SOUTH WEST COAST DRAINAGE AND LAND RECLAMATION PROJECT AN ASSESSMENT OF RESULTS

D. TENNAKOON

RESEARCH STUDY NO. 54

OCTOBER 1982

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

SRI LANKA

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ABSTRACT

Since the 1960's Government has sought to reclaim the low lying lands in the South West Coastal belt of Sri Lanka. Large acreages of which, from the standpoint of their soils suited for agriculture, are ill-drained and subjected to flooding and salt water inundation. Six schemes of reclamation are currently underway.

The reclamation programme has been hampered by several factors: environmental hazards, insufficient irrigation, shortcomings in the management of the programme, and the ineffective utilisation of irrigation and drainage facilities constructed at large cost by the Irrigation Department. These include drainage structures, canals, bunds, access roads and water pumps. A realisation of the possible benefits of the reclamation programme also requires better farming practices through agricultural extension and research as well as expanded credit facilities, crop insurance marketing etc.

To realise the full potential of drainage facilities action is needed in three important areas: (a) The formulation of procedures for correctly assessing drainage and irrigation needs. (Generally, drainage is important in the lower parts of each scheme and irrigation in the upper parts); (b) New organisational framework and procedural arrangement for wider farmer motivation on project improvements, for resolving problems such as farmer disputes and disagreements and for associating farmers with the management of the project; (c) Intensive research into the fertiliser-use and crop-varieties, based on the environmental characteristics of specific areas.

FOREWORD

The West and the South West coastal belt of Sri Lanka, stretching from Puttalam to Tangalla, has been for a long time unproductive, as far as agriculture was concerned, due to frequent flooding and water logging. This area covers about 30,000 hectares and it was considered a substantial national loss to allow so much of land to be kept abandoned. Hence, the government considered the necessity of draining these marshes and reclaim them for the cultivation of paddy.

An area of 5,300 ha covering six schemes were identified for development and with IDA assistance the Drainage and Land Reclamation Project was completed during a period of seven years from 1970-77.

These six schemes were Iranavillu in Chilaw, Bolgoda in Panadura, Bentota right bank in Bentota, Bentota left bank (Dedduwa Rantotuwila) in Bentota, Madampe in Ambalangoda, and Kiralakele in Matara.

One of the conditions in granting the loan by the IDA was that "the government would levy and collect service charges from the project beneficiaries to cover at least annual operation and maintenance costs of the project." The Irrigation Department, on the advice of the IDA, commissioned the ARTI to evaluate the effects and the impact of the project after three years of its completion, with a view to assessing the strength of the repayment capacity of the project beneficiaries. This document sets out the findings of the study conducted by the ARTI.

In this report an attempt is made to identify some of the major constraints that impaired the anticipated benefits of the project at the six different locations. It discloses that the mere provision of irrigation and drainage facilities would not be sufficient to achieve

the objectives of a project. Ensuring , the effective use of such facilities as well as the provision of complementary inputs to achieve production targets are equally important if the desired results are to be accomplished.

This study was conducted by Mr. D. Tennekoon, Research and Training Officer of this Institute with the assistance of Dr. J. Black Michaud, Colombo Plan Advisor to the ARTI. It is hoped that the findings in this study would be of some use to the Irrigation Department to have an assessment of the project impact. It is also hoped that the identified defects and shortcomings in the formulation and the implementation of the project would benefit the planners and implementators of similar projects in the future.

I wish to express my gratitude to the researchers and others who made this publication possible.

T.B. Subasinghe
DIRECTOR
ARTI

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Dr. Jacob Black Michaud, Colombo Plan Advisor/Consultant to the ARTI and Consultant to the project, gave his encouragement, advice and support from the inception of the project to its completion. Dr. H.D. Sumanasekera, Research and Training Officer, ARTI who had visited several sites of the project, provided valuable suggestions for designing the research programme. A special word of thanks to Dr. S.B.D. de Silva, Deputy Director (Research) of ARTI for editing the final draft and making intellectual suggestions. I shall also thank the Director of the Institute, Mr. T.B. Subasinghe for his watchful guidance and encouragement at all the stages of this Study.

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D. Tennakoon.

LAND & AGRARIAN RELATIONS RESEARCH GROUP
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LIST OF ABBREVIATIONS AND ACRONYMS

ADA	-	Agricultural Development Authority
AEO	-	Agricultural Extension Officer
AI	-	Agricultural Instructor
AIB	-	Agricultural Insurance Board
AMSL	-	Above Mean Sea Level
AO	-	Agricultural Officer
ARTI	-	Agrarian Research and Training Institute
ASC	-	Agrarian Service Centre
CO	-	Cultivation Officer
DLRP	-	Drainage and Land Reclamation Project
ha	-	Hectare
IBRD	-	International Bank for Reconstruction and Development
ID	-	Irrigation Department
IDA	-	International Development Association
IE	-	Irrigation Engineer
Kg	-	Kilogram
Km	-	Kilometer
KVS	-	Krushikarma Viyapthy Sevaka (Rural Extension Officer)
MSL	-	Mean Sea Level
NIV	-	Newly Improved Varieties
OIV	-	Old Improved Varieties
PMB	-	Paddy Marketing Board
TA	-	Techmical Assistant
WB	-	World Bank

WEIGHTS AND MEASURES

Conversion Factors

British to Metric Units

1 acre	= 0.405	hectares (ha)
1 pound (lb)	= 0.454	kilogrammes (kg)
1 long ton (2240 lbs)	= 1.016	metric tonne (mt. tonne)
1 hundred weight (cwt)	= 50.802	kg
1 mile	= 1.609	kilometres (km)
1 lb/acre	= 1.121	kg/ha
1 cwt/acre	=125.536	kg/ha
1 pint	= 0.57	litres
1 imperial gallon	= 4.55	litres

Metric to British Units

1 hectare	= 2.471	acres
1 kilogramme	= 2.205	lbs
1 mt. tonne (1000 kg)	= 0.984	long ton
1 metre	= 3.281	feet
1 kilometre	= 0.621	mile
1 litre	= 1.76	pints=0.219 imp. gallons
1 kg/ha	= 0.892	lb/acre

Paddy/Rice Conversions

1 bushel of paddy (46 lbs)	= 20.87	kg
1 mt. ton paddy	= 47.92	bushels paddy
	= 0.7	mt. ton rice
1 mt. ton rice	= 68.46	bushels paddy
	= 1.43	mt. ton paddy
1 bushel paddy/acre	= 51.55	kg paddy/ha

Chapter One

INTRODUCTION

1.1 Preamble

Along the south-west coast of Sri Lanka, stretching from Chilaw to midway between Matara and Tangalle, there is a paddy belt of about 28,350 ha. of low lying lands with boggy and half boggy soils (Cooray: 1967; Arumugam: 1969; Douglas *et al* 1969). But,because of problems such as drainage, flooding, salt water intrusion, and iron toxicity, cultivation was limited to only a small extent of these lands once a year.

In view of the substantial national loss due to the underutilisation of these lands, the government, on several occasions attempted to reclaim them to enable more intensive cultivation.

Measures to develop these lands were at first confined mainly to checking the entry of sea water due to tidal effects. The problem of drainage received little emphasis until 1962, when the present Drainage and Reclamation Branch of the Irrigation Department was established. With a view to providing drainage for these low-lying areas, the Department made detailed project investigations. During 1962 and 1963, it identified some 25,000 ha. of land in some 20 sites of low-lying lagoons and marshes along the south, south-west and north-west coastal regions. This preliminary proposal gained high priority from Government and could probably have been completed in five years. But its implementation was delayed, mainly because of financial and technical difficulties.

In 1964 and 1965, the Irrigation Department identified some 16,600 ha of marshy lands in the 10 important areas for immediate reclamation. The 10 project sites of the second proposal are:

1. Iranavillu-Puttalam district
2. Attidiya-Colombo district
3. Bolgoda-Kalutara district
4. Bentota Right Bank-Kalutara district
5. Bentota Left Bank (Dedduwa-Tantotuwilla) - Galle district
6. Dedduwa-Galle district
7. Madu Ganga-Galle district
8. Madampe-Galle district
9. Hikkaduwa-Galle district
10. Kiralakele-Matara district

Pilot projects were also launched to ascertain the practicability of draining such land even before 1969, the year in which the present six schemes of the Drainage and Land Reclamation Project-IDA Project 1 (DLRP schemes) were begun. At the time of our appraisal, six drainage and reclamation schemes were either completed or were under construction, with the aid of the International Development Association. Even at this time, progress was hampered by the shortage of the construction equipments. (Irrigation Department, 1979).

As international funding was limited, the government set out to develop only about 5,000 ha. in the four most important schemes: 2, 6, 7, and 9 of those mentioned above. This work was financed through the national budget, and construction work was begun in 1967. With regard to schemes 1, 3, 4, 5, 8 and 10 a feasibility report on the drainage and reclamation of low-lying lands along south and west coast was prepared for funding by the IDA. This was submitted in May 1969 and was accepted by IDA. A sum of US $2.5 million (equivalent to Rs. 14.9 million at the time) was provided for the reclamation of 5,342 ha of paddy lands in the six project sites mentioned above.

1.2 The Project

In this project area, apart from the drainage and reclamation problems, a majority of the cultivable lands have an elevation below. 0.6 m and they frequently suffered from excessive flooding and salt water inundation. The IDA Appraisal Team found that the paddy lands in the lowest areas would be benefitted least from the project, and that while double cropping was practical, drainage deficiencies and flood hazards would persist.

The project, therefore, had three objectives: (a) to extend the area cultivable with paddy at least once a year; (b) to ensure double-cropping of paddy mainly on lands at elevations above 0.61 m (such lands account for a little more than a half of the total paddy land in the project); and (c) to increase the yield by means of intensive paddy farming. At the end of 1960s, the Irrigation Department was entrusted with implementing the six schemes. The project consisted of three components: (a) infrastructure improvements; (b) agricultural research, and (c) intensive paddy farming. The infrastructure improvements which were perhaps the most important, involved the setting up of structures for drainage (as protection against salt water intrusion) and the construction of access roads (Douglas *et al* : 1969).

The construction work on each project site started in 1969, was to be completed around 1975. At the time of our survey, April/May 1981, the construction work had not been completed on any of the projects (on any of the DLRP schemes).

1.3 Objectives of the Study

One provision in the IDA loan agreement with the government was to levy a service charge on the project beneficiaries to cover at least the operation and maintenance costs of the project. On the advice of IDA, the Irrigation Department, in 1979, commissioned the Agrarian Research and Training Institute (ARTI) to evaluate the operation and impact of the project with a view to assessing the repayment capacity of its beneficiaries.

A detailed investigation into productivity and income levels, and living conditions of the farm families in the area concerned, was not possible due to lack of adequate and reliable data maintained by the government departments. In the absence of a baseline survey in the late 1960s when the six drainage and reclamation schemes were launched, a subsequent evaluation of the project was not possible. In respect of all six schemes, there was also a serious inadequacy of information on agriculture: the yields, the extent of areas originally scheduled for reclamation, the acreage cropped or abandoned in any given year, the ownership of *yayas* and the identity of tenants and farmers in the schemes (they had lands elsewhere).

In November 1980, the Irrigation Department therefore agreed that instead of a detailed survey, the ARTI should prepare a short study report to reflect the present status of the project beneficiaries, using available data supplemented with a limited number of field interviews (Appendix 1). In broad terms, the ARTIs study was designed to reflect the impact of the Drainage and Reclamation Project - Project 1 IDA, on the progress in paddy cultivation under the six schemes. The information to be gathered was related specifically to the changes in cropping pattern, use of inputs, profitability of paddy cultivation, labour absorption in paddy farming and off-farm activities. This would help the Irrigation Department in assessing the repayment capacity of the project beneficiaries. (Appendix 2).

1.4 Field Procedures

The research team carried out a series of detailed interviews with the field personnel of the relevant government departments as well as with farmers or land owners on the six schemes. The team spent four days in each scheme area, carefully observing the physical state of the drainage infrastructure. Subsequent interviews sought to establish the link between the specific weaknesses in the infrastructure and agricultural performance. Farmers were encouraged to explain their problems in regard to water supply, flooding, salinity, the adequacy of varieties proposed, the availability of inputs, etc. To check the ideas expressed at these farm-level conversations and to assist in their interpretation, numerous official personnel belonging to the

Irrigation Department, the Department of Agrarian Services and the Department of Agriculture were consulted.

