili needs the highest amount of cash and labor. **As** in other seasons, the family labor component was quite high. Farmers did not appear to have any difficulty in hiring labor. Chili gave the higher economic returns than greengram and soybean. Chili gave average net returns of Rs65,720 per hectare. The highest value was 141,028 Rs/ha. Greengram gave negative average returns of Rs339 per hectare during this season. Soybean gave very low net return of Rs721 per hectare. If family labor is valued at the market wage rate, greengram and soybean had very high negative net returns. Similarly low economic returns from these crops were shown in the 1987/88 OFC demonstration. These findings imply that these crops are not suitable at current output prices and average yield levels. However, a few farmers obtained higher income from these crops, upto Rs4,318 from greengxam and Rs13,625 from soybean. Chili and greengram have given higher income when grown on well drained soils. Soybean gave poor returns when grown on well drained soils. Chili seems to be the only crop that gives a higher income than paddy.

The economic performance of the chili crop grown in farmers' own fields **is** low compared to chili grown in the demonstration **area.** Over 90% of the chili extent was under local varieties. Input application was very low compared to chili cultivated in the demonstration area. Total current input cost was 3.5 times less than that of for chili in demonstration plots. It was observed that local chili variety was less prone to pests and diseases. The average income shows a low figure - Rs18,540 per hectare - compared to that of demonstration crop. However, if farmers were able to continue these chili crops during Yala they could get higher income from these crops. Many farmers think in this way. Therefore, it is difficult to compare the economic performance of improved chili and local chili varieties yet. The comparison will be possible only after the total local chili crop **is** picked during Yala.

Prices and Marketing: Profitability of other field crops depends mainly on output and factor prices. Prices in turn depend on market demand of the respective products. Generally, OFC production involves more risk and uncertainity than rice produciion. This is mainly due to price uncertainty, pest and diseases and other variations in physical conditions.

Figure **4.5** shows that there was a high variation in the green chili price. It was observed that different farmers sold chili at different prices on the same day. Local buyers offered a higher price for local chili varieties because the local demand for local chili is higher than that for improved varieties. The greengram price changed less frequently. During the early period (January), the greengram price was around Rs10 to Rs12 per kilogram. Traders offered low prices because of **the** poor quality of the greengram that came into the market. This happened due to the heavy rains received in mid December, which affected the greengram crop planted in highland areas. Towards the end of March the price rose up to Rs18 to Rs20 per kilogram.

Table 4.9
Yields, Labor Requirements, and Costs and Returns of Other Field Crops Under Irrigated Conditions In Farmers Own Fields, Left Bank Tract 3

	Chili	Greengram	Groundnuts
Sample size	25	1	6
Yield (green-chili kg/ha)	1,483	420	932
Price (Rs/kg)	23.08	24	18
Potential yield, kg/ha (on farmers fields)	1,250	2,000	
Gross revenue (Rs/ha)	34,237	10,078	16,776
Factor payments (Rs/ha)			
Current inputs:			
Seed		807	2,500
Fertilizer	1,333	0	0
Chemical	4,793	1,940	115
Sub-total:	6,126	2,747	2,615
Fixed capital	333	0	0
Labor:			
Family	19,772	9,547	9,416
Hired	9,238	922	3,026
Total:	29,011	10,496	12,442
Value added (Rs/ha)	28,111	7,331	4,334
Farmers' income (Rs/ha)	18,540	6,409	1,308
Land and surplus (Rs/ha)	-1,232	-3,138	-8,108
Labor productivity (Rs/day)	139	121	182

In April the greengram price rose to Rs25 to Rs27 per kilogram. The majority of the farmers had stored their greengram till the price rose to about Rs20 per kilogram. Some farmers were able to sell their greengram harvest at prices as high as Rs24 to Rs27 per kilogram.

There was no demand for soybeans at the local market. Many farmers could not sell the soya produce. DOA tried to sell farmers' soya produce at Rs20/kg. Almost all farmers sold their produce to local buyers.

