A PRELIMINARY ASSESSMENT OF THE PERFORMANCE OF A MAJOR IRRIGATION REHABILITATION PROGRAMME : THE CASE OF TANK IRRIGATION MODERNIZATION PROJECT

RESEARCH STUDY NO. 60

APRIL 1984

AGRARIAN RESEARCH AND TRAINING INSTITUTE,
114, Wijerama Mawatha, Colombo 7.

SRI LANKA

2009/06
2010/04

A PRELIMINARY ASSESSMENT OF THE PERFORMANCE OF A MAJOR IRRIGATION REHABILITATION PROGRAMME: THE CASE OF TANK IRRIGATION MODERNIZATION PROJECT.

W. A. T. ABEYSEKARA.

RESEARCH STUDY NO. 60

APRIL 1984

Agrarian Research and Training Institute
Colombo.
September 1983.

22048

22048

FOREWORD

Irrigation rehabilitation was one of the major public policies adopted to develop domestic agriculture from about 1930s. However, on the belief that once the physical system was put into order the other components will take care of themselves the emphasis was on the re-construction of the physical structures and canals. As the rehabilitated irrigation schemes did not live up to the expectations it was increasingly realised that system efficiency did not entirely depend on engineering aspects alone but also on a variety of other non-engineering aspects such as excessive use of water for weed control, bad levelling of the fields, damage to field channels and structures, non-adherence to irrigation schedules etc. The first systematic attempt to rehabilitate older irrigation schemes taking on farm water management into consideration was the Tank Irrigation Modernization Project which covered five major tanks in the north central dry zone of the country. This was undertaken in 1976 with World Bank assistance.

On the recommendation of the World Bank the then Ministry of Irrigation, Power and Highways commissioned the Agrarian Research and Training Institute to evaluate the impact of the TIMP. In accordance with the Evaluation Plan baseline surveys were carried out in the five schemes and their reports were submitted between 1978-80. The publication of the baseline studies aroused considerable interests within the TIMP, among donor agencies and among local institutions.

According to the Evaluation Plan a post-project evaluation was to be carried out after 4 years of project completion. However, the construction schedule fell behind and it took more time to complete the rehabilitation programme than envisaged. It was also observed that in the schemes that were rehabilitated some of the problems that were to be eliminated were still there even after rehabilitation and institutional devices were introduced for proper water management. A joint UK-WB mission that visited Sri Lanka in 1982 to renew the progress of the TIMP recommended that ARTI be commissioned to carry out further studies to critically compare the actual achievements of the project with appraisal expectations. Accordingly a study was undertaken and this report presents the findings of the study.

The study raises many issues which are of a fundamental nature pertaining to irrigation rehabilitation. The author points out that although it is recognized that a system free from design and construction errors is difficult to achieve it is equally important to recognize that such errors would lead to adverse user-management relationships and a weak user-participation in system management. The author also says that despite the intensions the development strategy adopted shows a significant lack of emphasis on the complementary institutional and organizational support. A detailed investigation is recommended to gain greater insights for finding a more practical approach within a technically feasible frame work. An economic evaluation with a cost-benefit analysis is also suggested once the agricultural benefits expected from the project have been realised at least to some extent.

This study was undertaken by Mr.W.A.T.Abeysekera, Research and Training Officer of this Institute. He was ably guided and advised by his Ph D Committee Chairman, at Cornell University, Prof. Randolph Barker. My thanks are due to them for their valuable contribution. My thanks are also due to the World Bank, the Irrigation Department and the Ministry of Land and Land Development for the confidence placed in the ARTI by commissioning this study making it possible for Mr. Abeysekera to complete his Ph D programme. I hope this study would contribute towards better understanding of the intricate nature of the irrigation system management.

T.B.Subasinghe
DIRECTOR.

ACKNOWLEDGEMENTS

In completing this report, the assistance of many, both within and outside ARTI, were received and all their services are gratefully acknowledged.

I owe a special word of appreciation to Professor Randolph Barker (Department of Agriculture Economics, Cornell University, U.S.A.) for the guidance and advice given throughout the study. Dr. S.B.De Silva (Deputy Director, Planning and Monitoring Division, ARTI) offered valuable assistance in editing the report. Dr. C.Kariyawasam, (Hydrology Consultant to this study) provided the technical information presented in Chapter two on Tank Water Availability. I also wish to thank Mr. T.B.Subasinghe (Director, ARTI) for all encouragement and assistance given in undertaking the study.

My special thanks are also due to Mr. Joe Alwis (Director, Water Resources Division, Ministry of Lands and Land Development) and Mr.U.N.S. Wickramarachchy,(Chief Project Engineer, I.D.,Anuradhapura) and to all members of the field staff in the study area for their most willing cooperation. I wish to thank Mr. P.Tennakoone, (Statistical Assistant) for the assistance provided in gathering and tabulating the study data. The typing was undertaken by Miss Anne Fernando.

As usual, any errors of facts and interpretation remain with the author.

GLOSSARY

Bethma	-	A conventional system of sharing lands in many irrigation systems during the water scarce, yala season. Here, the farmers share smaller extents of irrigable land located closer to the tank.
Chena	-	Slash and burn or shifting agriculture
Cusec	-	A measure of the rate of water flow in the channel, (cubic feet of water/second).
District	-	The principal administrative unit in the country. There are 25 in Sri Lanka.
Kanna meeting	-	Meeting of farmers and officials held before each cultivation season
Maha	-	North-east monsoon season (October-January)
Paddy	-	Unhusked rice
Rotational irrigation	-	Intermittant irrigation
Tank	-	Reservoir for local rainwater storage
Vel Vidane	-	An elected farmer representative
Yala	-	South-west monsoon (March to June)

CONTENTS

LIST OF TABLES

SUMMARY A D POLICY IMPLICAT ONS

1. This summary presents the findings and recommendations of a preliminary study undertaken for evaluating the impact of the tank irrigation modernization project (TIMP) initiated in 1978. The project involves 5 major irrigation schemes in the north central dry zone which were settled in the early fifties, covering about 31,500 acres of irrigable land supporting 10,000 farm households. The project was undertaken at a cost of about 274 million rupees.

2. The study findings are primarily based on observations made during many field visits and extensive interviews with farmers, farmer representatives and officials connected with the project. Farm level data were obtained through small scale sample surveys of farm households in three of the tank areas conducted in May 1983.

3. The Project was to be initiated in 1977 for completion in 1980. Due to many difficulties, construction work began only in 1978. In three of the tanks viz; Mahakandarawa, Mahavilachchiya and Pavatkulum work was completed in 1982 and the work on the remaining two, Padaviya and Vavunikulum, is due to be completed by the end of this year.(1983)

4. The development approach underlying the TIMP consists basically of three components: (1) physical improvements of the irrigation channels, (ii) adoption of strict water management and rotational irrigation practices, (iii) introduction of a package of new agricultural innovations for changing the existing farming system.

5. The physical improvements in the channel system mainly includes: (i) lining of D-channels and field channels to

reduce conveyance losses (ii) standardizing the water distribution network by providing one field channel (of 1 cusec capacity) for each rotation unit of irrigation (with an area of about 30 acres), (iii) increasing the size of the water inlet of the farm to 9 inches-from the previous 3 inches-to accommodate the rotational issue of water distribution and (iv) installation of control and measurement structures at different points in the system for effective monitoring of channel flows and to facilitate strict water rotations among farms.

6. The key components of the package of technical inputs recommended for farmers in the project include: (i) early tillage, under dry soil conditions, (ii) dry sowing of seed paddy for advancing the time of planting, (iii) adoption of short-age paddy varieties and (iv) cultivation of other seasonal crops in paddy fields during yala. The strategy is expected to lead to considerable savings in the tank water, while increasing the land use intensity. The basic concepts underlying this development approach mostly lend themselves to research experiences relating to cropping systems programme of the Department of Agriculture.

7. The study findings suggest that in general, a majority of farmers felt the irrigation network had improved as a result of modernization. However, farmers were also quick to point out considerable problems associated with the construction and designing of the conveyance system as well as in rotational water distribution system. It is recognized that a system free from design and construction errors is difficult to achieve straight away. However, it is also important to note that such problems, depending on their seriousness, would affect user-management relationships resulting in a weak user-participation in system management. Since the project is now

over, the available funds in the current maintenance budget appears inadequate to correct such errors. Hence it is important to provide adequate funds for this purpose. The investigations also revealed that the effective participation of farmers in the design and construction work has been extremely low. This appears to be a missed opportunity in terms of project development.

8. Despite the preparation of extremely detailed schedules for rotational distribution of water for individual allotments, the system appears to be hardly functioning below the field channel. An assumption implicit in the design of the rotational schedules is that farmers would extend their full cooperation to the programme. In contrast, what is seen is that, farmers are not organized and the system frequently leads to confrontations among farmers. Effective operation of the rotation is currently seen in few instances where Vel Vidane is efficient and acceptable to farmers. The Vel Vidane often supervise 50 or more farmers, and this makes it impossible for him to provide the intensive supervision needed. Smaller numbers, perhaps around 10-15 farmers per Vel Vidane seem to be most suitable in this regard. It is clear that without the active involvement of the farmers, farmer representatives as well as the field level officers, implementation of a strict rotation is unlikely to be effective. There seems to be a considerable confusion of the roles of different individuals at the field level with respect to water issues and as a consequence the new system appears to be counter productive at least to some extent. Furthermore, the Vel Vidane system of farmer representation itself needs improvement.

9. In contrast to the system of rotational water issues at the farm level, the capacity of the system to issue water on a

rotational basis at the D-channel and above, appears to offer a better potential for saving water, which is acknowledged even by the farmers. The critical problems of adopting a system of rotation at the farm level arise from the limited capacity of the system management for a strict implementation and supervision of the rotations. The problems seem to be more agravated since farmers too appear to be less convinced and uncertain about the potential benefits of adopting a strict water rotation schedule. The level of sophistication assumed in deriving the rotational schedules does not seem to have given adequate attention to the operational problems in the field.

10. Despite a substantial potential offered for saving tank water by preparing paddy lands prior to rains,this practice has not received favourable farmer response so far. Major problems in this regard are (a) high energy needs for ploughing the soils under dry conditions. (This is particularly important since these soils are rich in clay and heavy), (b) high tractor charges (Rs.500-550 per acre), (c) uncertain nature of rains. Farmer decisions to engage in land preparation under mud conditions appear to be strongly based on a full tank mentality, which guarantees the maha crop.

11. The innovation of dry sowing of seed paddy suggested in the TIMP is again, not established in the project area so far. Its future potential for wide spread adoption in the project area also seems to be rather low. The risks associated with a success of this practice appear to be overwhelming in relation to that of conventional mud sowing. Uncertain and erratic rainfall patterns, heavy weed growth under this system, the non-availability of suitable rice varieties for drysowing, and the absence of suitable pre-emergent weedicides are major inhibitory factors. In areas with a preponderance

of chena cultivation, potential conflict between early paddy cultivation and chena cultivation is also an important problem.

12. Cultivation of short age paddy varieties, (3-3½ months), has a distinct advantage in reducing the irrigation period. This practice is already adopted by most farmers in the project areas, where seed paddy is supplied by the local extension centre. However, in terms of preferences, the study noted a clear, farmer preference towards longer aged varieties due to their higher yield potential.