It was found that;

i. Large tracts of asweddumized land had been abandoned in *yala* 1979 and in *maha* 1979/80 due to inadequate drainage facilities;

ii. Paddy yields in *yala* 1979 and in *maha* 1979/80 were far less than what were anticipated by the Appraisal Team in 1969.

iii. Improved varieties were not used on the lowest lying paddy tracts, which account for about 55% of the total asweddumized lands;

iv. Double cropping is hardly practised;

v. Highland cultivation offers better returns to labour than does paddy cultivation (Kariyawasam, 1980);

vi. Off-farm activities are a major source of farmer's income (Kariyawasam, 1980).

The preliminary study prior to the detailed field research, revealed several weaknesses in infrastructure, extension work, and agrarian relations.

1. Faulty design and construction of the civil engineering work; Irregular and insufficient maintenance of irrigation structures (bunds, sluices, channels) and of mechanical equipment (pumps and engines); Inadequacy of roads for carrying bulky inputs harvested paddy.

2. Insufficient number of extension workers; The lack of short-cycle paddy varieties suited to waterlogged and saline conditions.

3. Uneconomic size of the most of paddy holdings and unfavourable tenurial terms.

Chapter Two

INFRASTRUCTURAL DESIGN AND CONSTRUCTION

2.1 The General Objectives of the Infrastructural Design

All the land of DLRP schemes of IDA Project I, are flood plains* in the lowest parts of the six major river systems in south and south-west coastal regions of Sri Lanka. Having taken into consideration the specific characteristics of those flood plains, the infrastructure improvement was specifically designed to serve the following purposes:

a) to control flood damage to the paddy fields;

b) to drain-out excess water in the lowest paddy fields (at an elevation near the Mean Sea Level, where gravity drainage was not effective, lift drainage facilities were provided with, eg. water pumping by machines);

c) to reclaim and protect the land from the salt water inundation;

d) to supply water to the paddy fields in the upper elevations during the times of low rainfall (see Appendix 3 for Major Land Types and their Locations).

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* The flood plain of a lagoon or a river can consist of,

a) fairly well drained land and soils which are located on the levees (embankment against river floods) and immediately adjacent to it.

b) Poorly drained marshy lands which are located around lagoons and close to rivers or tributories or main drainage channels. These problem areas are (i) filled up lagoons (ii) tidal marshes (iii) back swamps of the river systems and (iv) narrow valleys of the hinterland that have constructed drainage (Panabokke, 1977; 1-2).

2.2 The Major Infrastructural Components of the Project

The construction work by the Irrigation Department on the six schemes can be categorised as follows:

a) Removal of rock outcrop at sea outfall and the construction of a groyne to prevent the formation of a sand bar;

b) Reconditioning the existing drainage canals and the construction of new ones;

c) Construction of bunds, control regulators;

d) Construction of access roads;

e) Allocation of water pumps for water exclusion from the lowest paddy tracts where necessary.

The details of the construction work on the six schemes are given in the following table:

Table 2.1 - Details of the work involved in the six schemes

Name of the Scheme*	WORK INVOLVED			
	Construction of Groynes	Reconditioning existing drainage canals & construction of new canals	Construction of bunds & control regulators	Construction of access roads
Iranavillu	X	X	X	X
Bolgoda	X	X	X	X
Bentota R.B.	-	X	X	X
Dedduwa-Rantotuwila	-	X	X	X
Madampe	-	X	X	-
Kiralakele	-	X	X	X

Source : Irrigation Department (1979) Sri Lanka (Ceylon) Drainage and Reclamation Project, Completion Report (IDA Project 1) Memeographed.

* Location of DLRP schemes is illustrated in the Appendix 3.

2.3 The Work Accomplished and Shortcomings

Some very important and major drainage components of each scheme are still under construction or poorly constructed. For example in the Iranavillu scheme, removal of rock outcrop at sea outfall has caused salt water seepage into the paddy fields through Lunu Oya (the control regulators are not functioning). As a result hundreds of paddy hectares at Iranavilluyaya, Mattakotuwa yaya, Toduwawa yaya and lower part of Mahawewa yaya appear to have been destroyed. Likewise, in Bolgoda hundreds of hectares have been abandoned due to heavy salt water intrusion at Panadura.

The reconditioning of the existing drainage channels (by clearing and enlarging them), and the construction of new drainage canals have been completed with the aid of heavy machinery. In some schemes (eg. Bolgoda and Madampe scheme), the existing drainage channels are insufficient to discharge the excess water during floods. River water overflows into the inland lakes through the connecting canals and presses back into the paddy fields.

The construction of levees, bunds and salt water exclusion regulator structures etc., and of access roads is incomplete or faulty.

Though bunds along the canals and regulator structures were designed to check the flow of water into the paddy tracts during the high tide, most of the bunds seem to be too low for this purpose. Almost all the bunds in the six schemes are incomplete; in the Iranavillu scheme where a salt water exclusion bund from the Colombo/Chilaw main road along the Madampewelyaya fields has not yet been constructed; there is considerable damage from floods and salt water along the lower part of the *yaya*. In all six schemes nearly three fourths of the bunds are poorly constructed, the bunds are a structure of logs, alluvium and peat, and decayed vegetation. After the canals were dug, the scooped out earth was buttressed. The gravel is then placed on the top of these bunds to strengthen the beds. But usually water leaks through the bunds into the entire project area. The water control regulator structures that were built along the bunds have, in some instances, been already weakened due to faulty construction. In

the Iranavillu scheme, the regulator structure in the Mattakotuwayaya bund is cracked and has sunk, and most of the paddy fields in the Mattakotuwa and Mahawewa tracts are inundated with salt water and flood water.

In the six scheme areas most access roads are either badly constructed or incomplete in numerous portions. Most of the roads (as also the water control bunds) are constructed with earth (peat) excavated from the fields, and strengthened with a layer of gravel. Generally, the roads and bunds are breached in several places. The length of roads is insufficient in terms of the area of the scheme comprising about 2,000 ha. For instance, in the Morontuduwa yaya of Bolgoda scheme the construction of access roads has not been completed. The Bolgoda scheme has only about 12 km of access roads. In the Bolgoda and Kiralakele schemes, access to lower lying paddy tracts near the main drainage canals is very difficult. As the paddy fields, are generally situated on marshy lands, goods cannot easily be taken across them, and at times the bunds are used as access roads. During the rainy season farmers scarcely visit the paddy fields.

In each scheme, except Iranavillu, there is a number of pumping stations to prevent excess water. The original proposals envisaged the drainage by the gravity of lands whose elevation is 0.3 M. above Mean Sea Level, but in each scheme there is also a fairly extensive area of paddy lands that are of even lower elevation. In order to lower the water level of these lands during the sowing period, small size drainage pumps of capacities varying from 5 cusecs to 25 cusecs are installed (Irrigation Department, 1979). The bunds are constructed along both sides of the drainage canals to prevent the water of the drainage channel, from overflowing into the paddy lands while water already in the paddy fields is pumped out into the channel. The capacity of the pumps is inadequate to effectively control the water level during the cultivation season, even though the bunds are properly constructed. Even at the inception, pumping had appeared as a very expensive method of flood evacuation (De Silva, 1977:8). All the bunds constructed so far have been breached at numerous places. For this reason, as well as the ineffectiveness of the existing drainage facilities

inclusive of the pumps and regulators, water pumped into the drainage canals, flows back into the paddy fields over the incomplete or breached portions of the bund. The places at which the water flows, are also those, where the pump houses are installed (eg. Tudawa pump house in the Kiralakele scheme and the two pump houses in the Thalgasroda yaya tract of the Madampe scheme). Faulty construction of the control structures (bunds, canals, regulators, etc.) is a general feature of all the six schemes.[1]

Chapter Three

MAINTENANCE OF DRAINAGE INFRASTRUCTURE OF THE PROJECT

3.1 Maintenance

In the lower lying marshes along the south and south-west coastal region of Sri Lanka, the efficient maintenance and operation of drainage structures (bunds, sluices, regulators and drainage pumps) are generally seen as important features of the extent of cultivable land and the extent used for double cropping. Some Indian experiences relevant to the relationship between irrigation and intensive agriculture are found in Sally (1968) and Programme Evaluation Organisation - India (1965). Maintenance also should be considered as important as construction. But after years of neglect, the problems of maintenance of the drainage structures have reached a critical point in all the six schemes of the project.[2] The subsequent submersion of the paddy crop, partly in salt water, is one of the major constraints to paddy cultivation.

Apart from the inefficient maintenance of the regulator structures and sluices, thefts or damages to equipment (the planks, steel and brass components and wooden and iron gates) are rampant. For instance, in the Madampe scheme, a substantial proportion of operating parts of the drainage structures viz: locks, iron rods, iron handles and gates, is missing. At the main bunds of the Bentota Right Bank and Left Bank schemes, along both banks of the river, the majority of operating parts and doors of the control regulator structures are completely damaged. The malfunctioning of the drainage structures in these two schemes prevented the cultivation of large tracts of paddy fields during *yala* 1980 and *maha* 1980/81.

One of the important issues to be taken note of, is the officers' failure to act against the misuse of paddy lands (under provisions of Part III of the Agrarian Services Act No. 58 of 1979) theft and damages to irrigation infrastructures (under the regulations of the Irrigation Ordinance). This view is discussed in the other four - The Impact of Institutional Arrangement of the Project on Agricultural Development, and Chapter six - Conclusions and Recommendations of this report.

Wastage was also evident in all the six schemes. For instance, in the Bolgoda scheme, wooden doors and planks to be used as channel gates and sluices were lying idle at the Irrigation Department's Morontuduwa field office, and exposed to the elements for over two years. Most of these doors and planks became unusable, and some were used as firewood.

Most of the salt water excluding bunds and access roads, that were completed, have lapsed into an unrepairable state due to bad construction and maintenance. Bunds are also damaged due to regular passage of the buffaloes across them and frequent grazing of the cattle on them. When drainage schemes are not functioning, the farmers themselves breach the bunds to regulate water in the fields, and these breaches are not mended.

The majority of drainage canals are choked with salvinia and other aquatic vegetation as well as with silt, which after being carried by the frequent floods, settles and accumulates in the canal beds. This retards the drainage of water from the fields and encourages the growth of floating weeds. To the serious detriment of the paddy crop, the canals have remained uncleared over the past two years.[3]

In all the six schemes of the project, remaining the aquatic vegetation and desilting the canals should immediately be carried out; action is also due on repairing the breaches on the bunds and across the roads, the completion of construction work on the bunds, repairs to control structures, sluices and pumping stations and the removal of the sand bars which block the sea outfalls.[4]

3.2 Operations

The maintenance work, required for the efficient functioning of water control structures, involves, in the case of major drainage canals, their opening and closing daily conforming to the fluctuations of the water levels (due to tidal effects). When the level of the river falls, control structures should be closed in time to prevent the intrusion of sea water into the fields. The procedure is that when the water level in fields rises, the farmers inform the Cultivation Officer, who in turn instruct the operators accordingly. However, those employed for this purpose being casual labourers (majority), show little enthusiasm for their work. They do not always carry out these instructions unless they are also endorsed by the Technical Assistants of the Irrigation Department. Most farmers complained that the timely action, needed on such occasions, is seldom carried out.[5]

The operators, employed at major control structures as permanent labourers of the Irrigation Department, are outsiders to the villages where the structures are situated. The operators are frequently involved in squabbles with the fishermen living there, for their interest is to open the sluice gates during high tide. With open sluices fish, along with the sea water, are carried out into the rivers. Furthermore, fishing boats ply across the control structures from inland lakes (eg. Bolgoda lake, etc.). The operators of the control structures are then obstructed from carrying out their duties, as reported to us by those employed at the Madampe Ganga outfall at Ambalangoda. They are intimidated by the fishermen into leaving two or three gates open (out of a total of fourteen). After 6.00 p.m. the salt water gushes into the Madampe river and the Madampe lake along the river. Eventually the salinity brought about by this has caused the abandonment of hundreds of hectares of paddy land around the Madampe lake.[6]

In five of the schemes (except Iranavillu) several water pumps have been installed to regulate water in the lowest paddy tracts. Though there are two full-time employees for each pump station, one, during the day and the other at night, timely action is not always

taken. In the Bolgoda Scheme, while farmers reported that the operators were failing at their duties, most operators complained about a lack of fuel for the pumping machines.[7] In the Bentota Left Bank and Right Bank schemes, during the peak rainfall (May/June and November/December) the paddy fields are submerged in water continuously for five or six days and the plants perish at last.

Chapter Four

THE IMPACT OF INSTITUTIONAL ARRANGEMENTS OF THE PROJECT ON AGRICULTURAL DEVELOPMENT

4.1 Research and Extension

For successful paddy cultivation within the project area, more agricultural research and better extension services are required.[8] Most of the research carried out for the Wet Zone are related to well-drained soils. There is a need for (1) new, improved high yielding paddy varieties that are suitable for water logged and saline soils; (2) experiments on fertiliser use and crop protection for marshy lands; (3) techniques for the control of iron toxicity and bronzing* etc.