There were three kinds of buyers: a) collectors who come to the farmers' fields, b) buyers who operate. at the local market place at Pannegamuwa, and c) buyers who have their permanent places in the area, The third kind of buyers purchase legumes like greengram, groundnut, etc. Buyers at the Pannegamuwa purchase vegetables and legumes. They **seem** to have a good control over the market.

Agricultural Credit: Credit for OFCs was arranged through a state bank (Bank of Ceylon). Due to the long time taken for negotiation and implementation of the final decision, credit for OFC cultivators in LB tract **3 was** delayed.

Credit issued to OFCs by the bank was as follows:

Chili	(½ acre)	**Rs** 4,250
Greengram	(1 acre)	**Rs** 3,100
Soybean	(1 acre)	**Rs** 3,120
Groundnuts	(1 acre)	**Rs** 2,550
Cowpea	(1 acre)	**Rs** 3,260

Table 4.10
Average Yields and Net Income of Other Field Crops by Different Drainage Classes

	Chili		Greengram		Soya	
	Yield Kg/ha	Net Income Rs/ha	Yield Kg/ha	Net Income Rs/ha	Yield Kg/ha	Net Income Rs/ha
Well drained	5,395	73,469	543	1,133	393	-26
	(2,204)	(36,096)	(128)	(3,358)	(332)	(5,398)
Sample size		13		12		12
Intermediate and poorly drained	2,668	32,139	318	624	1,245	9,682
	(1,942)	(31,679)	(151)	(2,456)		
Sample size		3		2		1
Overall average	4,884	65,720	505	875	458	721
	(2,406)	(38,820)	(157)	(3,305)	(85)	(804)
Sample size		16		14		13

Figures in parenthesis are standard deviations.

Since this was the first attempt to obtain credit, farmers had to obtain their farmer identity cards, which are necessary to obtain credit from the banks. This was arranged by the Department of Agrarian Services (DAS). This took a considerable time to complete. The bank also had a problem of shortage of staff to handle credit to farmers.

The loans were released in installments. The first installment should have been released after preparing the bunds and land shaping. The loans were released to farmers in batches for the bank's convenience. The bank required that all farmers complete the activity to obtain the loan installment. Since some farmers were delayed, the bank found difficult to release loan installments. The first installment was released on the 18th November after the majority of farmers had their crops established.

Many farmers had to obtain credit from other sources since the credit issued to farmers from the bank was not sufficient. Table 4.11 gives the cash requirement and credit supplied by the bank. This indicates that farmers could meet only about 54% of the cash requirement for chili from institutional loans. For other crops, greengram and soybean, the bank provided 73% and 117% of the cash requirements respectively. Thirty-nine percent of the sample farmers obtained informal credit whose annual interest rates were between 180% and 240%. These rates are much higher than the bank interest rate, which was 16 percent per annum. The majority of the farmers who raised chili crops obtained credit from informal sources because the bank issued credit only for ½ acre of chili which was the area decided for chili cultivation at the kanna meeting.

4.4. Conclusions

Chili is the most profitable crop among the recommended other field crops. The poor economic performance shown by greengram, soybean and groundnut is mainly due to poor yields received by farmers. There were multiple reasons for farmers getting poor yields including low application of fertilizer, poor drainage conditions, late crop establishment (for greengram), lack of proper land preparation and pest and diseases. Nevertheless, there is a potential to get higher net returns from these crops because the yield potentials are high. However, cultivation of OFCs in poorly drained soils during Maha may not be economically viable.

During this season, many farmers could not follow the cultivation practices recommended by the DOA because farmers were not sufficiently well organized. Also, almost all farmers were new to OFC cultivation under irrigation condition, hence it was difficult to convince them to follow the recommended practices.