13. Despite a considerable extension input, the diversification of the cropping system of paddy lands through cultivation of other seasonal crops during <u>yala</u> has received little farmer attention. This practice clearly demands lesser quantities of irrigation water and hence helps to extend the <u>yala</u> acreage. However, the adoption of this innovation is heavily constrained by the strong farmer preference for growing rice in irrigable land. The preference seems to emerge from many factors extending beyond the household consumption requirement of paddy. Lack of assured marketing facilities is perhaps the most binding factor. Others such as water logging problems in the paddy fields, lack of planting material, unfamiliarity with the crops are also important obstacles.

14. Data on costs and returns of paddy indicate a substantial rise in production costs during the past 5-6 years. Crop yields in the project have not shown any consistent change during the period. Net returns to paddy farming in nominal terms, appear to indicate no substantial increments over this period. This could have had negative influences on the farmers' incentive for changing their production techniques.

15. According to preliminary indications, farmers have not adopted the anticipated development strategy and therefore the agricultural benefits expected from the project may not be forthcoming at least according to the original time schedule. Partly for this reason, it was felt premature to undertake a detailed analysis of the project benefits and costs in a preliminary exercise such as this.

16. Furthermore a breakdown of the total project cost does not seem to be available so far. Hence, it is strongly recommended that, detailed project costs should be made available at the earliest possible. It is suggested that the basic cost information can be given in the project completion report (to be prepared shortly) and should contain cost details in respect of each tank, disaggregated to a level which could provide a useful basis for a cost benefit analysis at a later stage.

17. The study also highlights the need for evaluating the performance of different materials used on channel lining in Mahavilachchiya. The initial cost of installation, maintenance requirements and the durability of the different materials, used as lining material seem to vary greatly.

18. Judging from the development trends so far observed it appears that the potential benefits of the TIMP are not likely to be realized unless the strategy of water management and agriculture improvement planned in the project is not revised. The development strategy adopted also appears to show a significant lack of emphasis on the complementary institutional and organizational support.

19. Despite shortcomings in the development strategy, the project offers considerable scope for improvement. Given the large

amount of resources already committed to the project area, - particularly for developing the irrigation infrastructure - more appropriate development alternatives must be urgently explored. A more adaptive, and feasible improvement strategy requires a deeper understanding of the physical environment, farmers' perceptions and objectives, and their decision making behaviour. Hence an indepth study is proposed which is designed to provide greater insights in to a more practical development approach,within a technically feasible frame work. The outline of this indepth study is given in Annex 2.

I. INTRODUCTION

1.1 Study Background

This report presents the preliminary findings of a larger research study designed to evaluate the socio-economic consequences of a major government investment in irrigation rehabilitation in Sri Lanka. Essentially it serves as an inception report aimed at identifying the more important consequences of the implications of the Tank Irrigation Modernization Programme(TIMP). The presentation focusses attention on the current operational status of the modernized irrigation net work in the five tank area and its implications for agriculture and irrigation water management. A central concern will be placed for studying the agriculture and economic trends underlying the project development and to highlight the key problems hampering the project success. The report, at its conclusion formulates a research strategy to deal with the problems in detail with a view to offer possible alternative solutions.

The investment programme, referred to as the Tank Irrigation Modernization Programme (TIMP), began in 1978, covers five major irrigation settlement schemes in the north central dry zone. The tanks included in the programme are: Mahavilachchiya, Mahakandarawa and Padaviya (in Anuradhapura district), Pavatkulam (in the Vavuniya district), and Vavunikulum (in the Jaffna district). All five tanks were a part of the ancient irrigation network, and were reconstructed in the early fifties after a few centuries of disuse. The project covers about 31,500 acres of irrigable land and about 18,000 acres of unirrigable highland. Around 10,000 farm families are expected to benefit by the project, all of whom were settled in early fifties. Apart from these regular settlers, it is estimated that the project supports another 1,500 inhabitant families living in the area, some of whom are landless. The modernization programme was undertaken at a total cost of Rs.274

පුස්තකාලය
LIBRARY

million. Though the project was originally envisaged to commence in 1976 and continue for five years, there had been considerable delays in its implementation.

The modernization programme aimed primarily to increase the cropping intensity of the irrigable area under the tanks during the yala season, by making better use of rainfall as well as tank water storage. It was also intended to ensure an equitable distribution of irrigation water among farmers through strictly enforced rotational delivery schedules. The functioning of the irrigation system was to be improved in several respects; rehabilitation and modification of the existing conveyance system; measurement and control of water flow at several points along the channels, and reduction of delivery losses by lining the channel surface. Other innovations that were contemplated in the modernization programme are, diversifying the rice monocropping pattern by cultivating other seasonal crops in paddy fields in yala season, early land preparation prior to maha rains, and dry sowing of seed paddy with short-aged varieties. The project was being viewed as a pilot effort in rehabilitating older irrigation schemes in Sri Lanka.

The present study on the economic consequence of the TIMP is undertaken by the Agrarian Research and Training Institute (ARTI) in response to a request made jointly by the World Bank and the Ministry of Lands and Land Development. The ARTI has already undertaken detailed bench mark studies on each of the five tanks, during the period 1978-1980.

1.2 Study Objectives

The specific objectives of this study are;

(i) To ascertain the evolution of agricultural and water management practices in the project area, with respect to

Project expectations and to evaluate how these practices have been modified by the findings of the earlier bench mark studies;

(ii) To examine the data on agricultural production, farm costs and returns so as to make a preliminary assessment of the project's likely economic impact and,

(iii) To identify the key constraints on the achievement of the project goals, with a view to investigate them in detail in a subsequent study.

1.3 Data Sources

Farm level information presented in this study is based on the systematic farm household surveys that were carried out by means of a structured questionnaire. The pre-modernization conditions were assessed from bench mark surveys conducted for each tank area during the period 1978-1980. Specific data on the current farm situation, was gathered by conducting farm surveys involving 50 farmers in each tank area. These surveys were conducted in May and June 1983, and covered three of the five schemes; Mahavilachchiya, Mahakanadarawa and Padaviya schemes. The survey data were mostly used to complement the information gathered through the extensive interviews conducted with the officials and farmers in all five tank areas.

1.4 Organization

The main body of this report begins with chapter two, which highlights the rainfall and other key environmental features determining the tank water availability and farming activities in the project area. The description is expected to assist in identifying the tank areas in terms of their hydrological potential for practicing irrigated agriculture. In the third chapter, attention is then drawn on the physical and functional aspects of the modernized irrigation network. A detailed treatment of the project consequences on crop yields and agricultural practices in the area is undertaken in the fourth chapter.

In the fifth chapter, economic consequences of the TIMP, at the farm level, is presented with a hope to provide insights in to the directions of change in farm costs, returns and producer incentives subsequent to system modernization. The report concludes with a research proposal designed to analyse the key problems affecting the project progress and to provide possible alternative solutions to these problems in the future.

II WATER AVAILABILITY & AREA IRRIGATED

Provision of irrigation water, to supplement the rainfall, forms one of the basic development strategies underlying the TIMP. Hence, the natural factors determining the irrigation water availability in the project area are examined in this Chapter. The discussion highlights that (a) the soil moisture stress is a major hindrance to attempts in intensifying the land use in the area, and (b) the uncertainity of rainfall (and hence, the tank water storage) is substantially large, implying a greater degree of production risks to farming in the project area.

2.1 Environmental constraints

The soils in the project area for the most part, are relatively shallow and overlain with an impervious bed rock. They are high in clay but low in organic matter, resulting in a heavy texture and a low moisture retention capacity. The available soil moisture content between the saturation and wilting points is characteristically narrow, implying that shallow rooted seasonal crops can only be grown only with frequent replenishments of soil water, either by rain or by irrigation. In years of low rainfall, even the cultivated perennial crops with deeper root systems such as coconut, jak, and citrus perish or perform poorly, due to soil moisture stress.

During the rainy season the ground water level rises temporarily but falls during the dry periods, and often disappears altogether during drought except in areas close to water sources. Hence, seasonal cropping in the five tank areas even during maha, often requires supplementary irrigation at the tail end of the season. Yala cultivation, if undertaken, is almost totally dependent on a supply of tank water.

The basic characteristics associated with the hydrology of these tanks are given in Table 2.1 Their catchment areas vary widely and likewise the ratios of catchment area to irrigated area. The most favourable ratio is in Vavunikulum and the least favourable is in Mahavilachchiya with 68 and 18 acres of irrigated area per square mile of tank catchment respectively. A large number of tanks that are functioning are found in the catchments of Mahavilachchiya, Mahakanadarawa, Pavatkulum and Vavunikulum tanks (Table 2.1) For example, the catchmen area of Mahakanadarawa tank currently has about 187 smaller tanks supplying irrigation water to about 8000 acres of cultivated land within the catchment. Such developments in the catchment areas could adversely affect the hydrology of the main tanks.

Table 2.1 Physical characteristics of the five tanks

Tank	Area irrigated (acres)	Tank storage capacity (Ac. ft)	Catchment area (sq. miles)	Ratio of catchment area to irrigated area (ac./ sq. mile)	No. of tanks in the catchment area
Mahavilachchiya	2,600	32,500	141	18	91
Mahakanadarawa	6,000	34,000	126	47	187
Padaviya	12,500	85,000	206	60	n.a.
Pavatkulum	4,400	27,000	115	38	122
Vavunikulum	6,000	35,000	88	68	70

Source: Irrigation Department Records.
n.a. Not available

2.2 Rainfall

In the Dry Zone where all five tanks are located, the average annual rainfall is less than 1900 mm. and the rain exhibits a distinct bimodal pattern. Typically, the major rains are during October to December (maha season) with minor rains during the months of April and May (yala season). In general, there is a pronounced drought from May to August, when the temperature and the wind velocities reach a peak, considerably increasing water losses from the soil as well as from the tank.

Rainfall is the most crucial factor determining the agricultural rhythem in all five tank areas. The most relevant rainfall factors are: Quantity of rainfall during the season, distributional pattern over the season, and the timing of the monsoon. As seen from Table 2.2 among the five tanks, Padaviya has the highest annual average rainfall (1790 mm.). Mahakanadarawa and Pavatkulum fall into the medium rainfall area, with about 1300 mm. per year. Mahavilachchiya and Vavunikulum receive the lowest annual rainfall, about 1165 and 1125 mm. per year respectively.

Table 2.2 Average annual rainfall in the five tank areas.[1]

Tank	Yala season (Feb. - July) mm.	%	Maha season (Aug. - Jan) mm.	%	Annual mm	%
Padaviya	530	30	1260	70	1790	100
Mahakanadarawa	390	30	915	70	1350	100
Pavatkulum	380	29	915	71	1295	100
Mahavilachchiya	390	33	775	67	1165	100
Vavunikulum	265	24	860	76	1125	100

Source: Meteorological Department

Rainfall in the project area is extremely seasonal. Around three quarters of the annual precipitation is experienced in maha season where the rains reach a peak in October, November and December. Rains during this period are relatively reliable and effective and are mainly in the form of many heavy storms of short durations. In contrast, Yala rains which reach a peak in April and May are generally unreliable, highly variable in intensity and duration, and are therefore relatively ineffective. The commencement of the rains is hard to predict and consequently there is a considerable uncertainty with regard to the time of initiation of farming activities in the season. It is often mentioned by farmers that the rainfall pattern has shown profound changes over the last decade or so.