4.1.1 Research

The Bombuwela Regional Agricultural Research Station has bred new high yielding paddy varieties, viz. ID 66, BW 100 etc. for the Wet Zone paddy lands. These varieties have proved themselves to be unsuitable for the reclaimed lands which are affected by water-logging salt water inflow, diseases, pests and climatic and soil problems (Balasooriya 1975, Balasooriya *et al* 1975, 1976 and 1978). Furthermore, since paddy cultivation in the Wet Zone, especially in the coastal belt of the Wet Zone, is mainly for home consumption, most farmers are concerned more with the palatability of rice which they grow than productivity. In the low country, there is a consumers' preference

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* Bronzing is a common problem in ill-drained areas of the Wet Zone (Mervyn and Thenabadu - 1977). The causes and effects of this problem have been reported by Ponnamperuma *et al* (1955), Ponnamperuma (1958), Ota and Yamada (1962), and Inada (1965).

for red rice, whereas almost all the new improved varieties that have been developed for the Wet Zone are white rice. This consumers' preference also should be taken into consideration, when varietal breeding programmes for varieties are undertaken for water logged, saline mixed soil in the DLRP schemes. In the absence of improved varieties for these lands, traditional agronomic practices persist: using low yielding varieties, bonemeal seed broadcasting etc. . Inevitably the level of agricultural performance on all the six schemes of the project has been poor.

4.1.2 Extension

Agricultural extension within the schemes has been inadequate. The Agricultural Instructor (AI), the middle level extension worker, and several *Krushikarma Viyapthy Sevakas* (KVS) - the village level extension worker, work partly in the drainage and reclamation schemes and partly outside the schemes. These personnel lack a sufficient knowledge of the intensive paddy farming in these marshy lands. Unlike extension work outside the project, poor accessibility to the farms, especially in the lowest paddy tracts, discourages them from visiting the project area.

The number of KVS on each scheme is inadequate in relation to the number of farmers and the land-extent. Outside the project, there is usually one extension field officer for 500 farming units (or less), whereas under this project the ratio is one per 1000 farmers. It is thus impossible for him to meet farmers even once a month. In the six schemes the number of farm units varies from 1000 to 5000, but there are only one or two village level extension workers per scheme. While it would be desirable to limit the responsibility of a village level extension worker to 500 production units, at least at the outset of a scheme, there should be a minimum of 4 village level workers for 2000 farm units. The proficiency of the extension workers should also be upgraded. Those, now employed mechanically tend to repeat season by season, what they have learnt at their training classes; there are scarcely any field demonstrations to the farmers, regarding new varieties, fertiliser use etc.

In all the six schemes agricultural extension work, as we observed, seeks mainly to increase farm inputs. Even when newly improved varieties are prescribed by district level extension officers, an adequate supply of seed is not available to farmers. The farmers are also induced to adopt the types and dosages of fertilizers and agro-chemicals made available by the firms which produce or market these materials rather than those prescribed by the extension workers. The farmers do not seem to be wholly confident in the scientific knowledge of the rural level extension workers. Information on the use of these materials is disseminated by successful advertising. The widespread use of Gramoxone as a chemical for weed controlling before planting the field, was propagated in this way. For instance, a few farmers having listened to its radio advertisement, had conveyed the news to others.

In the almost complete absence of agronomic research on paddy farming in the lowest marshy areas, in regard to varietal use, fertilizer, control of diseases and soil damage from bronzing and iron toxicity, the question of agricultural extension, in a sense, hardly arises.

4.2 Institutional Aspects of Development

There are several gaps in the existing institutional framework for paddy cultivation. Apart from a proper drainage infrastructure and its maintenance and operation that has been already emphasized, there is need for supportive services, and a procedure for settling disputes and conflicts among farmers and for encouraging them to participate more in the management and operation of the infrastructure facilities.

Though, there is room for spontaneous farmer organisations, and procedural arrangements could be made in line with customs governing such organisations, through the backing of rural level officials under the provisions of Part III of Agrarian Services Act of 1979, such organisations or arrangements are found to be missing in the individual schemes of the project. The former *Vel Vidana* system was set up for initiating concerted action among farmers in paddy cultivation (Weerasooriya, *et al* 1951:83; Moore and Wickramasinghe, 1978:25). Farmers placed such confidence and enthusiasm in the decisions taken

by *Vel Vidana* and other farmer leaders who were organised tract-wise (Moore and Wickramasinghe, 1980:140-150). Direct involvement in tract-wise activities such as channel clearing was perceived by farmers as equivalent to their obligations and duties they had to perform for the state (Harris, 1977:364-376). Within the present politico-economic framework, there is much scope for the generation of new spontaneous farmer organisations and *shramadana* movements to mobilize wider farmer praticipation in the construction and maintenance of drainage structures, and for timely undertaking of agricultural activities etc. To motivate farmers in this direction it is necessary to convince them of the benefits that will accrue to them as a result of such action. Lack of such procedural arrangements has partly caused a staggering in paddy farming, less confidence in project improvements and extension, low farmer participation in project management, and the presence of inadequate procedures for resolving farmer disputes and disagreements.

The great potential which exists in the six schemes of the project, for increasing employment and paddy output cannot be realized due to serious institutional weaknesses and inadequacies. A considerable amount of construction work, which having involved heavy capital investment over the past decade, still remains to be done. Using simple tools and manual labour, this work can be finished with no difficulties.

The existing problems are embedded in the patterns of rural level social organisations and state and village relationships. There is scarcely any local autonomy or initiative among the farmers as a group in the maintenance and operation of the irrigation and drainage infrastructure. An effective forum must be created among the technical officers and the farmers for the interchange of ideas and knowledge on these matters, as well as on cultivation practices. Technical and extension personnel must also gain more insight into local circumstances and problems.

4.2.1 State institutions and farmer organisations

The Agrarian Service Centres and Agrarian Services Committees, established by the Agrarian Services Act of 1979, are the sole state organisations at rural level for ensuring the availability and

efficient use of agricultural resources ie. land, seeds, agro-chemicals, etc. The Agrarian Services Committee meets once a month (this may vary according to needs) and discusses agricultural problems at the village level. However, the matters, which this committee is concerned mostly with viz. preparing a cultivation calendar, use of seeds and water supply etc., are not relevant to the lands in question - marshy, ill-drained, and those subjected to salt water intrusion. Evidently, none of these committees interacts with local officials of the Irrigation Department, who are responsible for the construction and maintenance of drainage facilities. The Irrigation Engineer, Technical Assistants, or other officials of the Department rarely attend the meetings of the Agrarian Services Committees.

In the six schemes as a whole, the problem of drainage and salt water inflow into the low lying paddy tracts, is not the only one faced by the farmers. There is also, in the highland paddy tracts above an elevation of 0.91 m. a limited supply of water for paddy cultivation. The deepening of drainage channels in the lowest paddy tracts causes a shortage of water in the upper tracts. The water shortage during the land preparation stage delays the sowing and curtails the time available for the succeeding crop. The uncertainty of the availability of water also discourages the intensive use of cultivation inputs, and reduces the yield.

The Agrarian Services Centres in each scheme are responsible for supplying farmers with fertilisers, pesticides, weedicides, as well as seeds. But in all six schemes, except the lowest paddy tracts farmed with local varieties, there are problems about the supply of high yielding seeds, because of the wide range of varieties used at any time and annual changes in them. When the Department of Agriculture releases a paddy variety to an Agrarian Services Centre, the demand for it by farmers could vary. In the last *yala* season farmers were supplied largely with seeds of BW and BG varieties, but none of which could be grown on marshy lands and thus, the local or old improved varieties such as H4, were ~~thus~~ resorted to. These varieties were also used for the upper paddy tracts of DLRP schemes. The choice of these varieties is also made due to a limited supply of newly improved seeds of the BW and BG varieties. While supplies (through Cultivation

Officer) of BW and BG seeds of newly improved varieties are relatively cheap, high prices are charged by the private dealers.

Though fertilizer and agro-chemicals are available at the Agrarian Services Centres at any time, almost all farmers of the upper paddy tracts do not make use of them sufficiently. In the lowest paddy tracts, the local and old improved varieties are resorted to along with the widespread use of bonemeal, sold exclusively by the private dealers.

The Cultivation Officers are mainly responsible at the village level, for the timely conduct of farming activities and the appropriate use of inputs. These officers are selected partly for their local knowledge and their informal and close interaction with the farming community. In the six schemes, almost all of them work in their own villages and are not transferable. The Cultivation Officers in the Kiralakele-Matara and Iranavillu-Chilaw are educated, well acquainted with the local affairs, and enjoy high social status and economic standing. They are thus acceptable to the farmers and can generally perform their job effectively. In contrast to this position, in the other four schemes, the Bolgoda scheme-Panadura, the Bentota R.B. scheme, the Bentota L.B. scheme, and the Madampe scheme-Ambalangoda, almost all the Cultivation Officers are from poor families, though educated and well acquainted with local affairs. These officers lack status in the eyes of many big farmers and land owners. But basically Cultivation Officers do not have statutory authority (unlike the *Vel Vidanes)* to intervene in farmer disputes and to take action against those who misuse the infrastructure facilities for paddy cultivation.

4.2.2 Credit

The provision of credit in all six schemes of the project has become mostly inoperative owing to defaults by farmers; at least eighty percent of them are found to be involved in defaulting. The uncertainty of harvests and high cultivation risks have discouraged lending by non-institutional sources. The inputs of farmers per acre are thus limited, to two bushels of local seed paddy, Gramoxone (two bottles) and 50 kg. of bonemeal. Family labour is predominantly used. The

virtual absence of institutional credit has contributed to the abandonment of lowest paddy tracts.

4.2.3 Crop Insurance

The intensity of natural hazards (ie. drought, flood and salt water inundation) and plant pests and diseases in all six schemes of the project have led to serious and frequent crop failures (Oudshooru and DeGlopper, 1969). While the assessment of crop damages, according to farmers, is insufficient even to cover the labour cost (ARTI: 1977), delays in indemnity payments under the Crop Insurance Scheme as well as the very low indemnities usually paid discourage farmers from paying their insurance premium (Sandaratna, 1974). Hardly any farmers in the lowest paddy tracts (especially those below 0.91 m. in elevation) have joined the Crop Insurance Scheme.

4.2.4 Supply of inputs and marketing of products

Material inputs, ie. new high yielding varieties of seed paddy, fertiliser, herbicides and pesticides are supplied mostly through the Agrarian Services Centres, while the traditional varieties of seed paddy and bonemeal are obtained from private traders or farmers. Pesticides and weedicides are available both from private traders and government institutions at the same price.

The question of paddy marketing does not exist in any of these six schemes, because of the predominance of subsistence farming and the higher open market price for paddy compared with government's guaranteed price. Private dealers purchase all marketable surpluses in an ungraded form directly from the farmer, sometimes at the threshing floor.

4.3 Alternative Uses of Paddy Lands

The use of paddy land for cultivating other crops, or digging clay for several rural industries like bricks, tiles and pottery and excavating limestones in it, or the use of land for various other purposes against paddy farming, can be explained as non-paddy farming activities that lead to high profitability. The low profitability of paddy farming (confined to the lowest lands below 0.91 m. of elevation)

is a direct result of a series of constraints ie., deteriorating drainage facilities and damages caused by salt water, inadequate maintenance and inefficient operation of infrastructures, inadequate extension and insufficient support services etc.

4.3.1 Reed growing

The reeds (*pung*) are cultivated largely on the lowest paddy lands, where high incidence of flash flooding inefficient drainage and salt water inundation appear (reed is one kind of aquatic weeds which grow on marshy lands). The reeds are usually flood tolerant and resistant to saline water. "The cultivation of Sedges (*pung*) entails much less risks than paddy cultivation and would be a new proposal for establishing a cottage industry in the integrated rural development plan" (Dimantha and Jinadasa, 1981:11). Therefore, at less input and crop protection, comparatively, high return is expectable, as is explained in the Table 4.1. The *pung* is widely grown for weaving mat and bag by the weavers of the area. Reed growing is widely practiced on paddy lands in the Bentota R.B. scheme and Bentota L.B. scheme. These two regions are widely known for *pung* bag and mat weaving and consequently there remains comparatively high demand for *pung*.

Table 4.1 - Reed cultivation input output analysis per year (1980)

(These information are from reed farms of size about 0.4 ha (1 ac.). Small farms (actually cultivated with reeds) of much less than 0.4 ha were excluded since they depend on family labour).