Table 4.11
Credit Supplied by the Bank and Cash Cost for Different Crops

	Credit Rs/ha (1)	Cash cost Rs/ha (2)	% (1)/(2)
Chili	20,995	38,500	54.5
Greengram	7,657	10,500	73.0
Soybean	7,706	6,600	116.7
Groundnut	6,298	5,641	111.6

4.5. Lessons Learned and Research Issues

Improve on-farm drainage conditions: OFC cultivation will be monitored with improved drainage conditions during 1992/93 Maha season. The herring-bone drainage system will be used in FCs 3 and 4 on the experimental basis to improve the drainage condition.

Improving the cropping pattern: Crops should recommended based on the drainage characteristics. Most of the farmers did not have a good understanding about the drainage conditions of their plots during the last season. This problem will not come once farmers have got a better understanding of the drainage conditions in their allotments after few cultivations. Time of planting is important for certain crops like greengrain.

Better regulation of water: This is a research issue in the next season. How can the stability of water flow in the canals be maintained? On-farm water management is important in OFC cultivation. How can on farm irrigation be improved to reduce over irrigation and wastage of water?

ANNEXURE

FORMAT FOR COLLECTING DATA ON INPUT REQUIREMENT

I. Seed Requirements

Step i. FRs will prepare a list of **seed** requirement at FC level using a format like the one appearing below.

Allot No.	*Seed* requirements paddy OC	Quantity available with farmers	Quantity required from outside

Step ii. The list indicating ***seed*** requirements can be forward to DC leaders by FC leaders. DC leaders can prepare a summary of **seed** requirements and send one copy of the list to AI (DOA) and the other Project Manager (IMD)

II. Other Input Coordination

IO *can* assist FR to prepare a list indicating the other input availability at FC level. The following format can be used for this purpose.

FC No: ....   Input ....

Allot No.	Tractor owned	Tractor arrangement	Credit available	Credit arrangement	Other inputs	needed

Once the above list **is** prepared IMD can identify the farmers of various categories like:

- those who have no problems with tractor and credit.
- those who have problems which can be solved at project level.

Farmer leaders can convey problems related to input supply to Sub-Project Committees. PMC and also to the Project Manager (IMD) for solution.

Monitoring and Evaluation by **FOs**

The farmer groups can keep records (**FRs** of each **FC** may be able to do this).

FC No: ……….   Input: ……….

Allot No.	Inputs	Problems	**Reasons**

The above format can be used for monitoring of input coordination. The evaluation of the input coordination can be done using the following format. Monitoring and evaluation of input coordination **need** to be done by farmer organization.

FC No: ……….   FO Satisfaction (indicate the number of farmers)