[1]The basic rainfall data for Table 2.2 and 2.3 are based on 18 years of data in Mahavilachchiya (1953-1964 and 1977-1982), 24 years in Mahakanadarawa (1957-1980), 26 years in Padaviya (1957-1982) 20 years in Vavunikulum (1963-1982) and 28 years in Pavatkulum 1955-1982.

Historical data on rainfall show the extreme variability of seasonal rain even within a tank area (Table 2.3)

Table 2.3 Rainfall pattern in the Five Tank Area, by season

Tank	No. of years of observa - tions	Frequency of rainfall (Percentage)					
		Below 600 mm.	600-800 mm.	800-1000 mm.	1000-1200 mm.	More than 1200 mm.	Total
Maha season							
Mahavilachchiya	15	27	13	33	20	7	100
Mahakanadarawa	24	13	12	46	8	21	100
Padaviya	26	7	4	15	31	50	100
Pavatkulum	26	4	38	31	15	12	100
Vavunikulum	18	11	50	5	22	11	100
Yala season							
Mahavilachchiya	15	87	13	0	0	0	100
Mahakanadarawa	24	96	4	0	0	0	100
Padaviya	25	92	4	4	0	0	100
Pavatkulum	25	100	0	0	0	0	100
Vavunikulum	19	100	0	0	0	0	100

Source: Meteorological Department

The above data clearly show that even in maha there is a considerable rainfall variation within as well as between tanks, ranging from less than 600 mm. to more than 1200 mm. per season. The likelihood of a rainfall less than 600 mm. during maha is relatively greater in Mahavilachchiya. On the other hand, a rainfall higher than 1200 mm. in maha occurs mostly in Padaviya.

If the cut-off point of 600 mm. of seasonal rainfall is taken as the minimum determining requirement for a success of a rainfed rice crop, the data confirm the necessity for supplementary irrigation water from the tank for raising a paddy crop even in maha.

2.4 Probability of Cultivation

With a view to ascertain the probability of cultivating the irrigable area under each tank with paddy, using the available tank water as well as rainfall, a simulation study was undertaken. The basic data required for the analysis were obtained from the Irrigation Department. Rainfall data needed for the analysis were generated for a 50 year period using the Thomas Fiering Serial correlation model. The results of this study are given in Table 2.4.

Table 2.4 Probability of cultivating a paddy crop in the tank areas using supplementary water from the tank

Tank	Probability of cultivating a paddy crop (percentage)			
	Less than 25% of the area	25-50% of the area	50-75% of the area	Greater than 75% of the area
Maha season				
Mahavilachchiya	12	5	14	69
Mahakanadarawa	0	6	15	79
Padaviya	3	5	10	82
Pavatkulum	0	2	20	78
Vavunikulum	8	3	30	59
Yala season				
Mahavilachchiya	17	70	11	2
Mahakanadarawa	12	18	65	5
Padaviya	17	40	35	8
Pavatkulum	13	45	32	10
Vavunikulum	19	43	36	2

The analysis indicates a relatively high probability of undertaking a full paddy crop under all 5 tanks in maha, except perhaps in Vanunikulum where the probability is only 59 percent.

Despite the high probabilities of a successful cultivation of a *maha* paddy crop shown by Mahakanadarawa (79%) and Pavatkulum (78%), there was no *maha* cultivation in both these tanks during the last two years. This suggests that apart from rainfall, water availability and the recharge of these tanks are also determined by other criteria such as catchment characteristics, number of tanks in the catchment area etc.

2.5 Tank water storage and the area cultivated

The role of tank water availability at the beginning of the season as a determinant of the area to be cultivated was then studied through a correlation analysis of the two variables. Here, it was hypothesized that the area cultivated would be largely correlated with the tank water availability at the time of commencement of cultivation. However, the results shown in Table 2.5 indicate that with the exception of Mahakanadarawa, the correlation between the cultivated area and tank water levels in *maha* season is low, (in one case it is negative). In *yala*, however, the correlation is relatively high indicating that the cultivated area is mostly determined by tank water storage at the beginning of the season.

Table 2.5 Correlation between the area cultivated and tank water storage at the beginning of the season

Tank	Correlation Coefficient	
	Yala season	Maha season
Mahavilachchiya	0.71	0.32
Mahakanadarawa	0.81	0.63
Padaviya	0.63	0.25
Pavatkulum	0.48	0.39
Vavunikulum	0.56	- 0.87

This preliminary analysis shows that in the five tanks concerned the tank hydrology is clearly far more complex than what appears and hence any studies on their actual irrigation potential, require more detailed investigations. For example, in both Mahakanadarawa and Pavatkulum tank areas, there had been no cultivation at all during the last two years due mainly to poor tank recharge. The rainfall patterns within the last two years for these areas appear to be within the 'normal' variation and it is suspected that the poor tank recharge is due partly to construction of many new village tanks in the catchment areas. To investigate these aspects an indepth investigation on Mahakanadarawa would be undertaken during the maha season 83/84 as a separate study[1]. This is expected to provide deeper insights into the water supply related factors influencing the tank water storage.

1 This study would be undertaken by the hydrology Consultant.

III. IRRIGATION STRUCTURES AND WATER MANAGEMENT

Functional aspects of the modernized conveyance system of the five tanks, with particular reference to their management implications and the degree to which farmers participate in managing the available water resources are discussed in this chapter. The improvement of control capability of the irrigation network is one of the key goals of the modernization project, and hence this aspect will be given more emphasis in the discussions to follow.

3.1. Irrigation Improvement Programme: The Time Schedule

Originally, the modernization programme was to be initiated in early 1976, and completed at the end of 1980. Under these plans the channel construction work in Mahakanadarawa and Mahavilachchiya tanks were to be initiated in 1977 followed by Vavunikulum (1978), Padaviya (1979), and Pavatkulum (1979). In each tank, the channel improvements were planned for seven months of the year (from April to October) with a view to minimise interference with cultivation and to avail of rainfree weather. During this period it was expected that no water would flow through the channels and that farmers could be employed in the project works.

However, the actual implementation of the work schedule deviated heavily from what was planned. In all tanks except Padaviya, initiation of channel construction work has been delayed by about a year (Table 3.1). The actual construction in all tanks has taken longer time than scheduled. For instance, in Mahavilachchiya and Vavunilulum, where the civil works were to be completed in one year, actual work lasted for almost five years. Similarly, in Mahakanadarawa, double the planned construction period of two years, was taken. Consequently, the final project completion date has been considerably delayed; 5 years in Mahavilachchiya and Vavunikulum, 4 years in Mahakanadarawa, 3 and 2 years in Padaviya and Pavatkulum respectively.

Table 3.1. Timing of civil works in TIMP

Tank area	Irrigated area (Ac.)	Plan period	Actual period
Mahavilachchiya	2600	Mar.77-Sep.77	Jan. 78-Dec.82
Mahakanadarawa	6000	Mar.77-Sep.78	June 78-Dec.82
Padaviya	12500	Mar.79-Sep.80	June 79-Dec.82
Pavatkulum	6000	Mar.79-Sep.79	June 80-Dec.82
Vavunikulum	4400	Mar.78-Sep.78	June 79-Dec.83

The delays in completing the construction work appear to have been partly due to: (a) organizational problems affecting the overall coordination of the project implementation, (b) shortage of rupee funds, (c) shortage of skilled man-power for handling the civil works and, (d) procurement difficulties. Some of these shortcomings were recognised in the later stages of project development, and remedial actions have been taken.

3.2 Improvements undertaken in the Conveyance Systems

The prevailing water distribution network and control facilities in general show a substantial improvement of the physical irrigation facilities in all five tank areas. Prior to modernization irrigation distribution network in all tanks reflected a markedly deteriorated water conveyance system. There were damaged channel bunds with a little or no measurement and control structures.

The major improvements involved in "modernizing" the conveyance system in the tank irrigation schemes are:

(a) Introduction of a rotational area concept under which each field channel is designed to carry a maximum of one cusec of irrigation water to an area of approximately 30 acres. Earlier, the extent of land irrigated by a field channel was extremely variable, ranging from about 12 to 50 acres;

22048
පුස්තකාලය

and some of the paddy lots were even irrigated directly by the distribution channel or even from the main channel itself. The improvements appear to have provided an important uniformity in the available physical distribution facilities.

(b) Construction of control and measurement structures along the main channel and D-channels up to the field channel. Unlike in the past, almost all these channels are now provided with lockable, cast-iron gates which are operated by the field level workers in the Irrigation Department. The farm turn-outs, however, are lacking in control devices and are operated by farmers themselves by placing earth taken out from the channel bund itself.

(c) Lining the field and distributary channels with materials such as cement/bricks or concrete. The lining reduces seepage and other ground losses of water and also achieves a quicker flow in the channel. The heavy emphasis placed on lining the secondary and tertiary branches of the channel system in the project appears to be rather a unique concept not widely followed in irrigation systems in Asia. In Mahavilachchiya the entire canal system, except for the two main channels, are lined with different types of lining material on an experimental basis to determine their relative efficiency.

(d) The installation of larger (nine inch) farm turn-outs in place of the existing three inch pipes. This change facilitates the adoption of strict rotational water issues at the farm level by allowing a larger flow of water over a shorter irrigation period.

3.3. Farmer responses to system improvement

Discussions with farmers and farmer representatives in the project area regarding the post modernization performance of the irrigation system appeared to yield a mix of reactions. A survey of farmer responses on two specific aspects of the modernised water distribution system indicated the following (Table 3.2).

Table 3.2 Farmer attitudes on the irrigation system modernization

Opinion	Tank area	% of farmer reporting as				
		Strongly agree	Agree	Disagree	Strongly Disagree	Total
1. Conveyance system now is better equipped to deliver and distribute water than before	1. Mahavilachchiya	48	29	8	15	100
	2. Padaviya[1]	27	27	23	23	100
2. Loss of irrigation water now is less than before	1. Mahavilachchiya	67	27	2	4	100
	2. Padaviya[1]	42	42	10	6	100

[1]In the case of Padaviya, only those farmers in the area where construction is complete was interviewed.

About three quarters of the farmers interviewed in Mahavilachchiya and one half of those in Padaviya felt that channel improvement work has resulted in better distribution and delivery of water. As regards the reduction of conveyance losses, almost all farmers in Mahavilachchiya agreed that the loss of water is smaller than before, which is perhaps expected, since all channels in this case are completely lined. However, in Padaviya only about 84% of the farmers interviewed thought that the anticipated reduction of water wastage from the conveyance system has materialized so far.

In Mahavilachchiya, a majority farmers, who do not agree that the present system is better equipped for water delivery and distribution, belong to the top end of the system. In contrast, all farmers in the tail end have expressed the opinion that the present system is better than before (Table 3.3). This therefore suggests that the system improvement has reduced some excess water availability to the farmers at the top end of the scheme and increased the water supply to farmers at the bottom end. System improvements in this case hence appear to have resulted in a greater equity of water distribution between top-end farmers and bottom-end farmers.