Activities	Inputs (non-labour	Value of family labour used Rs.	Value of hired labour used Rs.	Remarks
Land preparation, muddying & planting	x	160	60	When the farm size is smaller than 0.4 ha (1 acre) activities depend widely on family labour (most farmers use family labour only).**
Weeding-pest control and fertiliser use	80*	x	x	Reeds usually grow better than weeds and resist diseases and saline conditions.
Harvesting transporting & processing	x	80	x	(Sometimes all the crops are sold at the field, to outside traders).

* Cost incurred for weedicides used before planting x Not applicable

** It was observed that majority of farmers cultivate reeds without incurring any expenditure.

Gross value of production of 0.4 ha farm unit, (total harvested) is Rs. 1200/- per annum (once planted, four crops can be harvested-rough value of one crop harvested is Rs. 300/-). The profitability of reed cultivation on lower marshy lands of the project could be explained as follows:

Value of total input-per annum Rs. 380/- (value of family labour is Rs. 240/-).

Value of cash input - " " Rs. 140/-

Total value of output-" " Rs. 1200/-

Value added - " " Rs. 820/-*

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* This shows the profitability of reed growing in the lowest marshy paddy tracts compared to paddy cultivation in those lands of the DLRP schemes. Compare the statistics given in Table 4.1 relating to profitability of reed cultivation with the statistics given in Table 5.1 relating to input-output analysis of paddy cultivation in the lowest marshy lands of the DLRP schemes.

4.3.2 Limestone excavation and burning

Coral excavation on paddy lands widely appears in Madampe Scheme-Ambalangoda. Coral is mainly used for processing lime in this area and the region is one of the popular areas for the purpose. These marshy lands are completely stagnant and abandoned. On paddy tracts spreading parallel to shore, from south to north such as Kahawa, Illukpitiya, Akurala and near Hikkaduwa digging for limestone is widespread. Now most paddy plots of these particular *yayas* have been ruined, covered with weed and sporadically dug-pits filled with the saline-mixed water. In the Madampe drainage project, mining of coral for building purposes was more remunerative than using the land for paddy cultivation.[9] During mining operations, large amounts of saline water were pumped into paddy areas. This progressively destroyed the entire scheme.

4.3.3 Excavation of earth for bricks, tiles and pottery manufacturing

Earth excavation from paddy fields for manufacturing bricks tiles and potteries is widely observed in the Kiralakele scheme in Matara and the Iranavillu scheme in Chilaw. This is also a profitable industry

known as lime industry. This can be widely seen in Thalagasgoda, Kandamodara, Attudawa areas of Kiralakele scheme and in Mahawewa and Iranavillu track of Iranavillu scheme. Earth digging gradually makes the land low and accommodate more water logging. It makes the land further unfertile too. And it interrupts the tract-wise organisation of farmers adjoining to it.

Chapter Five

ASSESSMENT OF BENEFITS

5.1 Review of Benefits

Intensive paddy farming twice a year was one of the objectives, the project hoped to achieve. It was also envisaged that in the realisation of the project objectives, an overall improvement in the paddy sector would ensue leading to an increase in the household income. However, it is evident that none of the hoped changes have occurred in the six schemes during the last three years.

In the six schemes of the project, the beneficial steps taken for paddy cultivation can be gauged by the type of land features as against poor construction, maintenance and operation of drainage channels, lack of agricultural extension services and institutional support services. Unsatisfactory drainage structures and lack of knowledge of extension are the factors that decide the cultivation or abandonment of the lands altogether (eg., in the Bolgoda scheme hundred hectares of lowest tracts around Bolgoda lake are abandoned altogether). The Appraisal Mission Messrs. Douglass, Myint and Chang had stressed the effect of location on the project benefit; thus:

> "The project area is located in five districts (see map) and includes 5920 acres of land with elevations ranging from 2 to 5 ft. above sea level that would derive primary benefits and would be suitable for dependable double cropping of paddy. The project works would be directed mainly towards this area. However, 7279 acres of land with elevations ranging from 1 to 2 ft. above sea level would derive benefits to a lesser degree due to their low elevations." (Douglass, *et al*, 1969).

The current project situation in connection with paddy cultivation relating to all the six scheme areas of the project could be explained as follows:

1. A considerable proportion of lands of the **lowest paddy tracts** is below 0.91 m. of elevation, probably around 75% (4000 ha of 5340 ha of the project) of the total land extent of the project which are extremely unfavourable for intensive paddy cultivation. Only a small proportion, about one fourth of the project extent on **upper paddy tracts (highland paddy tracts)** above 0.91 M. of elevation, is favourably cultivated with paddy.

2. A majority of the **lowest paddy tracts** (probably 66%), especially the paddy tracts around the main drainage canals and lakes have been abandoned due to waterlogging and saline conditions and therefore, even the traditional local paddy varieties do not thrive there. The extent of these lands probably accounts for half of the total land extent of the project.

3. About one-third of the **lowest paddy tracts** are sporadically cultivated with traditional local varieties although they bear very low yields. It was evident that the average yield from these lowest paddy tracts does not exceed 1000 kg per hectare (inputs and outputs of paddy in details are discussed in sub section 5.2). The constraints to cultivate newly improved varieties on these marshy lands are indicated in the following sub-section of this chapter. The extent of lands cultivated with local paddy varieties is about one fourth of the total paddy lands of the project.

4. The **upper paddy tracts** (highland paddy tracts) are cultivated during the two seasons with newly improved high yielding paddy varieties such as BG and BW and also with old-improved varieties, such as H4, with a considerable degree of success. This type of land gives a good return to the farmers even in the absence of irrigation facilities. The average yield, obtained by farmers of the old improved varieties 2000 kg/ha as against 3150 kg/ha of the newly improved varieties. The total extent of upper paddy

tracts does not exceed 25% of the total project land and is the only land benefitted from the project improvements, in respec of drainage, mainly du to their locatior.

The adoption of new techniques (intensive farming) in paddy cultivation and the use of improved varieties vary according to land types. We would compare the present situation with the pre-project situation. Before the commencement of the Drainage and Reclamation Project, most lands in the lowest marshes (below 0.91 m. of elevation) were lying fallow. Only a small proportion was sporadically cultivated with traditional local varieties, with high incidence of crop damages and very low yields(Balasooriya, 1981). In the lands of higher paddy tracts (above 0.91 m. of elevation *yala* was successfully cultivated with local traditional and old and newly improved varieties, but flooding damaged the crop altogether or partly, once in five years (Douglass *et al* 1969). Double cropping was impossible because the farmers widely used 6 month *Mavi* varieties which successfully resist floods and salt water rather than any other 4½ month traditional local varieties. Except - the use of newly improved varieties (BG and BW varieties) in paddy tracts at high elevations (these lands do not exceed one fourth of the total extent of the project), the situation remains the same, even after the completion of the project.

5.1.1 Use of upper paddy tracts

As paddy cultivation is dependent on rainfall, farmers in the upland paddy tracts fill their lands after the rains with enough water in the plots. The reconditioning and construction of drainage channels under the project created a new set of problems in upland paddy tracts. As soon as the rains are over, water drains immediately to the marshes. This process made the land dry and tilling became difficult with traditional implements. Generally, in wet-zonal drainage projects more than one half of the paddy lands are cultivated on *ande*, tenancy, of which considerable proportion is on rotational tenure (Moore and Wickramasinghe, 1978A). Majority are very small farmers having 0.1 ha - 0.4 ha of upland paddy. They have enough family labour for tilling land. Therefore, use of power tillers or hired animals for land preparation is not economical for these farmers. Even in the use of

draught power, there should be some extent of water level in the plots. The non-existence of irrigation facilities further delays the early undertaking of farming activities for double cropping. According to the majority of farmers, inadequate water supply especially for land preparation in March/April is the major constraint to double cropping. This is mainly due to the absence of irrigation facilities as a result of not taking into account the water problem at the time of designing the project. For double cropping in *yala*, land preparation should be commenced in early March and sown before April and in *maha*, land should be prepared in September and sown before the end of September with 4-4½ month varieties. If, in March, irrigated water is available and released to the fields, farmers can first muddy the land with water, and sow paddy before the heavy rains in April to ensure the seedlings. If *yala* is sown in March, farmers can harvest the crop in mid-July. They can muddy the land in September with monsoon rains, sow paddy for *maha* season and harvest the *maha* crop in February.

The traditional local varieties and old improved varieties need more water and less fertiliser compared to the newly improved varieties. Hence, farmers in the upland paddy tracts prefer traditional varieties to newly improved varieties namely BG 3-5, BG 11-11, BG 34-6, BW 78 and BW 100. The assurance of an adequate water supply for favourable paddy cultivation in this part of the project area is urgently needed, eg. under the assured water supply. Sowing of the NIV, long aged varieties ie. BG 3-5, BG 400-1, and BW 100 and BG 276-5, a short term variety have shown satisfactory results compared to current popular long aged, local varieties (Krushi, 1979). The high yield (in field trials) obtained of BG 3-5 in the upper tracts of reclaimed areas of the Drainage Schemes is over 4125 kg/ha, (80 bushels/acre). One dissatisfactory feature of this variety is that it is susceptible to bronzing, bacterial leaf blight and damages of saline water. Therefore farmers of lower tracts have given up these types of long aged NIV - while the farmers in the upper tracts often suffer from water shortage. (Thenabandu *et al* 1975:126-139).

In consequence of the deepened and enlarged drainage canals, the fertilisers are washed away from these upland paddy tracts and get accumulated in the lowest paddy lands. The farmers who use high yielding

varieties in the upper paddy tracts, usually apply recommended high doses of fertilisers, which proved to be very unprofitable as most of the inputs are washed away. This situation further hinders the realisation of high yielding potential of newly improved paddy varieties.

The problem of iron toxicity in mineral soils is common in both upland and lowland paddy areas of the project (Peiris, F. Paul 1980: 29-30). It was obvious that iron toxicity sporadically damages the paddy crops bringing about low yields. The damages by iron toxicity are still hardly controlled by the farmers. The BG varieties do not resist the iron toxicity or other diseases inherent in the wet zone low lying lands. Short aged NIV ie. BW 272-6 B and 267-3 have been very much encouraging in well-drained upper tracts (Dept. of Agriculture, 1981). In these circumstances a few farmers cultivate traditional and old improved varieties that are palatable, tolerant of flash floods and resistant to diseases and iron toxity in the upland paddy *yayas*, in spite of low yields. It could be concluded that inadequate extension still retards the successful paddy cultivation, even in the upper paddy tracts of the project (Jesuda *et al*, 1976 and Wickramasinghe, 1976).

5.1.2 Use of the lowest paddy tracts

There is considerable resistence to the introduction of improved varieties in the low lying paddy lands of the project area (especially lands below 0.91 m of elevation). Investigations done by the Land Use Division of ID have proved difficulties, associated with managing the principal hydromorphic soils of the low-lying areas of south and south-west coast of Sri Lanka, ie. boggy soils, half boggy soils and different kinds of alluvial soils (Dimantha, 1977:13). In the areas of low lying paddy lands however, ie. in the half bogs and bogs), where flood and salt water inundation cause more problems, attempts have been made to cultivate the improved BG varieties and BW varieties without much success. Under these adverse conditions the BG varieties and BW varieties lost the chance of realising their inherent high yield potential as these varieties to not resist iron toxicity, salinity and do not tolerate flood water. In consequence of the deepened and enlarged drainage channels, the lowest lands became waterlogged due to improper infrastructural management. Though the fertilisers, used on the plots

of upland paddy tracts, are washed away from the plots and get accumulated in the lowest paddy tracts, they do not have any beneficial effect on the latter because of the high incidence of crop damage due to pest and diseases, flood and saline water inundation, and also as a result of the use of traditional varieties.

Due to excessive water logging, large paddy *yayas* in the lowest paddy areas, are more subject to adverse effects from pest and diseases than those of upland paddy areas. Sporadic cultivations of paddy plots cause the spread of pests (Brown Hopper, Gall Midge, Leaf-Rolling caterpillar and paddy bug). According to farmers these pests breed on abandoned, weed-covered and stagnant lowlands around the cultivated paddy plots.

Therefore, when the six schemes of the project are taken as a whole, a general feature, that emerges, is the vast existence of bottlenecks in respect of the introduction of high yielding newly improved paddy varieties. It was evident that three fourth of the cultivated paddy lands are suitable to be farmed only with traditional local varieties. They are *Mavi* 6-7 month, *Deveraddiri* 5½-6 month, *Muhudukiriyal* 4½-5 month, *Sula* 4½-5 month, *Heras* 4½-5 month, *Pokkali* 4½-5 month, *Samba* (two varieties) 4½-5 and 5½-6 month etc. (according to farmers). It means that the yield of paddy relating to three fourths of the paddy lands (due to potential of land type) of the project could hardly exceed 1000 kg per hectare. This is very unsatisfactory when compared to invested resources for the project development.