Input	Satisfied with services	Unsatisfied with services	Reasons

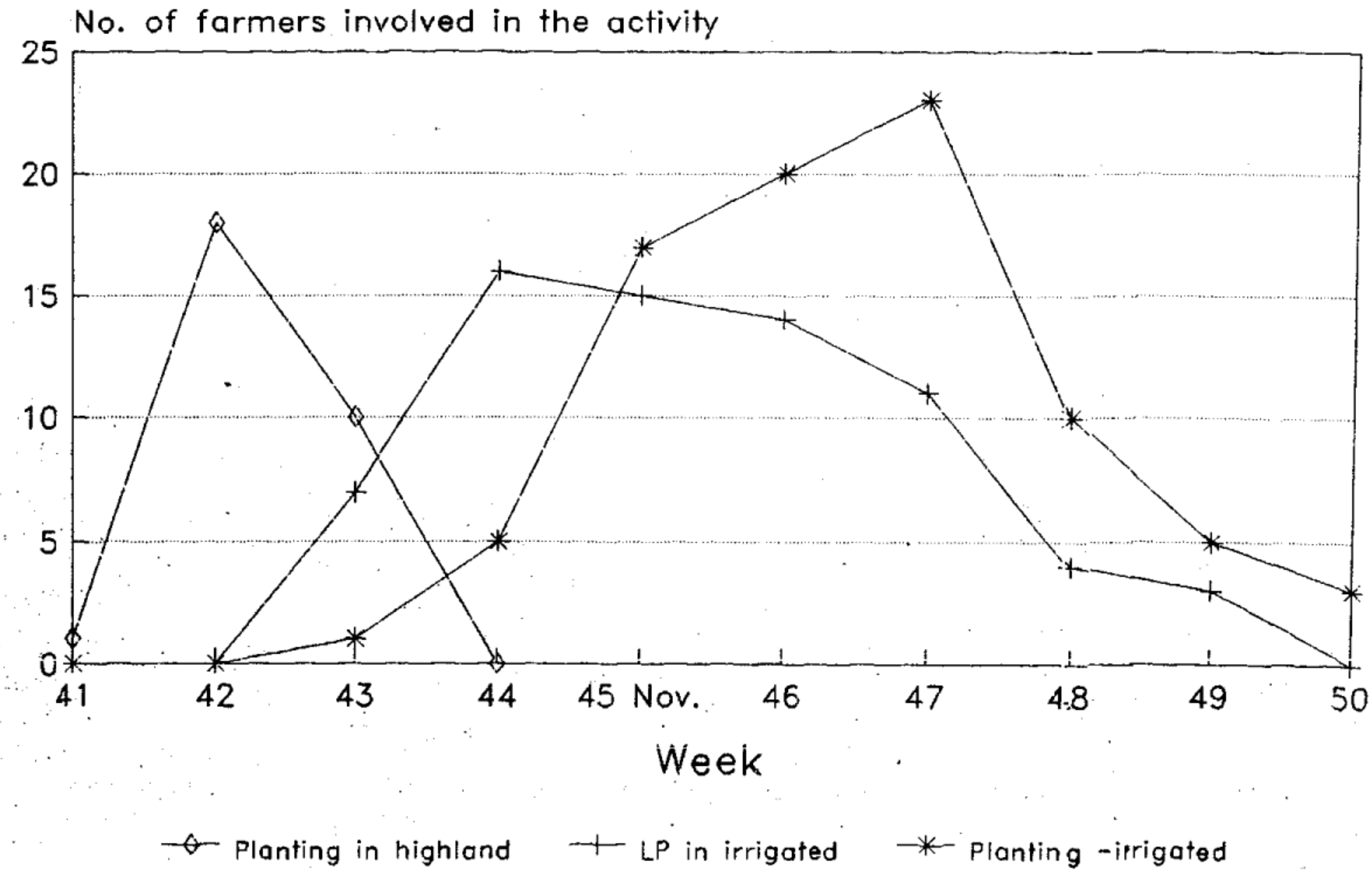
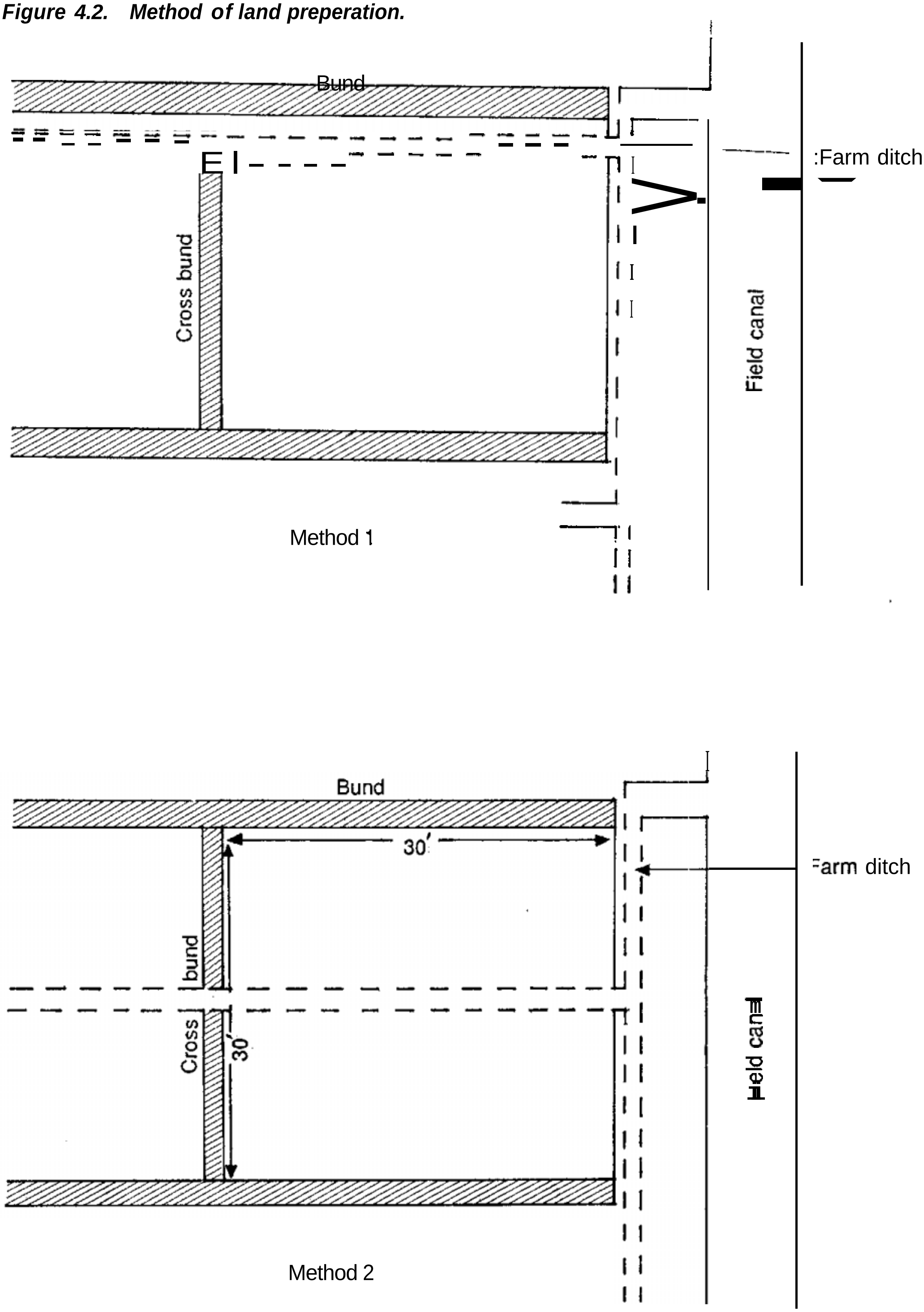