Table 3.3. Farmer opinion on water delivery and distribution classified according to degree of water availability: Mahavilachchiya

Farm Location	Percentage of farmers reporting that the present system is better equipped for delivery and distribution of water than before.				
	Strongly Agree	Agree	Disagree	Strongly Disagree	Total[1]
Head-end	50	20	15	15	100(20)
Middle	30	40	25	5	100(20)
Tail-end	75	25	0	0	100(20)

[1] Parentheses indicates the number of farmers reporting.

3.4. Current problems of the irrigation system

Despite considerable physical improvements made in the conveyance systems in the project area, the opinions of farmers, farmer representatives and some field officials on the operational consequences of the project again reflected a mixed reaction. A considerable fraction of the farmers were critical about a range of problems of the conveyance system particularly on those relating to the construction. It appears most important to identify and to rectify such problems without delay. Insufficiency of funds in the maintenance budget is a major constraint in rectifying the problems.

Adverse farmer criticisms on the modernized irrigation system appears to emanate basically from a variety of problems. They can be categorized under:

(i) Physical problems in the channel network; (ii) inefficient implementation of rotational irrigation system and, (iii) lack of farmer cooperation in water management activities, (iv) limitations of lined channels , (v) on-farm water distribution problems and, (vi) unavailability of data on actual area irrigated.

(i) Physical problems in the channel network

Field observations indicate that design and construction problems in the channel network in all five tanks are not uncommon. Their consequences are most evident only at the tail end of the cultivation season when irrigation becomes most crucial. Some of these problems are; insufficient flow of irrigation water in some of the secondary and tertiary channels during the period of water issue, inadequate gradient and even negative slopes in a few lined channels[1], incorrect positioning of irrigation turnouts, insufficient freeboard in some of the lined channels; submerged measurement structures that make it impossible to measure the water flows; uncovered hume pipes laid across farm roads, and leaky turnout gates.

In all five tank areas a substantial degree of deliberate destruction of the newly constructed control structures at the secondary and tertiary levels were also noted. Farm turn-outs and the cement control structures were tampered with and damaged. The rate of breakage should be a cause for serious concern to the project management, considering the fact that the system has been in operation only for few seasons. In general, the breakages are associated with an obstruction of water flow in the channels.

Damage done by farmers to the channel bunds, measurement and control devices by indirect means such as by removing soil from the channel banks to direct water flows was also significant. Such processes, if not checked, will soon a lead to the collapse of the channel lining and other water control structures. Damage to lined channels and channel bunds by buffalo-crossing and wallowing does not appear to be common so far, but could greatly damage the lined conveyance system.

1 e.g. Mahakanadarawa, L.B. Tract 2, D-2 Channel.

Many farmers felt that some channel lining material used are not not durable enough. These problems appear to be relatively more acute in Mahavilachchiya, whereas a variety of materials have been used to test their relative efficiencies as lining material. A systematic evaluation, of the efficiency of the different lining materials in terms of their utility, durability and costs appear important.

(ii) Rotational issues and related problems

The attempt to enforce strict rotational issues of water at the farm level in the tank irrigation modernization project is a major departure from the traditional system of providing irrigation to paddy farms on a continuous basis. It is to be noted that the use of irrigation water on a rotational basis is not a concept entirely new to the project area. For instance, Padaviya, even prior to modernization had practised some rotational water issues, at the distributory channel level. The bench mark survey of this area undertaken previously has shown that farmers in general favour this method of water distribution as a means of saving tank water, provided that it is properly implemented.

Rotational issues of water under the modernization programme was first practised in Mahakanadarawa in maha 80/81, where it was reported that nearly 70 percent of the total acreage was under this system. It is reported that the system was later extended to other four tanks, and in maha 81/82, covering about 26 percent of the total acreage in the project. In maha 82/83, nearly 45 percent of the total paddy acreage in the project is reported to be under rotational issues. Under the current practice of rotational issues of water, very precise water delivery schedules are developed for each farmer, based on a number of important assumptions relating to channel water flow and crop requirements. In Mahakanadarawa and Mahavilachchiya schemes the rotation schedules for each rotational unit are prominently displayed in the field. This rotation schedule often involves night time irrigation as well.

However, observations in the field on the actual operation of the rotational water issue at the farm level indicated major problems. The system currently works satisfactorily only up to the field channel. Beyond this, effectiveness of the rotations in terms of distributional equity among farmers is extremely low and questionable. Apparently, one of the key assumptions underlying the computations and planning of the rotation schedules has been that the farmers would follow the system to the letter, sharing water to the maximum possible extent. However, this particular assumption has little relevance to the prevailing practices and hence the system involves major water distribution problems at the farm level. There is a considerable degree of confusion and an apparent lack of understanding among farmers, farmer leaders and field level officials on the operation of this system. A flexible rotational schedule with a greater degree of farmer and official participation seems to be more useful and appropriate.

The efficiency of the current rotational system of water distribution is largely dependent on a high level of cooperation among the 10-15 farmers served by the field channel. The present system works well only in a few instances where the farmer representative (Vel Vidane) is active, efficient and acceptable to all farmers.

In many instances where the Vel Vidane is ineffective, rotational distribution of water leads to major conflicts among head-enders and tail-enders of the field channel. The former keep their turn-outs open continuously, not allowing water to pass to others lower down. The problem is more acute under the present channel system in which all farmers are provided with nine inch outlets - in contrast to three inch pipes they had prior to modernization. Infact, some of these farmers complained that the channel improvements were designed to create discord among the farmers. Hence, it appears that unless a suitable organizational device for eliciting farmer cooperation is implemented the mere physical improvements in the channels alone would not generate the expected results. In some instances it may even be counter-productive.

(iii) Low levels of farmer cooperation

Discussions held with farmers indicated their limited involvement in planning, designing and in implementating the channel improvements. Only in a few instances farmers have been consulted, on matters relating to construction of field channels, distributory channels, and installation of farm turnouts and anicuts (Table 3.4). Rarely if at all, Vel Vidanes (farmer representatives) have been appointed to supervise the work carried out by the labour gangs. Some Vel Vidanes have been employed as construction labourers.

Table 3.4 Type of activities for which farmers were consulted in system rehabilitation

Activity	% of farmers reporting in		
	Mahavilachchiya	Mahakanadarawa	Padaviya
Construction of channels and channel bunds	17	25	10
Installation of farm turnouts and anicuts	2	6	7
No consultations at all	81	69	83
All	100	100	100

The absence of an effective institutional mechanism to express farmers' needs in regard to designing and implementing the channel improvements has been a major deficiency. Since, irrigation improvements are undertaken in the farmers' interests, their views on the types and the means of improvements they need would have been more conducive to the technical and organizational success of the project.

The modernization programme was also expected to provide some income earning opportunities for the farm households by employing them in the construction activities. The survey indicated that a substantial proportion of the farmers interviewed have infact received some temporary employment benefits from the project works. (Table 3.5).

Table 3.5 Farmer involvement in construction work

Activity	% of farmers reporting Mahavilachchiya	Mahakanadarawa	Padaviya
Channel digging and bund improvement	36	31	13
Earth work in road construction	10	16	22
Helping masons	31	23	10
Masonary work	0	4	10
Other work	0	6	0
Not involved at all	23	20	45
All	100	100	100

Farmer engagement in routine matters relating to water management also indicates a low level of participation. This is clearly seen with respect to their attendance at cultivation (kanna) meetings which are a forum for discussion among the farmers in regard to tank water use. The meeting is held prior to each cultivation season. However, farmer attendance in these meetings is extremely poor and the decisions made are generally not adhered to by the farmers. This solution frequently leads to major water related problems such as the extension of tank water releases beyond the season or the irrigation of scattered plots in the project, at different times.

Perhaps the following situation in Mahavilachchiya is fairly typical of the experiences of kanna meetings in all tank areas. At the first kanna meeting of the 1982/83 Maha, held on the 27th of September 1982, farmers agreed to commence planting by the first of November, but preferred to plant 4-month rather than 3-month varieties. On the first of November there was only 2 feet of water in the tank and consequently farmers insisted on delayed planting until the tank level reached 8 feet. At a subsequent meeting in early December, farmers agreed to plant 3 month varieties and to complete the planting by January first. But at the onset of the first rains in late December, most farmers were busy preparing their chena lands and finally planting was mostly done in January. Despite such a long delay in planting several farmers still continued to plant 4 month varieties and planting was not completed until mid January. As a consequence, irrigation period was extended considerably and harvesting was done in Mid-April. As a result of these delays, sufficient water was not available in the tank for a yala crop.

(iv) Limitations of lined channels

As already mentioned, lining of the secondary and teritiary channel is a unique feature of the modernization project, and undoubtedly this is technically more sound than the earth channels which existed prior to modernization. Despite its technical superiority, the lined channel system (apart from its costly nature), is likely to pose some difficulties.

The lined channel system installed with a maximum capacity of one cusec, with 9 inch farm turnouts are specifically designed for a strict rotational water distribution at the farm level. The modernized system hence does not provide any room for continuous irrigation practiced earlier. The design also does not allow rotational issue of irrigation water at a higher level than at the farm level.

The current system design hence does not allow the project management many options in operating and distribution. Infact there are no options at all in the present system except to follow farm level rotations. The modernization programme therefore in a sense has imposed a major constraint on the system management.

Another potential problem concerning the size limitation of the channel in the modernized system and can be explained as follows[1].

[1] This aspect is more fully discussed in a paper, "one cusec channels: Implication for water management for irrigation schemes in Sri Lanka," presented by Gilbert Levine, water management consultant to the World Bank mission, at the Agrarian Research & Training Institute, April 1983.

Assuming that one channel serves an area of 40 acres, the maximum flow in the channel is about 15 mm/day. If the evapo-transpiration at the peak drought period in the area is taken as 6 mm/day and the percolation rate is taken as varying from 3 to 12 mm/day, the total irrigation water demand at the peak would range from 9-18 mm/day. This shows that the one cusec channel presently installed in the project area may impose some restrictions on the water delivery to the rotational area. This is particularly so if the rotational unit is located in the reddish brown earths which have larger soil permeabilities. Furthermore, the lined channels usually do not have too larger freeboards - unlike the conventional earth channels, and this/ could impose much restrictions in instances where it is necessary to increase the normal flow rate for shorter periods whenever necessary.

Perhaps another major problem that might later become serious is the increased maintenance expenditure which the lined system would make necessary.

(v) On-farm water distribution problems

The current system of water application within a farm involves the movement of irrigation water from liyadda (a single plot of paddy) to liyadda. An essential requirement under a rotational regime of water distribution is a quick delivery of water within the farm, and for this an efficient distribution network even within the farm is desirable. In many paddy farms, the unsatisfactory levelling often found in many paddy fields is a hindrance to efficient water management, within the farm.

(vi) Unavailability of data on actual area cultivated

The actual area irrigated within each of the tank areas at present is substantially larger than that officially stated by the Irrigation Department. The official figure relates to a acreage in the original plan of the scheme, which has become a gross underestimate of the actual area currently irrigated, due to subsequent encroacnments and cultivations of reservations. The underestimation of the area appears to be about 10-15 percent and such under estimates are likely to cause major problems in designing water delivery schedules. So far, no attempts have been made to identify the actual area irrigated and this appears to be a vital task requiring early attention.