The local varieties especially 6 months *Mavi* varieties need no chemical fertilisers and crop protection; pest control, weed control and treatment for diseases (Tenabadu, *et al*, 1978). Therefore, the six months traditional varieties could be grown with the least inputs (least cash inputs) especially with their family labour. Farmers usually accept low yields at the least cash input, mainly for subsistence. The high risk and uncertainty inherent in farming these lands does not permit the use of inputs intensively.

5.2 Input-Output Relationship in Paddy Farming

Distinct topography, soil conditions, efficiency of drainage and water availability relating to all six schemes of the project cause different input relationships in paddy cultivation as in other parts of Sri Lanka. The statistics pertaining to input-output relationship of paddy, taking into consideration the location of field, drainage and other variables relating to the entire project areas are presented in Table 1 and 2 of the Appendix 5. Table one deals with the lower paddy tracts while Table two provides statistics on the upper paddy tracts of the project. The following analyses in sub-sections 5.2.1 and 5.2.2 are based on the statistics presented in Appendix I.

5.2.1 Input-output relationship of paddy farming relating to the lowest paddy tracts

Lands formed with boggy and half boggy soils, and below 0.91 m. of elevation are considered as the lowest paddy tracts of the project (Dimantha, 1971). Damages of recurrent flooding and salt water inundation, mainly due to mismanagement of drainage infrastructure, are common to this area. Therefore, only traditional local varieties can be grown with the smallest degree of success. Use of machinery or draught power is impossible because the soils (bogs and half bogs) have no proper soil profile to support such heavy equipment or animals. Weeding during crop growing is also very difficult due to their physical situation. Therefore, almost all farmers in these lands, use traditional local varieties with flood and salt water tolerance, pest disease resistence and excessive growth over the weeds.

Table 5.1 - Cost of production and value of production of paddy in lowest paddy tracts (according to information relating to *yala*, 1980)

Yield in kg per 0.4 ha (1 acre) : 420	
Gross farmgate value of production : Rs. 1200	
Gross farmgate value per 21 kg (1 bushel) : Rs. 60 (per kg Rs. 2.85)	
Labour cost	Rs. 1215
Cost of other inputs	Rs. 560
Total value of inputs	Rs. 1775
Cost of production per 21 kg (1 bushel) (per 1 kg Rs. 4.25)	Rs. 89

Source : Table 1 of Appendix 5.

The experienced average yield as given in Table 5.1 above is 1000 kg per hectare. As the crops of these lowest paddy tracts give very low yields, the cost of production is always higher than the open market price. The open market price of 1 kg (paddy) is around Rs. 2.85. The cost of production of 1 kg (paddy) is around Rs. 4.25. Therefore, farmers of the lowest paddy tracts always look for minimising the value of cost by the least use of inputs, especially cash inputs.

The assessment of profitability or unprofitability of cultivating (own/rented) the paddy lands in these lowest tracts is not easy. Most farmers cultivate their paddy lands when they are free from any other business, ie. trading, hiring out labour, part-time employments in construction works and fishing etc. Some are encouraged to cultivate their lands by village level officers. The farming of marshy lands seems to be very unprofitable compared to value of inputs incurred. The total value of products is equivalent only to Rs. 1200/- if the farm is 0.4 ha (1 acre). If the farmer hired out his family labour (1 man, 1 woman, 1 child) he would gain a higher income than what he could from his farm.

5.2.2 Input-output relationship of paddy farming relating to upper paddy tracts

Lands completely formed with mineral soils (these lands are at an elevation of 0.91 m. above Mean Sea Level), located near and around highlands in between the bottoms of slopes of ridges (these ridges are covered with plantations and homegardens), fall into this land type. In our analysis of this report, we name these lands as upper paddy tracts which mean the higher areas of paddy lands of each scheme. Particularly, flooding and salt water inundation are not the serious problems for these lands, as for the other lowest paddy tracts. Even in this environment, farming practices and the use of inputs widely vary according to the farmer's traditional beliefs, strength of extension, state of physical environment (rainfall, water availability and maintenance of drainage structures etc.).

In the Iranavillu scheme, farmers complain that supplementary irrigation is needed for successful double cropping. Mainly due to

absence of water supply, farmers cultivate their lands with *Mavi* varieties in *maha* season with heavy rains. In this scheme the majority of farmers cultivate traditional local varieties even on lands, which are more favourable (formed with mineral soils and at higher elevations) using with draught power or tractors. For these paddy tracts which are farmed with local varieties as explained in Table 5.1 of the preceding sub-section of this chapter, cost of production per 21 kg (1 bushel) always appears to be more than Rs. 89/-. Even at the maximum use of inputs, local traditional varieties do not give any other beneficial effects on yield, as these varieties do not bear inherent high yielding potential as new improved high yielding paddy varieties.

In the other five schemes of the project, of the farmers who till paddy lands of this type, nearly four fifths use new improved varieties, while a few of them use old improved varieties and traditional local varieties. Fertiliser, herbicides and pesticides are also used, but in insufficient quantities. Soil preparation, and muddyingare done with mammoty and buffaloes.

Under a favourable environment, as seen in these upper paddy tracts of the project, variety and inputs used considerably affect the yield and, the cost of production per bushel as given in Table 5.2 below. With favourable water supply and proper crop protective measures coupled with newly improved high yielding paddy varieties, paddy can be cultivated to gain high benefits(Moore and Wickramasinghe, 1980:86-118). Under such a favourable condition, use of traditional varieties, even at minimum cash inputs is absolutely unprofitable as the yielding potential of traditional varieties is very low (1500 kg per 1 ha) compared to average yield of newly improved varieties (3150 kg per 1 ha).

upper paddy tracts (according to the information relating to *yala*, 1980)

Yield in kg per 0.4 ha (1 acre)	: 1260	
Gross farmgate value of production	: Rs.3600	
Gross farmgate value per 21 kg (1 bushel)	: Rs. 60	(per 1 kg Rs. 2.85)
Labour cost		Rs. 1280
Cost of other inputs		Rs. 845
Total value of inputs		Rs. 2125
Cost of production per 21 kg (1 bushel)		Rs. 35
		(per 1 kg Rs. 1.68)

Source : Table 2 of Appendix 5

As illustrated in Table 5.2 above, the experienced average yield is 3150 kg per hectare. The comparatively high yield from these upper paddy tracts is a direct result of the use of high yielding paddy varieties and chemical fertilizers. As the paddy crop of the upper paddy tracts gives a considerable yield, the cost of production of paddy (per 1 kg Rs. 1.68) is always lower than the open market price of paddy (per 1 kg Rs. 2.85).

Conversely, in the lowest paddy lands under adverse conditions, farmers consider it reasonable to get whatever the yield with the least input. But the situation is different on the upper paddy tracts of the project. The farmer can minimise the cost getting higher yield through the use of intensive farming techniques. It was observed that both new and old improved paddy varieties give high benefits at proper crop protection, rather than with the use of more fertiliser or manure. For instance, the problems of weed, pests and diseases strongly affect the crops. It is generally realised that, weeds have an adverse effect on the yields. They can be controlled easily by increasing the number of ploughings. As we experienced in several schemes of the drainage and reclamation project, ie., Bolgoda scheme, and Bentota R.B. and L.B., schemes, majority of farmers use "Gramaxone" (a kind of weedicide which is used before planting) in order to completely control the growth of weed. In the eyes of many farmers, the use of "Gramaxone" is more profitable than the use of mammoties in the first weeding during the first land preparation.

It is also observed that the optimal plant protection input levels are substantially higher than the existing levels relating to all six

schemes of the project. We experienced the productivity of plant protection to be very high (this is much relevant to the upper paddy tracts of the project). This is exactly due to high sensitivity of paddy crops to pest and diseases. Even on the lowest paddy tracts of the project, where weed and pest diseases seriously damage crops, increasing the use of plant protection (weeding-pest control) at the least fertiliser application, a few innovative farmers add more to the returns. Before the rapid increase in the prices of fertilisers (chemical mixture) and manures (bonemeals), farmers should look for another way to increase returns. In the eyes of more experienced farmers, proper water management and crop protection are more important than the use of high quantities and different doses of fertilisers that have been recommended by the Department of Agriculture.

5.3 Cash Operating Expenses for Paddy Farming

Under the farming practices prevalent over paddy cultivation relating to all six schemes of the project as in the rest of the island, cash production expenses (value of cash input) per unit of land are relatively small. On the other hand, value of cash input varies according to productivity potential of the lands. The average cash outlay per 0.4 ha of paddy cultivated in the lowest paddy lands, where productivity potential is considered low, during *yala* 1980 is around Rs. 1170/- which is less than 90% of the cash operating expenses incurred in productive paddy lands on upland paddy tracts of each scheme. The farmers in the lowest paddy tracts use least inputs and avoid costly inputs such as fertiliser, pesticides, weedicides and machinery. The average cash inputs incurred in the same season on the paddy lands in upper paddy tracts as given in a previous section of this chapter, amount to around Rs. 1315 per 0.4 ha. Therefore, it can be concluded that, lower cash costs imply applications of lower levels of purchased inputs generally associated with traditional farming practices which are prevalent over all these schemes.

Table 5.3 - Cash operating cost per 0.4 ha (1 acre) of paddy classified according to major inputs - *yala*, 1980

Items	Lowest paddy tracts	Upper paddy tracts
Labour wages	52.2	35.0
Buffalo charges	-	22.8
Seed paddy	12.8	11.5
Fertiliser/bonemeal	9.4	16.4
Agro chemicals	14.1	7.5
Other (sprayers & transport)	11.5	6.8
Total	100.00 (Rs. 1170)	100.0 (Rs. 1315)

Source : Table 1 and 2 of the Appendix 5.

In the cultivation of the lowest paddy tracts, wage payments to hired labour form the most important single item of cash cost, which amounts to be more than half the total cash outlay. But in the lands of the upper paddy tracts the labour cost does not exceed 35% of the total cash outlay, because in the land preparation farmers widely use draught animals. Usually, in addition to the draught power, manual labour is used mostly for land preparation. The next item of cash input is the fertiliser application. This does not apply for the lowest paddy lands as farmers of these lands do not use chemical fertilisers at all, but only about 50 kg of bonemeal per 0.4 ha (1 acre).

In the case of farming the lowest paddy tracts farmers use their resources carefully, Under the existing adverse situation in the schemes, they do not look for intensive paddy farming, but only for home consumption. The farmers of the lowest paddy tracts are mostly reluctant to use inputs due to high risks and uncertainties.

5.4 Recovery of Costs of Operation and Maintenance of Drainage Infrastructure

According to our studies on assessment of the results of the Drainage and Reclamation Project, it is a very difficult task to assess the degree of benefits and the repayment capacity of farmers of

all the six schemes of the project. All the lands in each scheme of the project are not benefitted equally (follow Appendices 3 and 5 in order to assess the degree of benefits and to identify the areas of benefits).[10] As we grouped all lands (Appendix 3) only the lands of upper tracts show progress in paddy cultivation in each scheme area. Even in these types of lands all the farmers do not show an equal progress. The degree of benefits widely vary according to the efficiency of drainage and the state of irrigation facilities. Farmers in this category maintain that if there are developed irrigation facilities in addition to the drainage, they could pay a lev around Rs. 100/- (according to the assessment of farmers themselves) per year per ha in order to recover an appropriate share of capital costs as well as operation and maintenance cost (this is equivalent to 2.5% of their anticipated net profit from 1 hectare of paddy land through proposed irrigation improvements).

In the other land type, the lands on the lower paddy tracts of the project, paddy cultivation does not give attractive returns to the farmers (Table 1 of Appendix 5) due to a specific series of constraints against paddy farming in these lower paddy lands as discussed in detail in the previous chapters. The benefitted lands of the project, as given in detail in sub-section 5.1 of this chapter, are very few (not more than 25%) in relation to the total land extent of the project.

Chapter Six

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This section attempts to present the major conclusions on the study with regard to specific constraints affecting paddy cultivation in all the six schemes of the Drainage and Reclamation project. Having based on these conclusions, in the next section of this chapter, certain suggestions and recommendations are made regarding the future policies.