Figure 4.1 Agricultural Activities 'n LB Tract 3

Figure 4.2. Method of land preperation.



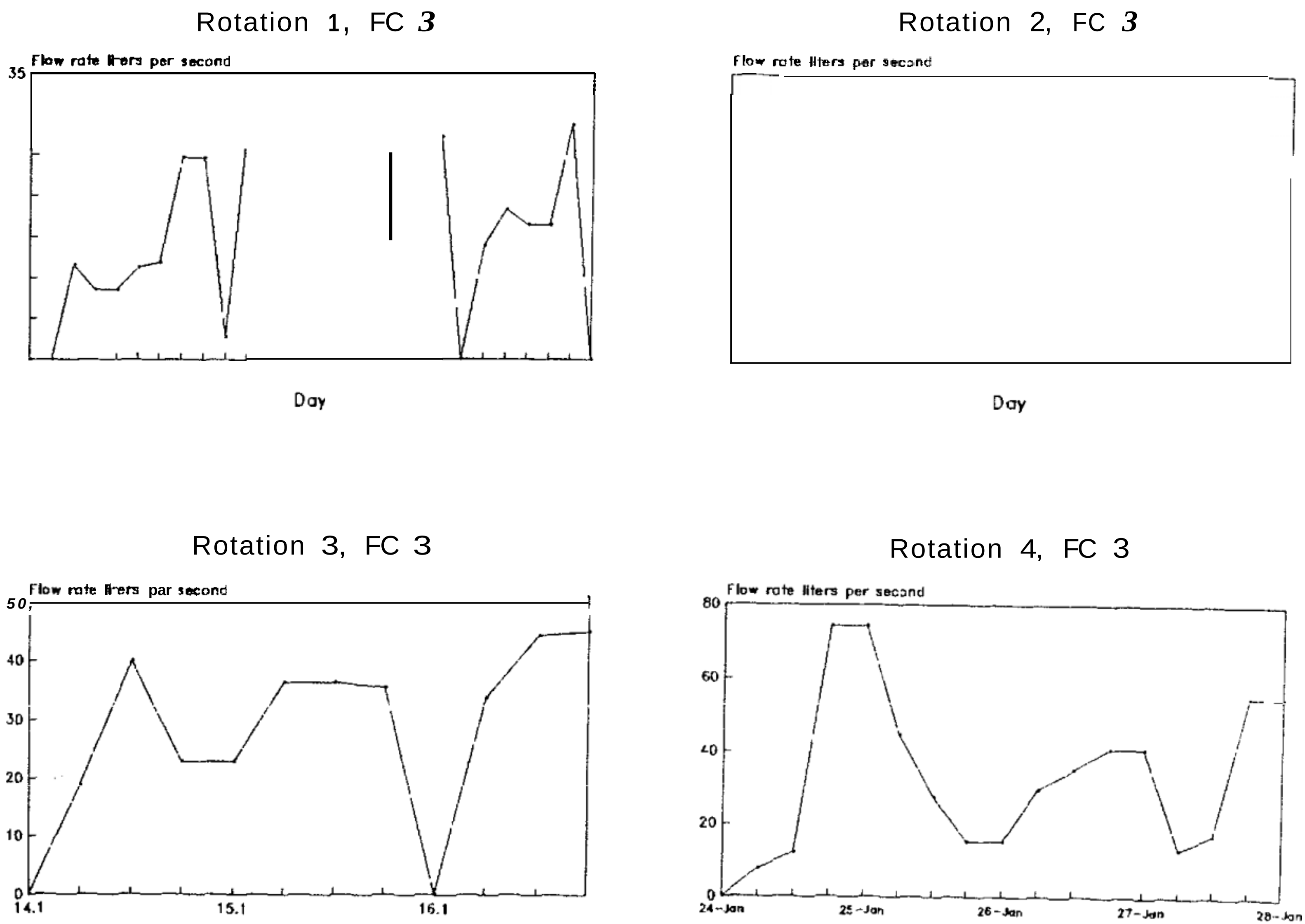

Rotation 1, FC 3
Flow rate liters per second
35
Day
Rotation 2, FC 3
Flow rate liters per second
Day
Rotation 3, FC 3
Flow rate liters par second
50
40
30
20
10
0
14.1
15.1
16.1
Day
Rotation 4, FC 3
Flow rate liters per second
80
60
40
20
0
24-Jan
25-Jan
26-Jan
27-Jan
28-Jan
Day