IV. CROPPING PATTERNS & CROP PRODUCTIVITY

The influence of the Tank Irrigation Modernization on farming activities in the project area would be presented in this Chapter. The modernization programme seeks major transformations in the conventional agricultural practices followed in the area. Hence, in this chapter an attempt will be made to examine to what extent such a transformation has taken place already. The project has been in operation only for few seasons and hence, the following discussion aims to identify the directions of any future changes in agriculture in the projects area.

4.1 Anticipated transformations in agriculture

The benefits from the modernization programme are based on the adoption of a package of new agricultural practices by the project farmers. There are four main components in this technical package recommended to the farmers by the extension personnel. They are;

(a) In the yala season;
Cultivation of seasonal crops (other than paddy) in the irrigable lowlands,

(b) In the maha season;
- (i) Land preparation prior to the maha rains (under dry conditions) using tractors,
- (ii) Dry sowing of paddy, before the onset of the maha rains instead of the present methdd of sowing under mud conditions;
- (iii) Adoption of short age varieties of paddy (3-3½ months)

The improved measures adopted in this Project appear to be based mostly on research conducted at the Agricultural Research Station at Mahailluppallama. It closely resembles the strategy underlying the "Walagambahuwa Concept" of developing the minor irrigation tanks in the dry zone. This strategy was initiated under the cropping systems research programme in 1975[1]. This concept aims at maximising the use

---

[1] See, Nimal F.C.Ranaweera, "Cropping Systems Pilot Production Programmes in Sri Lanka. A Case Study", Division of Agricultural Economics and Projects, Department of Agriculture, Peradeniya, 1982.

of <u>maha</u> rain fall for an obtaining a <u>yala</u> crop under village tanks in the dry zone.

4.2 Crop Yields

Crop yields are an important indicator of change in agriculture. Paddy yield data in the <u>maha</u> seasons which were examined in this regard during the past six years show hardly a consistent pattern of variation both across the tanks, as well as within a tank (Table 4.1). The variations of per acre yields appears to be mostly reflective of the water availability and rainfall.

Table 4.1 Average paddy yields in the project area: (<u>Maha</u> seasons, in bushels/acre)

Tank area	76/77	77/78	78/79	79/80	80/81	81/82	82/83
Mahavilachch[illegible]ya	36[a]	*	35	77	46	54	49[b]
Manakanadarawa	38[a]	*	55	69	*	30	-
Padaviya	*	*	52[a]	81	50	56	53[b]
Pavatkulum	*	43[a]	47	*	*	33	49
Vavu[illegible]kulum	*	4[illegible][a]	61	*	*	52	-

Source: a. ARTI bench mark surveys, prior to modernization
b. ARTI farm surveys 1983.
All others from the Census and Statistics Department, and Agriculture Department.
* Data not available.

Information on other field crops also do not suggest any significant trends of change in their cultivation methods and yield increases during past few years. It is clear that the current per acre yields of these crops under the project are substantially low in comparison to those expected under the project. As an illustration, Table 4.2 compares the current yields of these crops in Padaviya with those expected at project maturity.

Table 4.2 Current and expected per acre yields of selected food crops in Padaviya

Crop	Average per acre yields	
	Maha 82/83	Expected at the project maturity
Paddy (bu/ac)	53	79.5
Cowpea (Cwts/ac)	6.9	14.0
Chillies (Cwts/ac)	6.0	N.A.
Green Gram (Cwts/ac)	7.8	13.2
Soya bean (Cwts/ac)	15.7	N.A.

4.3 Cultivated extent and cropping intensities

Increase in the annual cropping intensity (from 108 percent to 160 percent) in the irrigable lowlands is a major expectation of the modernization project. This increase would be solely from expanding the cultivation of non-paddy crops, in irrigable lowlands during yala season. It was envisaged that with the completion of the project about 60 percent of the lowlands would be cultivated in yala.

In all five tank areas it shows an extreme seasonal variability even during maha. The study shows that the cropping intensities, even in maha season in all tanks, except Mahavilachchiya and Padaviya, are relatively low and varied around 50-70 percent, during the past five years. (Table 4.3) Infact, in Mahakanadarawa and Pavatkulum there has been no paddy cultivation for the last 2 years due to water shortages. In overall terms, the annual cropping intensities in the tank areas during the past five years do not suggest a clear trend of increasing land use pattern.

Table 4.3 Cropping intensities in the project area by seasons 1978 - 1983

(Percentage)

Tank	Total irrigated area (Ac)	Maha					Yala				
		78/79	79/80	80/81	81/82	82/83	79	80	81	82	83
Mahavilachchiya	2600	96	93	93	93	100	0	50	42	36	0
Mahakanadarawa	6000	67	58	58	0	0	0	0	0	0	0
Padaviya	12500	100	84	80	79	61	*	*	1	2	37
Pavatkulum	4400	60	63	74	20	8	0	0	0	0	0
Vavunikulum	6000	70	80	66	77	73	7	24		27	33

Source: Irrigation Department records.
* Data not available

4.4 Crop diversification in the lowlands and chena cultivation

Field survey information relating to farmer preferences on the crops to be grown indicates that the strong conventional preference for growing paddy, whenever water is available still persists irrespective of the season. Even in yala, farmers prefer to cultivate paddy indicating that despite much extension effort farmers are reluctant to cultivate subsidiary food crops in paddy fields in yala. The non-paddy crops that had been cultivated in a limited number of cases involves cowpea and soya bean. High income crops such as chillies and onions have not been cultivated in the paddy fields in yala by most farmers. This is primarily due to the high costs and heavy risks involved in cultivating these two crops. Although the project plans had emphasised sorghum and maize as having a major potential, they too have been totally neglected, due mainly to low prices and marketing problems.

The resistance of farmers to the growing of subsidiary food crops in paddy lands during the yala was also highlighted in the earlier ARTI bench-mark reports. The important constraints determining the farmer preferences at present is listed in Table 4.4. The basic problems hence appear to be the same as those existing before modernization.

Table 4.4 Reasons for not cultivating field crops in paddy fields during the yala seasons (82/83 maha, Padaviya) (Percentage of farmers reporting)

1.	Soil problems associated with drainage	27
2.	Inadequate irrigation water supply	21
3.	Marketing problems	19
4.	Lack of familiarity	17
5.	Heavy cash requirements.	10
6.	Others	6

The drainage problems also seem to be confirmed by numerous studies undertaken at the Agricultural Reasearch Station at Mahailluppallama. In yala, rains are mostly of a short duration and the showers tend to be very heavy. The onset of the Yala rains (usually in late March) causes the soil water table to rise gradually until about the mid-April, when Yala rains are at the peak. This situation in particular causes the soils in most irrigable lowlands to remain more or less saturated which therefore is not conducive to cultivating subsidiary food crops, unless suitable precautions are taken to avoid water logging conditions-such as planting in raised beds, or cutting drains to let the excess water out. On the other hand a major proportion of the soils of the irrigable lowlands in the project area are ideally suitable for growing paddy under irrigated conditions. The imperfectly drained reddish brown earths, low humic gley soils, and alluvial soils belong to this category. For example, in Mahavilachchiya, about 60 percent of the paddy lands belong to this soil category, which is ideal for irrigated paddy.

Most of the subsidiary food crops are affected by soil saturation or near soil saturation for long periods. The available technical evidence appears to suggest that, when there is water logging the planting of seasonal crops in paddy lands should be postponed until the heavy yala rains in April are over. In such cases, planting appears to be best undertaken in May, when the rains are receding and it then become necessary to meet the crops water requirement, with tank water.

Study data also shows that chena cultivation still continues to play a dominant role in the farming system in locations where forest lands are readily available (Table 4.5). Among the five tanks, chena cultivation is mostly seen in Mahavilachchiya.

Table 4.5 Cropping system adopted by farmers in Mahavilachchiya and Padaviya (% of farmers)

	Mahavilachchiya				Padaviya			
	Yala season		Maha season		Yala season		Maha season	
	76	82	76/77	82/83	79	82	79/80	82/83
Paddy	-	85	100	98	80	-	94	96
Chena	71	29	98	50	1	2	1	13
Highland	-	82	92	96	9	96	3	4

Source: A study of Five Settlement Schemes Prior to Irrigation Modernization, Vol. 1, Mahavilachchiya 1979 and Vol. V Padaviya 1980.

In general, where chena cultivation is undertaken most of the preparatory work in chena cultivation is done before the onset of maha rains, and planting during the first few showers. In Mahavilachchiya it is seen that even at present farmers who cultivate chenas return to their paddy land only after few weeks of rain, by which time the tank is full and the paddy fields are soaked and easy to plough. This sequence of operations also conforms with the distribution of available farm labour (Figure 4.1). However, most farmers operating chenas indicate that if opportunities for cultivating paddy in yala are available, their preference for chena cultivation would be very low.

4.5 Land preparation

Typically, paddy land preparation in the project reflects the conventional system involving mud cultivation of land in late November or in December when a good portion of the maha rains is already over. Although the rains usually fall in late September/ early October, farmers postpone their land preparation until the tank water reaches a safe level which guarantees a minimum of risk of irrigation water shortages during the crop season.

Tillage, under dry soil conditions, demands a heavy draught power which cannot usually be supplied either by buffaloes or by 2 wheel tractors. Having recognized this situation, a large number of new tractors were brought to the area during the period 1978-1979 under the TIMP. These tractors were initially given to the Agricultural Productivity Committees (APC) and Cooperatives Societies in the area. Later they were also given to private individual in the area as well. Under this programme 100 four wheel tractors and 135 two wheel tractors has been introduced up to 1979. Currently, the draught power position in the project area does not indicate a shortage of tractors or buffaloes. Infact, in some tanks most tractors appear to have been moved out by owners for work elsewhere.

Problems associated with draught power are repeatedly mentioned as hindering timely land preparation for paddy cultivation. One of the suggested solutions to ease this draught power problem in the dry zone involves land tillage, immediately after crop harvest in maha[1]. The main advantages claimed in this method are: (i) Soil tillage immediately after crop harvest involves less drought power since the soil is yet moist, (ii) farmer's cash flow situation is at its best and this makes it easy to hire tractors (iii) at this time tractor services are least demanded and hence readily available. However, at least in the five tank areas this method is unlikely to be adopted by farmers due to; (i) the long intervening period, from the end of one maha to the beginning of next maha, (ii) due to the long intervening period, the land again needs another ploughing immediately before sowing.