At the beginning of the project, most paddy farmers thought that they were no longer controlled by the vagaries of the monsoon rains and tidal effects, in farming their paddy lands within the project area. The project envisaged that the anticipated benefits would result from the provision of drainage and other facilities to farmers within the project area to increase both their cropped area and per hectare yields of paddy (Appendix 6). But such benefits from the project improvements are not equally distributed among all the six schemes of the project. We have clearly demonstrated tract-wise differences in soil, topography and elevation relating to all six schemes. Improvements and better management of drainage facilities and the control of salt water inundation will have a direct bearing on the yield and cropping intensity. Only the upper paddy tracts which represent a small proportion of the total extent expected to bring under paddy farming are double-cropped and thus bring about comparatively high yields though they are below expected targets. The other land type, the lowest paddy tracts of the project, (lowest marshy lands with boggy and half boggy soils and middle paddy tracts close to drainage channels) are cultivated one season a year with much hardship, bringing low yields

involving high risk. This is characteristic of the pre-project situations. Apparently three fourth of the paddy lands in each scheme fall within this land type.

The degree of constraints on paddy cultivation also vary according to land types. The lowest paddy tracts are plagued with the twin-problems of worsening drainage conditions and persisting salt water intrusion. When all lands, regardless of elevations in the project are taken as a whole, it is evident that, deteriorating drainage condition is one among the many problems faced by the paddy cultivators of the project. In the upper tracts, which are at an elevation above 0.91 m above mean sea level, problems arising from flood, salt water, pest and diseases are not so serious as in the other land type which is lying below 0.91 m of elevation in close proximity with main river courses and major drainage canals. The foremost problem faced by the farmers of the upper paddy tracts is the worsening system of supplying irrigation water. According to the majority of paddy farmers in each scheme, the most serious constraint, affecting paddy cultivation in the upland tracts, appeared to be the lack of adequate and timely water supply.

In the upper paddy tracts located in the project sites, it was observed that the magnitude and duration of excess water and salt water intrusion seem to be lessened considerably, compared with the pre-project situation. This is attributable to the improvements of drainage in the project areas, especially,a direct result of deepening of the canals.[11] Gravity drain quickens the smooth flow of water in contrast to the lowest paddy tracts. In respect of this category of paddy tracts, there should be a proper procedure of maintenance and operation of the drainage infrastructure in order to bring all marshy lands under paddy cultivation. It was evident that the drainage infrastructure development in the lowest paddy tracts of the project did not have any beneficial effects either on the yield or cropping intensity due to unsatisfactory project maintenance. As three fourth of the project are marshy paddy lands, the state of development of these lands will have a great effect on the progress (or benefit) of the project. When the project is taken as a whole, no satisfactory increase in paddy production was recorded in any year or season, over the past three years after the project's completion because irregular and insufficient

management impeded farmers' reaction to improvements in drainage, and did not permit them to recognise the benefits of the scheme.

Regarding drainage, upland paddy tracts ('C' type lands as shown in Appendix 3) do not actually create problems in paddy farming, due to improvements of drainage, especially deepening and enlargement of existing drainage canals (these lands are a very small percentage of the project area). Lands that are + 1.3m, above Mean Sea Level, in the project are also benefitted from the point of view of drainage. Even highlands (cultivated with the crops other than paddy), village compounds and roads are also reclaimed from flash flooding and from long lasting submergence. This has created another problem (due to immediate draining) of water shortage for upland paddy and homestead vegetable farming. Shortcomings and failures in project construction, maintenance and management equally appear throughout all paddy tracts (*yaya*) and all schemes (project sites). Finally, the causes of the unsatisfactory level of development relating to all sites of the project area can be attributed to three factors:-

a) Peculiar environmental hazards inherent in the area;

b) Shortcomings of project involvements such as construction of irrigation and drainage infrastructure (a successful *yala* crop could be harvested in the entire region of the project, except in Iranavillu where only the *maha* crop could be expected, if a satisfactory system of supervision and maintenance was introduced);

c) Inappropriate project co-ordination and institutional arrangements.

In the next section of this chapter some remedies are indicated for future action, (to combat insufficiencies and failures incurred), particularly regarding (b) and (c), for easy identification of potentials for future improvements. Even in the relatively poor agricultural environment relating to lowest paddy lands, which are almost marshes, (relating to all six schemes of the project of the low country wet zone) there exists a great potential for increasing agricultural output and employment through organisation, construction and management. The absence of dialogue between the technically

qualified officers working at village level and the farmers who are knowledgeable of the local conditions has contributed among other reasons, to the absolute failure of the project.

Two other important reasons in the sphere of irrigation and drainage, which are major constraints to successful paddy farming are: (a) adverse effects of flooding and salt water inundation, and (b) improper maintenance of drainage and other infrastructures of the project. Other constraints in the sphere of supportive services are: (a) inappropriate research, agricultural extension, and crop insurance, (b) inefficient input supply at farm level,(c) the non-existence of the improved high yielding paddy varieties with specific resistance to iron toxicity, bronzing and inherent pest damages and tolerant of flood and resistant to saline water (these varieties should be short cycled to facilitate double cropping) and (d) smallest sized majority of holdings and unfavourable tenurial terms.

6.2 Recommendations

6.2.1 Farmer participation

Within the general area of project management and institutional arrangement, farmer participation should be considered as an important element. In order to achieve this participation, proper operation and maintenance of drainage infrastructure, adequate agricultural extension, credit and effective crop insurance should be provided.

6.2.2 Major issues need immediate action

With proper and efficient management, the potential for improvement seems to be high. In the general areas of project management, there are five main issues which need to be considered.

a) A satisfactory system of drainage should be introduced and maintained on the lowest elevations (perhaps in marshy lands below sea level) by the installation of more pumping stations, heightening and strengthening of salt water exclusion bunds, proper maintenance and operation of drainage structures.[12] This would also give beneficial effects on paddy farming in both upper and lower paddy tracts, especially lands at an elevation ranging

from + 0.6 m to + 0.91 m above mean sea level, and in all lands of upper paddy tracts of the project during *maha* season.

b) Assurance of paddy farming in the two seasons by proper management of drainage infrastructure and minor irrigation works (eg. irrigation tank at Madampe in Iranavillu scheme) relating to all land types of the project in each scheme. Lack of proper maintenance of the existing irrigation and drainage infrastructure (minor irrigation works) appears to be the major constraint to successful paddy cultivation in a considerable part (in most areas) of the project.

c) To exploit the potential of the project area, identify and implement the necessary construction and maintenance for drainage, access roads and irrigation facilities. Since there is a seasonal water shortage for paddy cultivation in the upper paddy tracts, measures should be taken to provide a continuous supply of water for paddy farming. The construction of new irrigation works where necessary and rehabilitation of existing ones are urgently needed (eg. Thinipitiya and Mahawewa Tanks which supply water for paddy lands of Iranavillu scheme) in all six schemes of the project.[13]

d) Public co-operation and help at all stages of the plan should be considered. Wider farmer participation should be considered in drainage infrastructural maintenance. "Shramadana" basis organisations at village level could be involved in construction as well as in maintenance involving various activities namely channel cleaning, road construction, damming field anicuts and bunds etc. But as observed, none of these occurs at village level in each scheme of the project at present.

e) Assurance of a continuous supply of suitable seed paddy of new high yielding varieties with specific traits of resistance to iron toxicity, bronzing, pest damages and salt water and floods. And also the provision of adequate supplies of fertilisers, appropriate agro-chemicals and new farming techniques through extension work is equally important.

6.2.3 Work organisation and project co-ordination

The project authority should look into the project co-ordination.[14] The main constraint to better project management is in the sphere of organisation. On one hand, the Irrigation Department personnel at village level lack knowledge of paddy farming and are unaware of the farmers' needs. Farmers' need to sow or plant in time before the floods and to harvest before the next influx of floods and to sow early for the next cropping season be heeded. Different organisations and officials belonging to different Ministries and Departments are involved in paddy farming at project level. There should be coordination among the various agencies and officials involved in implementing the different aspects of the project. On the other hand, farmers' heavy dependance on the state further impedes their timely undertaking of farming activities. As evident in these six schemes of the project, the existing pattern of state involvement in project management, especially in drainage and minor irrigation, has led to a number of adverse consequences such as, inappropriate type of project selection, excessive investment in concrete structures and machinery and the growing dependence of farmers on the Irrigation Department even for relatively small maintenance activities such as cleaning and deepening of canals and repairing bunds etc.

In certain respects, the Cultivation Officer system which has been newly introduced, replacing the Old Cultivation Committee, is more effective in organising farmer activities, supplying inputs at village level than the various organisations which existed earlier. But the problem seems to be the uneven spread of paddy lands in each scheme over a number of command areas of the Agrarian Services Centres and numerous Cultivation Officers' divisions eg. Kiralakele scheme spreads over three Agrarian Services Centres and more than 15 cultivation officers are involved in facilitating paddy farming. Therefore, there should be dialogue and agreement among both officials and farmers in all these village level institutions. This seems to be very difficult, but for successful paddy farming through better management, it is necessary. To overcome this adverse situation, lands and farmers in all schemes should be organised on a common institutional base at scheme level for better management.

6.2.4 Institutional reforms

New remedies, procedures and institutions are required in the following areas. These are to be considered in planning the project management as they are very important requirements.

a) From project selection through planning, construction, maintenance and managing more formal dialogue and consultations among officials, ie. civil engineering staff such as technical assistants and work supervisors, research personnel, extension personnel and officers of agrarian services and farmers,could improve the project quality and management. Farmers can help technically qualified officers with their first hand knowledge of the locality, as observed, in all the six schemes of the project.

b) There should be opportunities for farmers to participate widely in maintaining the minor drainage infrastructure adjoining to their paddy plots. Responsibilities of the maintenance of small channels and bunds belonging to paddy tracts must be entrusted with cultivators of such paddy tracts, as they could organise and involve (tractwise themselves in such improvement activities.

c) For the solution of conflicts and disputes relating to small farmers at project level, it could be accepted that there must be some provision perhaps through simple, cheap and easily available court procedures (Moore and Wickramasinghe, 1978). According to the provisions of the Agrarian Services Act No. 58 of 1979, the Cultivation Officers and Divisional Officers can find solutions at village level and at divisional level for such farmer disputes; they also face much difficulties because most village level farmer disputes are deeply rooted and are mostly related to land ownership and water delivery. In this type of dispute, if an agreement between both parties is impossible, they have to go to a Court of Law which is a very expensive and time consuming procedure for farmers.

d) The project level officials and organisations must be given adequate authority to supervise and organise project maintenance and cultivation activities. Since all the six schemes of the project

fall under major irrigation works, punishments stipulated in the Irrigation Ordinance should be meted out for offences connected with wilful damage to irrigation structures etc. Action should be taken to concentrate at project level the powers derived from these laws for better project management. Project management should have the authority to act against persons, who abandon their paddy lands, without reasonable cause.

e) Land fragmentation is widely observed in all six schemes of the project. The small size of the majority of holdings and unfavourable tenurial terms are the most adverse constraints to the successful paddy farming within the project. Since the landowner does not provide with any input for drainage and reclamation of the land, it is unfair that the tenants generally surrender 1/4 of the produce to the landowner, as these lands are in a specific situation (especially lowest paddy tracts of the project). Fragmentation still continue due to the existing property laws. Remedial measures such as prohibiting fragmentation of paddy lands and the introduction of group farming system in paddy cultivation and the control of the landlords' share of produce should therefore be taken to reduce these adverse effects.

f) The peculiar hazards prevailing in the six areas of the project, call for several improvements of the existing Crop Insurance Scheme. An arrangement with special indemnity payments as an incentive to popularise the use of higher inputs, would be helpful in introducing improved agricultural techniques and agro-inputs. In fact such a crop insurance scheme should form an item of a recommended package of practices. This view has been stressed even by the Irrigation Department in the Completion Report of the project (Irrigation Department, 1979).

g) Taking into consideration the existing hazards (soils, elevation and so on) all paddy tracts should be surveyed and categorised according to elevation, soil, state of flood and salt water inflow and other prevailing constraints in order to identify potentialities for the proper dispensation of agro-inputs. Agrarian Services Centres should

note the above variations and should maintain records in regard to hectarage, number of farmers, quantities and qualities of required agro-inputs relating to the respective paddy tracts.

6.2.5 Research and training

I suggest more detailed agrarian research in respect of farmer behaviour, farmer participation, labour absorption in on-farm and off-farm activities and other socio-economic conditions that hinder the alternative possibilities of resource allocation for paddy farming in these wet zone areas. In the light of these research findings, I suggest that the Project Authorities should undertake training activities at the grass-root level for personnel such as Farmer Leaders, Cultivation Officers and Divisional Officers of the Department of Agrarian Services, village level technocrafts of the Irrigation Department and village level extension officers of the Department of Agriculture.

NOTES

1. It is generally accepted that the lowest marshes in each drainage scheme themselves become problematic when they are developed for paddy cultivation. Drainage projects have a peculiarity, where land elevation drops continuously with time, as boggy soil oxidises (Dimantha, 1977). Settlements of bunds and structures are inevitable if pumping is to be installed, and pump capacities have to be increased with time (Silva, 1977).