Figure 4.3

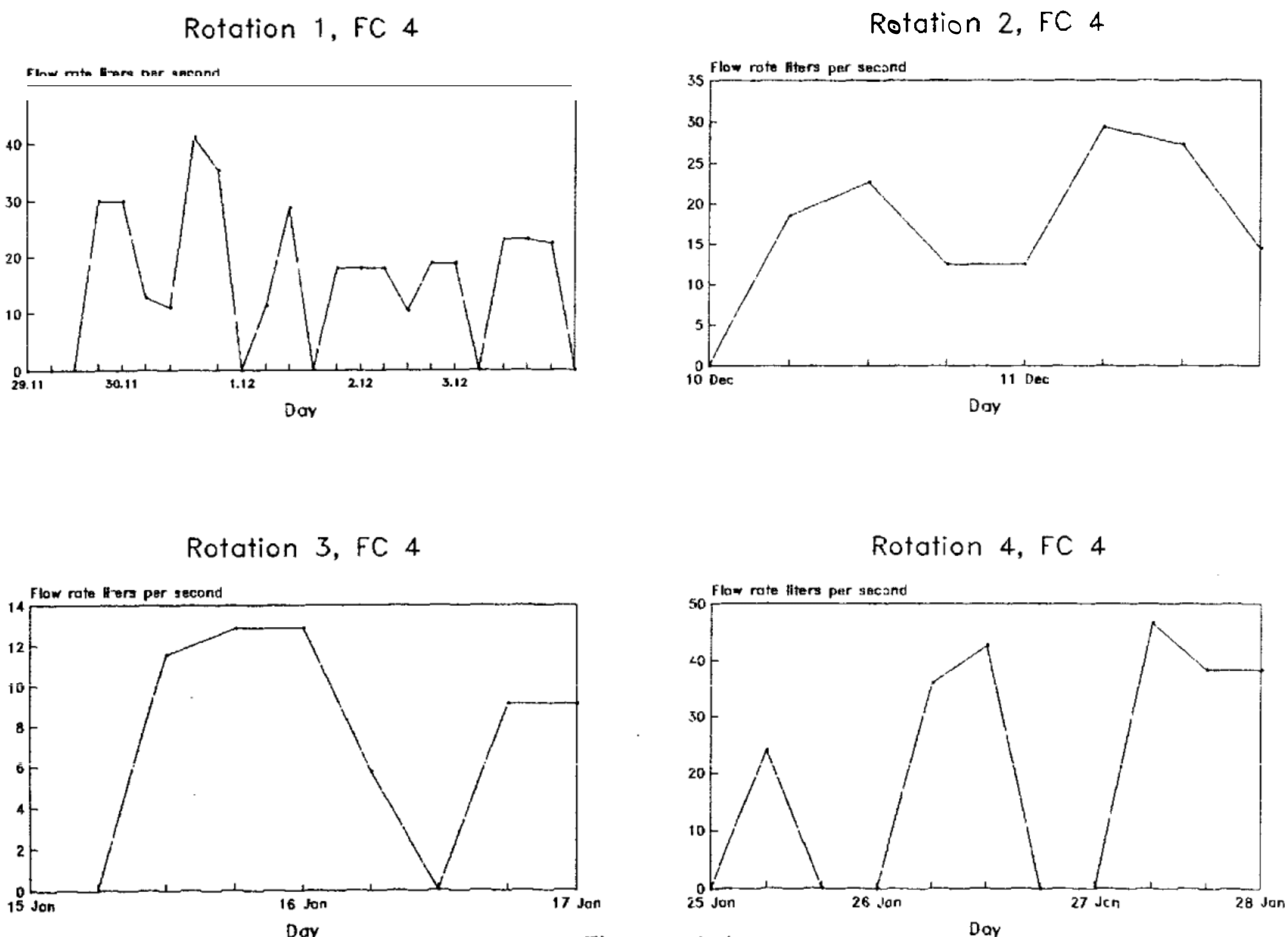

Rotation 1, FC 4
Flow rate liters per second
Day
29.11
30.11
1.12
2.12
3.12
Rotation 2, FC 4
Flow rate liters per second
Day
10 Dec
11 Dec
Rotation 3, FC 4
Flow rate liters per second
Day
15 Jan
16 Jan
17 Jan
Rotation 4, FC 4
Flow rate liters per second
Day
25 Jan
26 Jan
27 Jan
28 Jan