4.6 Sowing practices

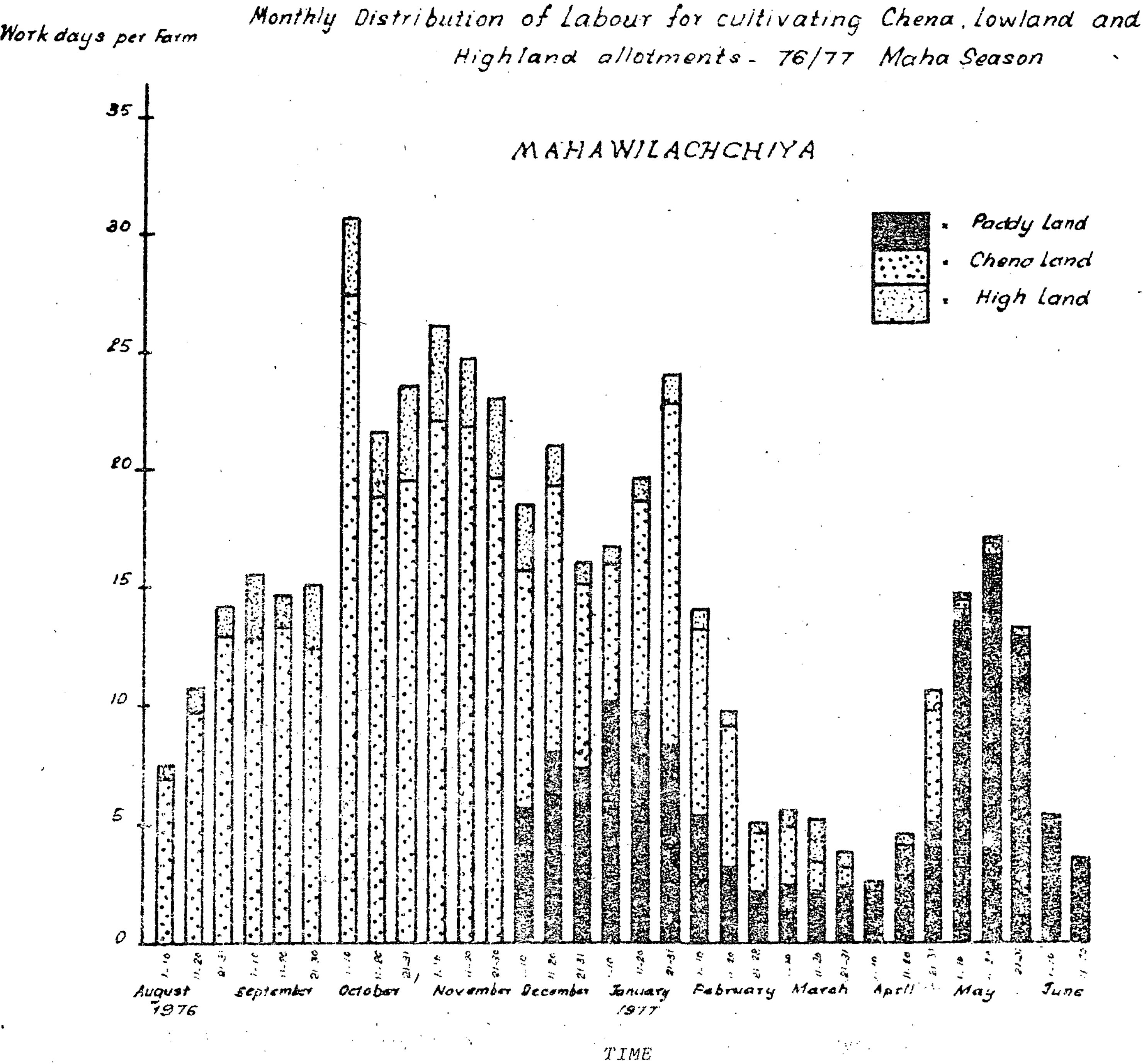
Broadcast sowing under mud condition is continued without change and dry sowing is virtually non-existent. Transplanting too is seen only in a limited scale (Table 4.6).

---

[1]See, Farm Power and Water Use in the Dry Zone, Farrington, J. and Fedrick Abeyratne, ARTI Research Study No. 43, 1980.

FIGURE 4.1

Monthly Distribution of Labour for cultivating Chena, lowland and Highland allotments - 76/77 Maha Season



SOURCE : A Study of Five Settlement Schemes Prior to Irrigation Modernization : Vol. 1, Mahavilachchiya ARTI Research Study No. 28, 1979,

Table 4.6 Type of planting methods adopted in Mahavilachchiya and Padaviya (% of farmers)

Planting method	Mahavilachchiya		Padaviya	
	76/77 Maha	82/83 Maha	78/79 Maha	82/83 Maha
1. Broadcast sowing - Mud	97	99	80	85
2. Broadcast sowing - kekulan	-	-	-	-
3. Transplanting	-	1	20	15
4. Seed dibbling	3	-	-	-
All	100	100	100	100

of
The sowing/ungerminated seed paddy suggested in the project plan is a practice typically followed under rainfed conditions in chenas or in some unirrigable lowland. The practice is common in certain locations in the Dry Zone where the soils are light in texture, and the land is prepared under dry conditions before rains.

Farmer preference for dry sowing in the five tank areas strongly indicates a pronounced farmer resistance to this practice. This was revealed in the earlier bench mark investigations as well (Table 4.7).

Table 4.7 Reasons for not adopting dry sowing

Reasons	No. of farmers reporting (%)
Erratic rainfall	50
Difficulties in weed control	46
Lower yields	2
Unavailability of tractors	2
	100

Source: A study of five settlement schemes prior to modernization, Vol V Vavunikulum, Agrarian Research & Training Institute, Colombo, 1979.

Farmer responses also indicate that yields obtainable under dry sowing are extremely sensitive to the crop management standards and rainfall patterns. Frequently the output obtainable by this method is less than that under mud-sowing. Often, the practice leads to total crop failure.

The erratic and unpredictable <u>maha</u> rainfall is perhaps a crucial constraint on the practice of dry sowing in the project area. Under the system of dry sowing, seed paddy is expected to germinate with moisture from the rainfall, and at this stage the seedling is extremely succeptible to soil moisture stress. Owing to the limited moisture retention capacity of paddy soils the young seedling cannot thrive by itself without frequent replenishment of water either by rainfall or irrigation. Hence under an erratic system of rainfall particularly when the tank water is uncertain, dry sowing is most likely to fail.Dry sowing, in addition, requires 2-3 times more seed than for mud sowing to replenish losses due to bird damage, low germination rates as well as to obtain a dense crop cover for smothering weed growth. This, means an additional cost of about Rs. 200 - 300 per acre, adding further to production risks.

Excessive weed growth is another major constraint on the adoption of dry sowing. A seed bed sown under dry conditions stimulates weed growth at the expense of paddy seedlings; the weeds get ahead of the paddy. Under mudland conditions, the submergence of the soil for 8-10 days after each tillage operation ensures a weed free seed bed which cannot be achieved under dry sowing. The alternative method of weed control under this system is to use chemicals which if used according to recommendations could cost about Rs.600 - 700 per farm. The most potentially effective means of weed control under dry sowing is to use a pre-emergent type of weedicide for which a suitable product has not been developed by the research so far.

Another important agronomic constraint on the adoption of dry sowing is the lack of suitable paddy varieties to be sown under rainfed conditions. Those currently available to project farmers require assured irrigated conditions. A variety ideally suited for dry sowing appears to be one with characters such as; shortage (95-100 days) early seedling vigour, a strong root system adaptable to soil moisture stress, a plant type with a more "open" and, good tillering habit; moderately long leaves with a lateral spread and a moderately taller habit (100-120 cms). These features are lacking in the rice varieties that are presently cultivated in the project, and this partly explains the reluctance of farmers to do dry sowing.

Despite many attempts over the last 4-5 years to make farmers adhere to a specific date of sowing agreed at the kanna meeting, staggered sowing is still widely practiced, causing serious water management problems, in the project areas. Specific data for Mahavilachchiya indicate that the extent of staggering essentially remains the same as in the pre-modernization period (Table 4.8).

Sowing time in general, is observed to be dependent on a number of factors such as: date of tank water issue, tank water level timely,availability of draught power (for land preparation) cash and seed paddy, commitment to chena cultivation. In areas with a more assured water supply sowing time is seen to be mostly staggered; in such areas farmers can afford to delay planting with no risk of crop loss due to water shortage.

Another important aspect of the sowing time leading to water management problems relates to the delays in actual sowing time beyond that decided at the kanna meeting. In consequence, the irrigation dates decided at those meetings, is generally extended in all tank areas by considerable periods (Table 4.9). Such unscheduled extensions of the irrigation periods to overcome the effects of dry weather substantially reduces the tank water storage.

Table 4.8 Period of sowing in Mahavilachchiya 76/77 maha and 82/83, (Percentage distribution of farms)

Sowing period		76/77 Maha		82/83 Maha	
		Right	Left	Right	Left
Month	Week	Bank	Bank	Bank	Bank
December	1st	-	-	1	-
	2nd	-	-	1	-
	3rd	-	-	3	2
	4th	-	-	33	15
January	1st	45	-	43	48
	2nd	35	10	15	35
	3rd	20	30	3	-
	4th	-	-	1	-
February	1st	-	45	-	-
	2nd	-	0	-	-
	3rd	-	10	-	-
	4th	-	5	-	-
Total		100	100	100	100

Source: Information for 82/83 Maha was obtained from the records available at the project office, Mahavilachchiya, Data for 76/77 was obtained from ARTI Bench Mark Study, 1979.

Table 4.9 Planned irrigation periods in relation to actual adopted in the project area - 82/83 Maha

Tank area	Period decided at the Kanna meeting		Actual period	
	From	To	From	To
Mahavilachchiya	Dec. 6	March 15	Dec. 6	April 3
Padaviya	Jan. 1	March 31	Jan. 1	March 31
Pavathkulum	Not decided		Jan. 3	March 28
Vavunikulum	Nov. 13	Feb. 15	Nov. 13	March 15

Source: Evaluation Report on Maha 82/83 cultivation from the Water Management Aspect, Y.Y. Choo, Unpublished Mimeograph.

4.7 Adoption of varieties

All farmers in the project area cultivate new improved rice varieties. Traditional rice varieties are hardly used in the project area. Despite a strong farmer preference for long-aged varieties of rice, a majority of the farmers have infact grown short-age varieties; 3-3½ months (Table 4.10). **The only source of seed paddy available to them was the local extension centre where only the short-age varieties were available.**

Table 4.10 **Adoption of paddy varieties in Mahavillachchiya** and Padaviya, 76/77 Maha and 82/83 Maha

(Percentage of farms)

	Mahavilachchiya		Padaviya	
(A) variety	76/77 Maha	82/83 Maha	78/79 Maha	82/83 Maha
Traditional	-	2	2	2
Old high yielding varieties	10	2	12	18
New high yielding varieties	90	96	86	80
All	100	100	100	100
(B) Age group				
3-3½ months.	90	85	N.A.	N.A
4 months	10	15	N.A.	N.A.
All	100	100		

N.A. Data not available

Farmers in the project area appear to have a considerable preference for 4 month rice varieties. Infact, in Mahavilachchiya during 82/83 maha, where sowing time was already delayed, about 15 percent of the farmers cultivated 4 month varieties against the firm advice of the irrigation officials. The preference for long age varieties is due primarily to their potentially higher yields compared to 3-3½ months varieties. Farmers estimate the yield-advantage of 4 month varieties over 3-3½ month varieties to be about 10-15 bushels per acre.

Among farmers who cultivated 4 month rice varieties include a few who are not concerned about a yala crop. Such farmers seem to place a relatively lower value on a yala crop which is extremely risky, and such cultivation is carried out only in small extents (1-1½ acre) under a "bethma" system[1]. A higher paddy output is thus preferred in maha, based on long age varieties.