2. The ID stressed the importance of authors' findings of the problems of maintenance as follows.

   "The report correctly emphasises inadequate maintenance as one of the causes of the deterioration of the coastal drainage project. This conclusion is justified as necessary maintenance activities were not carried out.

   a) due to lack of funds and

   b) due to lack of necessary personnel following the break-up of the Department into the T C E O and D/M & E which absorbed most of the machinery, nearly all the officers and even office premises" (DI's observation sheet on the report dated 29th November, 1982)

   The ID further stated that a crash programme in 1973 changed the original implementation plan of the project. According to the ID sources, the original proposal approved by IDA was confined to gravity drainage. In order to save the paddy production hit by the recurrent draught, the then-government obtained assistance from foreign countries. One of the areas, where this was tried out, was the coastal drainage area. The proposal was to widen the area of cultivation by introducing pumping and extend the drainage project to lands down to a 1/2' (o.15 m) above mean sea level from the 2 ft (0.61 m), the mean sea level originally envisaged. Accordingly, in 1973 under a crash programme, pumps were installed in all the

drainage projects. These pumps were obtained as a gift from Australia. The pumps were installed on timber foundations as it was a crash programme, to reduce the time of construction and installation. Subsequently, as there was no programme to make them permanent, the timber structures decayed and by 1980, the time of ARTI report, they were unserviceable. The pumps on Nupe canal and Thudawe in Kiralakelle were erected on the top of the concrete regulators, again to reduce cost and for quick installation. Further these were installed on an experimental basis, as there were no facilities for permanent installation without obstructing the gravity sluice. On the other hand farmers as well as rural level officials complained about the mismanagements of tender procedures of constructions followed by the ID during 1972-77. In the eyes of such complainants, the sub-contracts of construction given to unsuitable persons were not done properly as planed by the ID. The Research team could not collect any information strong enough to confirm such complaints, during the field data collection at six sites of the project.

According to author's observations the changes introduced after the original plan are as follows:

a) The new installation of water pumps obtained as a gift from several foreign countries.
b) The original plan was aimed at reclaiming a total of 13,200 acres (5,300 ha) of land. Of this total, 5,920 acres (2,380 ha) of land had elevations ranging from 2.5 ft. (0.61-1.6 m) above sea level and 7,279 acres (2,920 ha) of land had elevations ranging from 1-2 ft. (0.31-0.61 m) above sea level (IDA: 1969 Ceylon Drainage and Reclamation Project, Memeographed pp 3-4).

3. From the viewpoint of the ID officials, even though the canals were cleared by the ID with its own machinary and labour, acquatic weed growth could not be controlled, as the weeds on the tributaries of the drainage canals were not cleared by the farmers (farmers are responsible for clearing all tributaries under the regulations of the Irrigation Ordinance). Thus, when the gates were opened, these weeds entered the cleared drainage lines and flourished giving an

appearance that clearing had not been done anywhere. Conversely, under the existing procedural arrangements (other than provisions or rules of any regulations) in the Six sites of the project, farmers are not responsible for maintaining drainage infrastructures. From the farmers' viewpoint, the duties associated with the maintenance of drainage infrastructure, are in the hands of the ID.

4. The farmers constantly complain of sand bar obstructions at Iranavillu. Formation of sand bar is a countinuous process. Groyne construction cannot stop it. It can only delay such formation. However, to overcome such problems maintenance also should be considered as a continuous process rather than a sporadic effort. But the inadequacy of funds needed for the activities such as keeping the river outfall open throughout the year, by continuous dredging etc., caused the supposed proper maintenance impossible.

5. The less enthusiasm of operating personnel of ID is a reflection of poor understanding of their duties. Since some of watchers and pump-operators were appointed at the behest of the then political authority (during 1974-77), they did not have a sufficient knowledge of the tasks they were entrusted with. Problems do not arise with regard to recruitment of personnel if basic requirements are adhered to. The highest consideration should, however, be given to the training of new recruits to cope with the duties. The neglecting of required training also has contributed much to the rapid decay of the operations and maintenance of these drainage projects.

6. Of the six coastal drainage projects Madampe and Iranavillu had two basic conflicts of interests. In both schemes, the interest in fishery was dominant. The words "Fishery Harbour" inscribed in the tablet set up to mark the inauguration of Iranavillu scheme by the Minister, are also evident of the above interest. In Madampe the lake was used for prawn culture. The Department had not given sufficient weight to this interest when it constructed the single salt water exclusion structure at the sea outfall. This eventually resulted in the interest in fishery opening up the gates during

high tide either by threat, coercion or bribe. It is admitted that if several structures had been constructed on the periphery of the lake, both fishery and agricultural interests would have been catered to satisfactorily. In the context of energy costs, and urban development, conflicting interests of fishery and coral mining have cropped up. Hence the viability these types of project will be questionable (DI - camment sheet on the ARTI report, dated 29th Nov. 1982).

7. Diesel and fuel issues were restricted on account of rising costs and subsequent reduced allocations on maintenance, especially since 1975. (ID 1979 - completion report of the project).

8. Agronomic research, on the contrary was persued at Induruwa coastal drainage area research station which was funded by the ID under the IDA programme (ID completion report of the project, 1979). However, lack of support from the Agricultural Department and inability to appoint officers considerably for a long period led to the neglect of this station (DI - comment sheet on the ARTI report dated 29th November 1982). It could be accepted and considered as one of the failures in project implementation. Presently this Research Station is combined with Bumbuwela Regional Rice Research Station which jointly has launched agronomic research programmes related to water logged lands of the wet zone.

9. A male labourer digs corals worth more than Rs. 100/- per day. The average farm family could earn more than Rs. 3,000/- monthly deploying their labour in processing lime.

10. It is admitted that all the lands in the six schemes will not benefit equally. This disadvantage is inherent in drainage projects where benefits accrue according to the elevation of the land. If drainage infrastructures had been well-maintained and operated, majority of lands under each DARP scheme, which are at lower elevations, could have been cultivated at least once a year with traditional paddy varieties.

11. The terms 'lowest' and 'upper' are used in this report to identify the landscape of the project. The worsening drainage conditions and salt water intrusion could be seen in the lowest paddy tracts where proper maintenance of drainage infrastructures was needed. In case of upper tracts attention should be paid to water supply as well as to drainage. Since, there remain a neglect of irrigation and no thorough attention to the augmentation of drainage canals, farmers suffer from water shortage during lean monsoon rains.

12. The ID has doubts about the recommendations on draining marshy lands to the lowest level. According to the ID this is a dangerous proposal as it will again incur further capital expenditure and lead to a further drop in the ground water table. In such an event there will be a greater clamour for irrigation facilities in the upper tracts. More technical research is needed in this aspect, and proposals, contemplated, should be studied and compared with the technical knowledge gained by other countries in this respect.

13. The irrigation engineers view that providing a continuous supply of water can only be accomplished by installing pumps. This will increase the cost of paddy production, as it is not possible to construct tanks in the areas the projects are located. More technical observations are needed in this aspect. The farmers in the scheme areas, are familiar with the traditional irrigation system, described as *'pitavana system'*. This can be defined as a water delivery system connected to diverting water from the upper part of the river tributories and the paddy lands, using easy local techniques.

14. This report complains of and spotlights the lack of project coordination. The lack of sufficient coordination at the scheme level among the officials of the Ministries and Departments, that are concerned with the project development was prominent in each DLRP scheme. At the time of project construction, there had been a project coordination committee headed by the then Secretary of the Ministry of Irrigation, Power and Highways and another sub-committee of the representatives from the Departments concerned.

REFERENCES

Alles, W.S., *et al* (1972). Some observations on paddy cultivation in the Coastal Drainage Project Areas in relation to experimental work. Mimeographed.

ARTI (1977). Report of the Sub-sectoral Committee on Credit, Insurance, Subsidies and Incentives - Medium Term Plan 1977/81. Mimeographed, 26p.

Arumugam, S.,(1969). Water Resources of Ceylon, Colombo. A Water Resources Board Publication, 415p.

Balasuriya, I.,(1975). Result of field trials in rice, in farmers' fields in Coastal Drainage and Reclamation Schemes, 1971-1974. Proc. Symposium on the Lowlying lands of the low country Wet Zone. Soil Sci.Soc. of Sri Lanka.

Balasuriya, I.,*et al* (1975). Response of the long aged rice variety BG 3-5 (5½-6½ months) and short aged variety, BG 34-8 (3 months) to forms and levels of phosphorous fertiliser in cultivator's fields in the Iranavillu drainage and reclamation scheme. Proc. 31st annual sessions of the Sri Lanka Association for the Advancement of Science, sect. B.

Balasuriya, I., *et al* (1976). The response of improved rice varieties BG 11-11 (4-4½ months) and BG 34-8 (3 months) to phosphorous fertiliser in the Bolgoda and Kiralakelle drainage and reclamation schemes - *yala* 1975. Proc. 32nd annual sessions of the Sri Lanka Association for the Advancement of Science, sect. B.

Balasuriya, I., *et al* (1978). Differencial performance of rice varieties in relation to tract environments in the Kiralakelle drainage and reclamation scheme, results of *yala* season - 1977, Proc. 34th annual sessions of the Sri Lanka Association for the Advancement of Science, sect. B.

Cooray, P.G., (1967). An Introduction to the Geology of Ceylon, Colombo. National Museum of Ceylon Publication, 324p.

Department of Agriculture (1981). Two new rice varieties from Bombuwela, Agricultural Newsletter, BI-monthly publication, No. 2 April, 1981. Mimeographed.

Dimantha, S., (1971). Report on the Soils of the Drainage and Reclamation Project along the West and South-west Coast of Ceylon. Land Use Division, Irrigation Department.

Dimantha, S., (1977). Soils of the low-lying areas of the Weat and South-west Sri Lanka, their properties and management. Tropical Agriculturist, III, cxxx, 15-27.

Dimantha, S. and Jinadasa, L.D., (1981). Land Suitability Evaluation and Land use Study of the Matara District. ARTI, Occasional Publication No. 21, Colombo. 66p.

Douglas, *et al* . (1969). Ceylon Drainage and Reclamation Project: IDA Project I, Mimeographed, 16p.

Harris, John (1977). Problems of Water Management in Hambantota District. Farmer, B.H. (ed) Green Revolution. London: The Macmillan Press Ltd., 364-376.

Inada, K., (1965). Studies of the bronzing diseases of the rice plant in Ceylon-(2) Cases of the occurrence of bronzing. Proc. Crop Science Society. Japan, 33: 315-323.

Irrigation Department (1979). Sri Lanka (Ceylon) Drainage and Reclamation Project - Completion Report (IDA Project-1) Mimeographed, 19p.

Jesuda, S., *et al* (1976). Response of improved rice varieties of different age groups (long, medium, short) to fertilisers in the South-west sector drainage and reclamation schemes, 1974-1975. Proc. 32nd annual sessions of the Sri Lanka Association for the Advancement of Science, Sect. B.

Kariyawasam, Merril (MP for Agalawatta) (1980). IDP for Underdeveloped and Undeveloped Agricultural Lands of the Kalutara District. Agalawatta, Mimeographed, 49p.

"Krushi" (1978). a New High Yielding Rice Variety. in Krushi, a quarterly publication of the Documentation Centre, Department of Agriculture, October 1978, Vol. 1 , No. 2, mimeographed.

"Krushi" (1979). Three New Improved Rice Varieties in Krushi, a quarterly publication of the Documentation Centre, Dept. of Agriculture, July, Vol. 2, No. 1, Mimeographed.

Kumar, P., (1977). Economics of Water Management. New Delhi: Heritage, 117p.

Mervyn, W., and Thenabandu, M.W., (1977). Fertiliser characteristics of soils, nutrition and Physiological problems of rice in the low-lying lands of low country Wet Zone. Field Trials Division, Department of Agriculture, Peradeniya.

Moore, M.P. and Wickramasinghe, G., (1978a). Thattumaru Kattimaru Systems of Land Tenure. Colombo:ARTI, (Research Study Series, No. 26), 52p.

Moore, M.P. and Wickramasinghe, G., (1978b). Managing the Village Environment. Colombo :ARTI, (Occasional Publication, No. 16), 26p.

Moore, M.P. and Wickramasinghe, G., (1980). Agriculture and Society in the Low Country (Sri Lanka). Colombo : ARTI, (Research Study Series No. 37), 176p.

Ota, Y. and Yamada, N., (1962). Physiological Study on Bronzing of Rice Plant in Ceylon - Preliminary Report. Proc. Crop, Science, Soc. Japan, 31: 90-97, 1962.