Figure 4.4

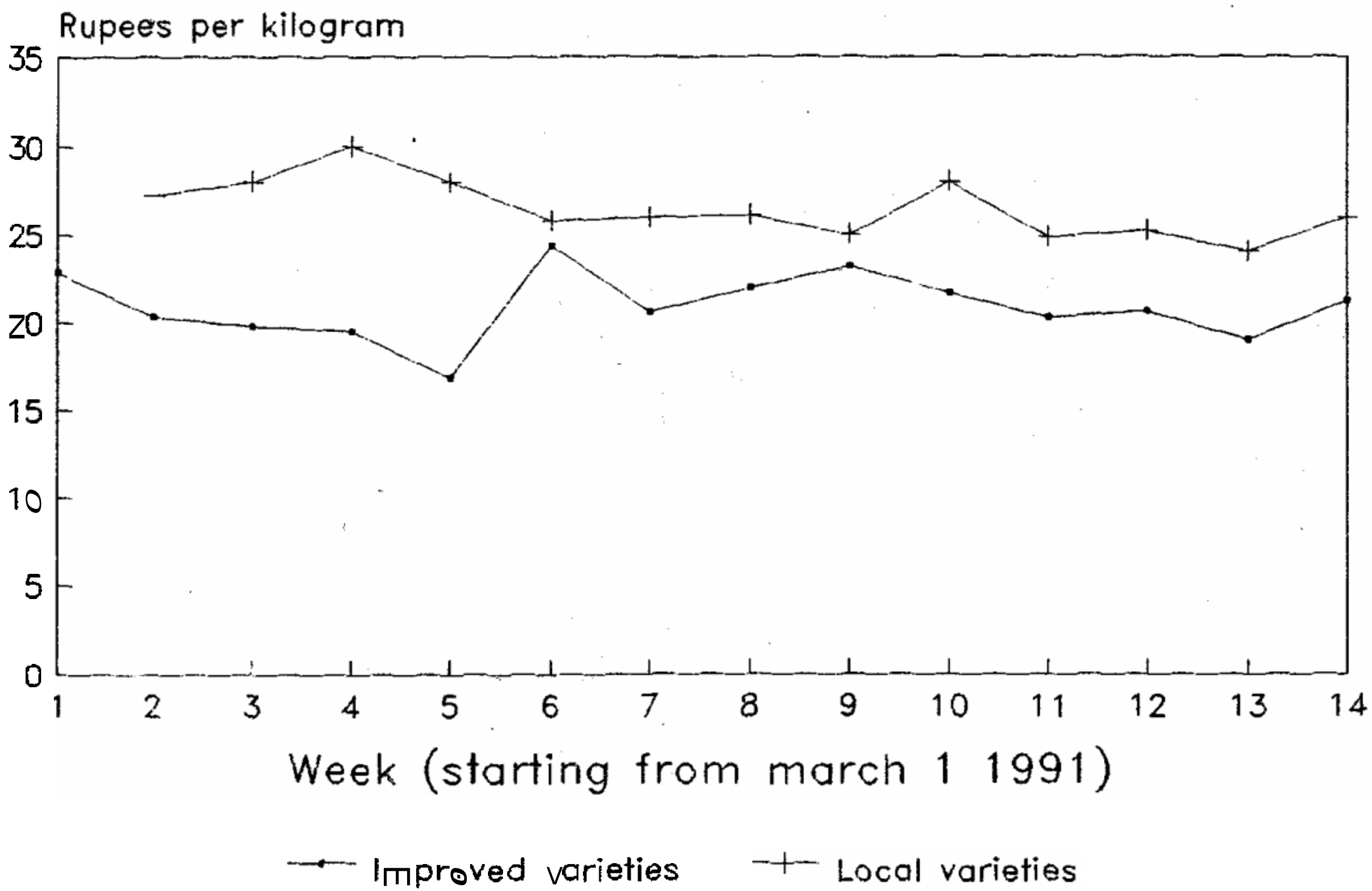


Figure 4.5. Weekly Variation of Chilli Price