4.3 Fertilizer application

Despite a considerable farmer awareness on the importance of fertilizer, its actual use varies significantly. The more important factors determining the fertilizer use among farmers are: their liquidity position, access to institutional credit, and the availability of fertilizer locally. For instance, in Mahavilachchiya and Mahakanadarawa, fertilizer use during the 76/77 maha season was extremely low, primarily due to the non-availability of fertilizer in the local market (cooperatives). In contrast, the situation in the 82/83 maha season is different, and this indicates a substantially higher adoption rate mainly because of a better credit availability (Table 4.11). Available information, however, does not indicate a consistent pattern of fertilizer use in the tank area.

[1] Bethma system involves a sharing of a contiguous area of irrigable lands closer to the tanks during Yala season, by all farmers in the project. In some instances this requires farmers to travel 6 - 8 miles. Cultivating under "Bethma" is almost a rule in yala season in the tank areas concerned.

Table 4.11 Fertilizer application by farmers in Mahavilachchiya and Padaviya, (76/77 Maha and 82/83 Maha).

	Mahavilachchiya		Padaviya	
	76/77 Maha	82/83 Maha	78/79 Maha	82/83 Maha
Percent of farmers using fertilizer	18	96	80	88
Quantity per acre (cwts)	.2	1.76	1.7	1.35
Cost per acre (Rs.)	N.A.	261.00	N.A.	195.0

N.A. - Data not available

4.9 Weed control practices

Weed competition for available nutrients and sunlight is a major problem affecting the rice cultivation particularly when water is limited. Under the conventional system of paddy cultivation in Sri Lanka weeds are kept under control through continuous submergence of the field by irrigation water.

It is seen that almost all farmers practice some form of weeding. However, the quality and efficiency of the practices vary greatly. Currently farmers spend about Rs.200 per farm on weedicides, which is about a 15% of the total cash production costs (Table 4.12).

Table 4.12 Use of weed control practices among farmers

	Mahavilachchiya		Padaviya	
	76/77 Maha	82/83 Maha	78/79 Maha	82/83 Maha
Percentage of farmers practicing weed control	82	96	75	92
Cost of weedicides Rs/Ac	N.A.	74	N.A.	68
Cost of weedicides Rs/Ac	-	209	-	190

The commonest weed control method used in paddy cultivation is the spraying of selective weedicides of which most widely used is MCPA, effective against a narrow range of weeds. More effective, wide spectrum weedicides such as 3.4 DPA, are used only to a small extent, since they are more costly. Farmers in the study area do not use pre-emergent weedicides, which could be most useful if dry sowing is done on a wider scale. However, suitable pre-emergent types of weedicides adaptable to dry sowing are not developed yet.

Hand weeding on a systematic basis is virtually absent. The hand weeding of broadcast sown crops is unpracticable especially when there is little or no water. The high wage rate prevalent in the area (Rs.20-25/day) are also a deterrent to the use of hired labour for mannual weeding.

4.10 Under utilization of highland allotments

The relative neglect of the unirrigable highlands by the farmers in the project area and the absence of a systematic highland development programme are two key aspects that require deeper attention by the project authorities. The lack of attention to this was also highlighted in the earlier ARTI bench mark reports as well; However, only the salient points related to this aspect would be dealt with here.

The unirrigable highland allotments given to the settlers in the project area and these lands cannot be supplied with gravity flow irrigation water from the channels. Such lands account for about 40 percent of the total area in the project, amounting to about 20,000 acres; the size per farm ranges from about 1.5 to 2.0 acres.

Cultivation of crops in the highland allotment at present is mostly limited to a few permanent tree crops such as mango, murunga, and coconut. Seasonal crops are rarely grown on a commercial scale even during rainy seasons. A major constraint on the intensive cultivation of highlands with seasonal crops is the lack of irrigation water. Lack of soil management has resulted in a considerable loss of fertility and this too appears to contribute low productivity.

Of the two important problems, the lack of soil management practices leading to soil erosion and impoverishment seems to be a more fundamental problem though it appears to have received little or no attention in the past. Hence, a more systematic approach to conserving soil, improving its nutrient and organic matter content would contribute towards raising the productivity of these lands.

An improved system of intensive cropping with perennial tree crops could also increase the intensity of land use among highlands. In this regard crops such as mango, papaw, castor appear to be ideal; they thrive extremely well even under adverse climatic conditions while contributing substantially to the cash income to the farmer during the dry period.

Intensification of animal husbandry provides another potential means of increasing the level of highland use. Cattle rearing which is already done to some extent in all tank areas, could be organized on a more intensive and commercial scale. Infact, in Mahakanadarawa, with the establishment of a milk collecting centre, cattle rearing by farmers has been substantially increased over the last 2 years. Absence of grazing grounds seems to be a major constraint in this regard, and hence arrangements should be made to provide more land to be used as common grazing grounds. Establishment of quick growing fodder crops on the highland allotments also appears to be a feasible solution to this problem.

V. COSTS AND RETURNS TO PADDY FARMING

In this chapter, the main features of production, expenditure and returns associated with paddy farming are discussed briefly, with a view to provide insights into the farm economy. Paddy forms the vital component of the farm activities and hence this investigation is focussed on the current state of this enterprise, particularly in relation to the pre-modernization situation. The discussion concludes with a broad assessment of the project impact on the farmer's economy, which to a large extent influences the economic participation of farmers in the project activities. The data used here, refers to Padaviya and Mahavilachchiya schemes, and it relates to 82/83 maha season as well as to the maha season immediately before modernization. Since production patterns show marked yearly variation, it is somewhat difficult to identify any changing trends based on these two sets of data alone.

Inspite of a possibility of extending the farm level economic analysis into a more elaborate and comprehensive study covering a benefit-cost analysis for the entire project, this was not attempted. Given the low level of project maturity and the meagre changes observed in agriculture so far, it was felt that such an analysis is premature to be adopted at this stage.

In this regard, it must also be added that a detail breakdown of the costs and physical units of the project inputs used, disaggregated at the tank level is not available so far. Since this information is essential for undertaking any evaluations in the future. It is strongly suggested that attempts be made to obtain such information on a more systematic basis. It appears that the cost details, both in physical as well as monetary terms on an yearly basis, could be included in the project completion report, which is being prepared currently.

5.1 Production costs and its structural changes

Information on cost of production of paddy in two of the project areas, Padaviya and Mahavilachchiya are provided in Table 5.1. This indicates that on an average, the total costs of production of paddy during 82/83 *maha* season in the two areas are around 1900 rupees per acre or about 2500 rupees per farm. A comparison of the current (82/83 *maha*) production costs with that before modernization indicates a substantial rise in production expenditure. The increase is most marked in Mahavilachchiya where the production costs over a period of 5 years have risen by almost three fold. In contrast, the cost escalation in Padaviya is much less sharp, where over a period of 4 years, total production costs have increased only by about 50%. The main sources of cost increase are tractor hire charges, wage payments to hired labour and use of chemicals and fertilizers.

Given the subsistence mode of operation and the poor financial resources of most project farmers, undoubtedly, the cash component of the production cost is more relevant to a detailed consideration in this discussion.

The survey data indicate that the cash requirements for purchased inputs in paddy cultivation in the two areas concerned in *maha* 82/83 are around to Rs. 1350 per acre (or about Rs. 3700 per farm). Cash expenditure is mostly associated with the tractor and buffalo hire (23-32%) payments of wages of hired labourers (18%) and application of fertilizer and chemicals (16-21%). Infact, the tractor rates which stood at Rs.175-225 in 77/78 had increased to about Rs.550 per acre in 82/83. Similarly wage rates (without meals), during this period has risen from Rs.15.00 to Rs.30.00 per day. Similarly buffalo hire rates, fertilizer and other agro chemicals too have shown substantial increases during the last 5 years.

5.2 Returns to paddy farming

An analysis was then made of the different indicators of returns to paddy farming in the two study areas. In terms of gross returns

Table 5.1 Changes in paddy production costs, since modernization (Rs./Acre)

	Mahavilachchiya				Padaviya			
	76/77		82/83		78/79		82/83	
Av. size of allotment	2.8		2.72		3.0		2.79	
Av. yield per Ac.	36		48.8		51.8		47.6	
Purchased Inputs	Value (Rs.)	%	Value (Rs.)	%	Value (Rs.)	%	Value (Rs.)	%
Fertilizer	19*	3*	261	14	178*	12	201	10
Weedicides & Pesticides	-	-	124	7	-	-	111	6
Seed paddy	97	14	106	6	103	7	47	2
Labour	77	12	342	18	337	23	358	18
Buffaloe	97	15	97	5	65	5	53	3
Tractor	43	6	339	18	243	17	585	29
Irrigation and other fees	54	8	40	2	9	1	26	1
Sub total	387	58	1309	70	935	65	1381	69
Own Inputs[1]								
Labour	256	39	391	21	390	27	342	17
Buffaloes	14	2	59	3	55	4	60	3
Tractors	6	1	29	1	55	4	39	2
Seed paddy	3	-	97	5	0	-	169	9
Sub total	279	42	576	30	500	35	610	31
Grand total	666	100	1885	100	1435	100	1991	100

* includes the cost of weedicides and pesticides also.

1. includes farmers own resources, valued at the market price.

and cash returns per acre the amounts received per acre by farmers in Padaviya and Mahavilachchiya do not show much difference (Table 5.2). The gross returns appear to vary around Rs.2,800 per acre, whereas cash returns are around Rs.1,300 per acre (Table 5.2).

A comparison of gross returns between the maha season immediately before and after modernization indicates a 145% increase in Mahavilachchiya where as in Padaviya the increase is considerably less (44%). However, the increase in gross returns are primarily a reflection of increases in the market price of paddy. For instance the government guranteed price which stood at Rs.40.00/Bushel in 79/88 maha increased to Rs.62.50 per bushel at in 82/83 Maha. The table also shows that the value of paddy sales at present are higher in both tank areas and the increase is most significant in Mahavilachchiya.

Table 5.2 Returns from paddy cultivation

Item	Mahavilachchiya 76/77	Mahavilachchiya 82/83	Padaviya 78/79	Padaviya 82/83
Gross Returns:[1]				
Value in Rupees/Acre	1141	2778	2072	2975
Amount in bushels/Ac.	36	44	52	48
Cash Returns:[2]				
Value in Rupees/Ac.	386	1377	1145	1298
Amount in bushels/Ac.	12	22	29	21
Net Returns (Rs.)[3]	475	893	637	984
Net Cash Returns (Rs.)[4]	-1	68	210	-83

1. Value of total paddy output, at market price.
2. Value of total sales.
3. Gross returns - total production costs.
4. Value of total sales - cash costs.

Attention was then focussed on the returns obtained by farmers in the two project areas per bushel of paddy produced. Results of this are summarised in Table 5.3.

Table 5.3 Returns per Bushel of paddy

Item	Mahavilachchiya 77/78	Mahavilachchiya 82/83	Padaviya 78/79	Padaviya 83/83
Total production cost per bushel (Rupees)	18.00	40.00	27.70	41.80
Cash production cost per bushel (Rupees)	11.00	27.00	18.00	29.00
Net returns per bushel, assuming the prevailing guaranteed price (Rupees)	22.00	22.50	12.30	20.70

Despite substantial increases in the sale price of paddy over the past few years, the net returns (profits) obtained by farmers per bushel of paddy seem to be highly variable among the project areas. For example, in Mahavilachchiya during 82/83 Maha net returns per bushel have remained almost constant in relation to 77/78 Maha, and in Padaviya they have increased from Rs.12.30 to Rs.20.70. If the inflationary factors are also taken into account the value of real gains per bushel is negative in Mahavilachchiya.

It was thought that it would be of interest to compare the farm gate price offered to farmers in the project area with the World Market Price. This was done through a computation of import parity price (or parity economic value) which is the price or value of a bushel of paddy that is based on a border (import) price adjusted for expenses between the border and the project boundary. The results of this analysis are given in Table 5.4., which indicates that the price received by the project farmers (62.50 per bushel) is considerably lower than the import price of about Rs.71.00 per bushel.

Table 5.4: Import parity price of paddy produced in the project area (1983)

	Rupees
CIF Value of 1 ton of Rice (195 dollars)	4680.00
Port handling charges	215.00
Transport to Project Area (150 miles)	500.00
Other costs including handling	150.00
Total	5545.00
Less	
Processing charges per ton of rice	115.00
Handling and Transport	100.00
Price of one ton of rice, at the farm gate	5330.00
Cost per ton of paddy (milling out turn of 65%)	3464.00
Cost per bushel of paddy (import parity price)	71.00
Guaranteed price of paddy per bushel	62.50

1 dollar is taken as equivalent to Rs.24.00

5.3. Returns from Paddy vis à vis other seasonal crops

The farm surveys undertaken in all project areas indicated a strong preference of farmers for paddy, whenever sufficient irrigation water is available. Some opportunities for cultivation of seasonal crops were indicated only for yala and even this is undertaken on a limited scale, under a bethma. Informal discussions with the farmers indicated that the cultivation of soya beans and cowpea was most feasible and economic. The relative profitability of these two crops vis-a-vis paddy can be identified from the following budget prepared for Padaviya scheme, based on 82 Yala data (Table 5.5). This table shows that, in particular soyabean cultivation is most profitable with a net returns of about Rs.4000 per acre.

Table 5.5. Costs and returns for cultivating Soya beans and Cowpea in paddy lands during Yala.[1]

	Soya beans	Cowpea
Land preparation:		
Land clearing	80.00	80.00
Ploughing	250.00	250.00
Cutting drains and ridges	300.00	300.00
Seed	300.00	225.00
Planting	240.00	200.00
Fertilizer	160.00	160.00
Weed control	180.00	180.00
Agro-chemicals	200.00	100.00
Harvesting	280.00	380.00
Total cost	1990.00	1875.00
Yield (Kgs)	1000.00	600.00
Estimated returns Rs.	6000.00	3600.00
Net profit	4010.00	1725.00

[1] These estimates were prepared in consultation with farmers and extension officers in Padaviya. (yala 1982)

In concluding this brief analysis of the economics of paddy farming in the project, perhaps a few points may be worth emphasising.

(i) Paddy production costs have increased significantly since the initiation of modernization programmes. However, during this period neither the paddy production nor the returns have shown commensurate increases on a sustained basis.

(ii) Cash costs of paddy cultivation account for a substantial component of the production expenditure. In instances where double cropping is not undertaken on a regular basis, this poses a major financial burden to the farmer. Frequently this is one of the major reasons for the failure of farmers to adhere to cultivation calenders decided at the Kanna meeting.

(iii) Cultivation of seasonal crops such as soya beans and cowpea in paddy fields in yala is an economically feasible option. Soya bean cultivation is particularly attractive to farmers in terms of returns obtainable and the level of inputs used. However, marketing appears to be a critical bottleneck in this regard.

Annex I

PROJECT EXPENDITURE IN TIMP (1977 - 1983)
(in million Rupees)

Item	Cost	
Civil works:[1]		
Mahavilachchiya	22.0	
Mahakandarawa	55.0	
Padaviya	63.0	
Pavatkulam	24.5	
Vavunikulam	29.0	
Sub total		193.5
Construction, Vehicles & Equipment		63.0
Agric. Equipment & supplies for extensions		6.3
Technical assistance		11.7
Grand total		274.5

1 Includes Engineering & Administration costs as physical contingencies.

Source:- Irrigation Department.

Annexe II

Indepth Research Investigation -- An Outline[1]

The primary objective of the indepth study will be to examine the range of possible alternatives for saving tank water during *maha*, with a view to eventually testing the alternative (or alternatives) which seem most acceptable to farmers. Implicit in this approach of development is a dialogue between farmers and irrigation system managers which extends beyond the *Kanna* meetings, the decisions of which, no one appears to follow or feel the least obliged to follow.

The proposed study will focuss principally on the Mahavilchchiya tank where a series of indepth investigations will be conducted, using the sample of 50 farmers originally interviewed as a part of the preliminary report. The choice of Mahavilachchiya is because it is the first tank to be completed, and it has been in operation for two years already. It is the smallest of the tank and weather conditions over the past few years, have been well within the normal range. Furthermore, a useful data base for an indepth analysis of this tank is already available.

This study might proceed along the following lines:

1) In consultation with farmers, irrigation officials and other agriculturalists in the area (extension, Agrarian Services, *Vel Vidane*) choose a set of alternatives to be examined. These alternatives should include:

   a) current farmer practices (i.e. planting in early January

[1] This is given in a report prepared by Dr. Randolph Barker as a part of his consultancy visit to TIMP in August, 1983.

and growing 4 month varieties in atleast a part of the tank area),

b) The TIMP plan (i.e. early land preparation, dry sowing, 3 month varieties etc.),

c) The plan agreed to, in the Kanna meeting for 1983/84 maha.

d) Other alternatives would include some combinations of maha sowing date and variety which invariably assumes mud sowing.

2) Budget out the alternatives in terms of water requirements and water savings during the maha and potential area planted to paddy in the yala assuming three levels of rainfall conditions, (favourable, average, poor) along with estimated probabilities of occurrence of each level.

3) Budget out the alternatives in terms of costs and returns taking particular care to assess differences in labour opportunity costs at critical periods and other slack periods.

4) Using a simple format as possible, and one which can be easily understood by farmers, present the various alternatives in such a way that farmers can indicate their preferences and hopefully their reasons for prefering one alternative to another. It is hoped that it would be desirable to present the alternatives to the 50 farmers individually and then to farmers in small groups meeting of half a dozen or so. The latter approach is hoped to be more effective in encouraging a discussion among farmers which will bring about the reasons for farmer preference.

5) Present a revised concept or strategy to the tank systems management and water users for possible testing in the fields.

The key variables to be considered in developing the revised strategy are 'advanced sowing date' and use of short age varieties, both of which has the potential of reducing water requirements by advancing the harvesting date. Earlier sowing can be achieved by a number of means, besides dry seeding. Farmers may start land preparation earlier or reduce the time now taken to complete land preparation. Alternatively the amount of water used for land preparation can be reduced by rotating irrigation water to the right and left bank, staggering the land preparation and sowing dates. The alternatives to be budgeted might include some or all of the following:

1) Present practice of mud sowing in early January, planting 3 and 4 months varieties;
2) TIMP proposed plan of dry sowing with tractor power and enhanced weed control methods;
3) Present practice with 3 month varieties;
4) Sowing one month earlier with 4 month varieties;
5) Sowing one month earlier with 3 month varieties;
6) Sowing one month earlier, with 3 months varieties and rotation of water in left and right banks to reduce land preparation water requirements.

In relation to the time of initiation of land preparation it is seen that the farmer decision making is largely determined by the date at which the tank water level reaches 8 feet. Hence, some of the alternatives may have to be based around this date. It would be important to know how much year to year variation there is in the date at which this occurs and to what extent does a late filling of the tank precludes the possibility of yala crop if the 8 feet rule is followed by farmers.

In developing this new strategy, it will be important to identify the unique features and resource constraints of Mahavilachchiya tank. It may also consider the degree to which the results of Mahavilachchiya be applicable to other tanks. For example does the extensive chena lands in Mahavilachchiya compare to some of the other tanks dictate a different strategy for cropping systems development.

Another major area that is hoped to be examined closely in the rotation irrigation system that as currently practiced. The differences between the planned and practiced would be carefully studied and the underlying reasons would be commented. What is the number of farmers and land area covered by the Vel Vidanes who are responsible for implementing the rotations at the farm level? How much water is supposed to be saved by the planned rotation over and above the usual practice, or is it the objective of farm level rotation to ensure a more equitable rotation?

In terms of rotation issues of water evidence indicates that rotations within the field channel is not so practicable as expected. In contrast there seem to be a greater potential for rotation at the main and secondary level. Irrigation engineers for example, indicated the amount of water that could be saved if water releases for land preparation in the Right Bank of Mahavilachchiya tank were initiated ahead of water releases in the Left Bank. Farmers seem to insist that water should be released to both Banks at the same time.

SELECTED BIBLIOGRAPHY

Barker, Randolph — A preliminary report on The Performance of the Tank Irrigation Modernization Project: Consultants report, Agrarian Research and Training Institute, Colombo. (June 1983).

Farrington, J., Abeyratne, F., M. Ryan, S. Bandara. Farm Power and Water Use in the Dry Zone. Research Study 43. Agrarian Research and Training Institute, Colombo. (1980).

Farrington, J., Abeysekera, W.A.T. Some Issues in Farm Power Use and Water Management in the Dry Zone. Occassional Publication 17. Agrarian Research & Training Institute. Colombo. (1979).

Irrigation Department, Sri Lanka. Report on the Joint Investigation in to the Water Management in Sri Lanka at Mahakanadarawa Scheme. Unpublished mimeo. (February, 1975).

Ranatunga, A.S., and Abeysekera, W.A.T. A Study of Five Settlement Schemes Prior to Modernization. Volume I. Mahavilachchiya. Research Study 28. Agrarian Research and Training Institute. Colombo. (1979).

__________ A Study of Five Settlement Schemes Prior to Modernization. Volume II. Mahakanadarawa. Research Study 31. Agrarian Research and Training Institute. Colombo. (1979).

__________ A Study of Five Settlement Schemes Prior to Modernization. Volume III. Pavatkulum. Research Study.38. Agrarian Research and Training Institute. (1980).

__________ A Study of Five Settlement Schemes Prior to Modernization. Volume V. Padaviya. Research Study 39. Agrarian Research and Training Institute. (1980).

Ranatunga, A.S., Farrington, J., Abeysekera, W.A.T. Some Issues Confronting the Rehabilitation of Major Irrigation Schemes in the Dry Zone. Research Study 44. Agrarian Research and Training Institute. Colombo.

Ranaweera, Nimal F.C. "Cropping Systems Pilot Production Programme in Sri Lanka. A Case Study". Unpublished mimeo. Division of Agricultural Economics and Projects. Department of Agriculture Peradeniya. (1982).

Vithanage, N., Chena Paddy Interrelationship and dry sowing: The experience in an irrigation scheme in Sri Lanka. Sri Lanka Journal of Agrarian Studies. Vol 3. No. 1 (June 1982).

Vithanage, N., Sensitivity Analysis and Risk Analysis in Evaluation of Irrigation Projects: A Case Study of the Mahavilachchiya Scheme - Sri Lanka Journal of Agrarian Studies. Vol 3. No. 2 (December 1982).

World Bank Appraisal of the Tank Irrigation Modernization Project. Report No. 951-CE, (1976).

World Bank Tank Irrigation Modernization Project: Review mission aide memoires, (restricted).

LIBRARY

22048