Oudshoorn, H.M. and Deglopper, R.J., (1969). Ceylon Drainage and Reclamation Project along the Western and South Western Coast. FAO/IBRD Cooperative Programme, Rome: Italy, 67p.

Panabokke, C.R., (1977). Definition, setting and general problems of the low lying lands of the low country Wet Zone. Tropical Agriculturist,Agricultural Journal of Sri Lanka. Vol. cxxxiii, No. 1, January-June, 1977. Department of Agriculture, Sri Lanka, 1-5.

Peiris, F. Paul, (1980). Progress in Rice Breeding at Bombuwela. Krushi, Vol. 2, No. 2. Mimeographed, 29-30.

Ponnamperuma, F.N., *et al* (1955). Physiological diseases of rice attributable to iron toxicity, Nature. 175: 265.

Ponnamperuma, F.N., (1958). Lime as a remedy for physiological diseases of rice associated with excess lime, International Rice Commission News Letter, 7. (1). 10-13.

Ponnamperuma, F.N., (1960). Admin. Report. Director of Agriculture, Ceylon. Page, C. 190.

Program Evaluation Organisation - India (1965). Evaluation of Major Irrigation Projects - Some Case Studies. New Delhi, 256p.

Salby, H.L., (1968). Irrigation Planning for Intensive Cultivation. Bombay: Asian Publication House, 208p.

Sanderatne, Nimal, (1974). Using insurance to reduce risk in peasant agriculture - Guidelines from Sri Lanka's experiences. Development Progress and Planning No. 43, June 1974 of Agricultural Development Council Teaching Forum. New York.

Silva, S.H.C. de, (1977). Engineering Problems of Flood control and drainage in the low lying lands of the Wet Zone in Sri Lanka. Tropical Agriculturist, Agricultural Journal of Sri Lanka. Vol. cxxiii, No. 1, January-June 1977. Department of Agriculture, Sri Lanka, 7-12.

Thenabadu, M.W., *et al* (1975). Response of long aged rice variety BG 3-5 to fertiliser in four coastal drainage and reclamation schemes, Tropical Agriculturist. 131: 126-139.

Thenabadu, M.W., *et al* (1978). Studies on fertiliser response of rice varieties BG 3-5 and *Mawee* at the Iranavillu coastal drainage and reclamation scheme. Tropical Agriculturist. 134: 55-66.

Weerasooriya, N.E., *et al* (1951). Report of the Kandyan Peasantry Commission. Sessional Paper, No. xviii of 1951, Colombo, 529p.

Wickramasinghe, D.L. and Balasooriya, I., (1976). The performance of improved varieties of long, medium, and short aged groups in cultivators' fields of Bolgoda, Bentota left bank and Kiralakele drainage and reclamation schemes - *yala* 1974 *maha* 1974/75. Proc. 32nd Annual Sessions, Sri Lanka Association for the Advancement of Science, Sect. B.

Appendix One

INTERNAL MEMORANDUM OF THE DISCUSSION BETWEEN ARTI AND IRRIGATION DEPARTMENT

27th November, 1980

Yours Ref: 8/3/300

Director/ARTI

Title of the study: Benefit Evaluation of the Drainage and Land Reclamation Project

The discussion, aimed to make clear the purpose and objectives of the proposed study, was held at the Irrigation Department on 25th November, 1980. The following were present:

1. Mr. K.D.P. Perera/Senior Deputy Director (Irrigation)
2. Mr. K. Celvarajah/Senior Deputy Director (Irrigation)
3. Dr. J. Black Michaud/Colombo Plan Consultant, Consultant to the ARTI
4. Dr. H.D. Sumanasekara/Senior Research and Training Officer/ARTI

Mr. Perera informed that after the completion of the construction work of the project, the IDA repeatedly requested that a study be conducted to ascertain the impact of the project on the beneficiaries.
Dr. Black Michaud pointed out, that, in the absence of a baseline study of the project area, it is now difficult to make the proper assessment of the project benefits. He further suggested that the Irrigation Department might write to IDA informing, that due to the above technical difficulties, it was not possible to make a scientific evaluation of the benefits.

In response to this Mr. Perera said that since the Irrigation Department had already written to IDA indicating that ARTI had agreed to undertake a study it might not be proper to indicate now the difficulties of conducting such a study. Mr. Perera suggested an alternative and indicated that without conducting a detailed survey and attempting an indepth study, ARTI could prepare a short study report to reflect the present status of the project beneficiaries using available data supplemented with limited number of field interviews. Such a report may not include specific conclusions of policy implications as such but mainly fulfil, at this late stage, that a study has been done to satisfy IDA needs.

On observing the feasibility of such a study Dr. Black Michaud and myself agreed that we would abandon the previous idea of a detailed study and in its place conduct a small study and prepare a report accordingly.

In view of the above facts, the proposed evaluation plan needs revision and the revised version will be submitted in due course.

Dr. H.D. Sumanasekara
Co-ordinator/Study Team

clc. to: Dr. J. Black Michaud.

Appendix Two

THE REVISED RESEARCH PROPOSAL

Board Paper No:.....

To : The Chairman and the Members of the Board of Governors

From : Mr. D. Tennakoon - R&TO
Dr. J. Black Michaud - Colombo Plan Advisor and Consultant to ARTI

Through the Director - ARTI

Revised Proposal for a Post-Project Evaluation by
ARTI DRAINAGE AND RECLAMATION PROJECT CR 168 CE

Agrarian Research and Training Institute
114, Wijerama Mawatha
Colombo 7.

March 1981.

DRAINAGE AND RECLAMATION PROJECT CR 168 CE

(six sites on the southwest coast between Chilaw and Matara).

Funding agency: International Development Association - World Bank (IDA & WB)

Implementing agency : Irrigation Department.

Revised proposal for a post-project evaluation by ARTI

1. Preamble

The present document is based on information gathered and experience gained in the preparation of two earlier proposals. The first of these contains a certain amount of useful background material that is unnecessary to be reproduced here. This proposal was declined in October 1979 by the Research Committee largely, it would appear, on methodological grounds.

A second more elaborate proposal was accepted by the Committee in August 1980. But when implementation was attempted, those, concerned became aware that the statistics kept by the government departments did not always offer a quality or coverage that could match the sophistication of the investigation designed. Problems encountered in recruiting research consultants of sufficient calibre further delayed the working out of a compromise solution.

In 1979, the Irrigation Department had initially commissioned a piece of socio-economic research to comply with a clause in its own much earlier agreement with the International Development Association. This reads as follows:

> 'A study should be made to review benefits and repayment capacity of farmers with a view to assessing charges which would return to the Government, an appropriate share of capital costs (depending on degree benefitted) as well as operational and maintenance costs from beneficiaries.'+

+ Ceylon Drainage and Reclamation Project, pp ii, 16+8 annexes + 1 map, cyclostyled, no date, no author, p. 13.

Unfortunately, Sri Lanka's research capacity was in the late '60s not geared to this kind of demand and it was therefore not possible at that time to carry out a regular baseline survey with a view to permitting a later comparative evaluation of the project's impact. The difficulties experienced by the ARTI team in designing an appropriate framework for the *ex post facto* evaluation requested, are closely related to the absence of adequate socio-economic data for the peripd prior to and during the time the six drainage and reclamation schemes were constructed.

In November 1980 a meeting was arranged between ARTI and two Deputy Directors of the Irrigation Department to discuss what could be done in the circumstances. Messrs. K. Chelvarajah and K.D.P. Perera accepted the research team's proposition that:

> '... without conducting a detailed survey and attempting an indepth study, ARTI could prepare a short study report to reflect the present status of the project beneficiaries using available data supplemented with a limited number of field interviews.' (Internal memorandum dated 27th November 1980 to the Director of ARTI from Dr. H.D. Sumanasekera - ref. 8/3/300).

It was thought that such a report would satisfy the terms of the Department's agreement with IDA.

2. Issues

Preliminary investigations in the field have suggested that in all six schemes:

i. paddy fields have remained far lower than anticipated;
ii. there is considerable resistance to the introduction of improved varieties;
iii. double cropping is hardly practised;
iv. large tracts of asweddumized land have been abandoned;
v. highland cultivation offers better returns to labour than does paddy production;

vi. off-farm activities are the source of the greater proportion of most farmers' income.

It is hypothesized that this state of affairs is determined by:

i. design defects in civil engineering works;
ii. inadequate standards of construction;
iii. irregular and insufficient maintenance (bunds, sluices, pumps, engines, channel clearance);
iv. an insufficient network of service roads for the delivery of bulky inputs and the removal of paddy;
v. inappropriate types of crop insurance;
vi. sporadic availability of agro-chemicals and fertiliser;
vii. an exceedingly low ratio of extension workers to farmers;
viii. the inexistence of short cycle paddy varieties suited to water logged and saline conditions;
ix. the small size of a majority of holdings and unfavourable tenurial terms.

The team proposes to investigate all these issues with a view to:

i. assessing the present state of farmer motivation on the recl. imed land;
ii. identifying institutional, economic and technical obstacles to an increase in paddy production;
iii. discussing the potential for improvement.

3. Methodology

Cursory field trips have already demonstrated that:

i. there exist no reliable data on yields in the schemes;
ii. the precise extent of areas originally scheduled for reclamation is not always known(eg. Iranavillu);
iii. the acreage cropped or abandoned in any given year has not been recorded;
iv. the ownership of *yayas* and the identity of tenants is difficult to establish with accuracy;
v. farmers in the schemes often also crop asweddumized land elsewhere.

In these circumstances a statistical approach is quite out of ~~the~~ question. The team proposes instead to base its investigation upon a series of in-depth interviews with, on the one hand, the field personnel of all government departments concerned and, on the other, with farmers actually tilling or merely holding title to land on the six schemes.

Such methods are not new and have been used in a similar context with success in Kenya, by Prof. D.W. Norman in Nigeria and by the Agricultural Research Station situated at Malkerns in Swaziland. The rationale behind them is that totally random sampling has been shown in small-scale schemes to be expensive and to produce considerably less revealing results than the sensitive analysis of specific cases selected to represent in each instance a 'typical' cluster of circumstances.

Approximately three to four days will be spent by both researchers in each of the scheme areas. Particular attention will be paid to an inspection of the physical state of the drainage infrastructure. Subsequent interviews will attempt to establish the link between specific weaknesses in this infrastructure and farmers' performance. Farmers will be encouraged to explain their successes and failures in terms of water availability, induced drought conditions, flooding, salinity, the adequacy of varieties proposed, the accessibility of inputs, and so on. Irrigation Department personnel, Agrarian Services Department Cultivation Officers and KVSs will also be interviewed as a corrective to the picture which emerges from these farm level conversations.

4. Analysis

Analysis of the results and writing-up will take some five weeks.

5. Research team personnel

The following research staff will handle the study:

i. D. Tennakoon - Research and Training Officer, ARTI

ii. J. Black Michaud - Colombo Plan Advisor and Consultant to ARTI

Mr. Tennakoon will act as Coordinator of the study.

6. Tentative Schedule of Activities

Activities	Duration (Months)					
	1981					
	0	1	2	3	4	5
i. Field work			------			
ii. Analysis				----		
iii. Report writing					---	

* * * * *

D. Tennakoon/ARTI
Research and Training Officer
Coordinator of the Project
Colomb, 25th, February, 1981.

Appendix Three

MAJOR LAND TYPES OF THE PROJECT

In order to have an effective benefit assessment according to the land types (taking into consideration land characteristics, ie. elevation, slopes, soils, drainage etc.), the paddy lands relating to all the six schemes of the project can be easily classified into three types according to their location with respect to the watershed as follows:

	Type of Land	Land Class	Location
A	Lower paddy tracts with marshes *(hala kumburu)*+	IV and VI (boggy soils)	In close proximity with main rivers and lagoons with elevation from 0.3 m to 0.61 m above MSL. By far the most serious problems for these lands are excess water and salt water.
B	Lower paddy tracts with semi marshes +	III and V (mineral soils and half boggy soils)	These lands are located in close proximity with highlands near marshes and far behind the rivers and lagoons, in the upper part of lower lying paddy tracts next to marshes. In these lands problems from excess water are not effective as compared to the problems from salt water. This type of land also varies with elevation from 0.61 m to 0.91 m above MSL.

C	Upper paddy tracts *(goda kumburu)*++	I and III (mineral soils and half boggy soils).	These lands are located widely in the valleys between two ridges (village compounds) around highlands. These lands are above 0.91 m above MSL and successfully cultivated in *yala* and *maha* seasons. (*maha* is risky)

MSL = Mean Sea Level
Land Classes= For details of land classification of the project, see Irrigation Dept., (1979): Page 9 of Annex 5.

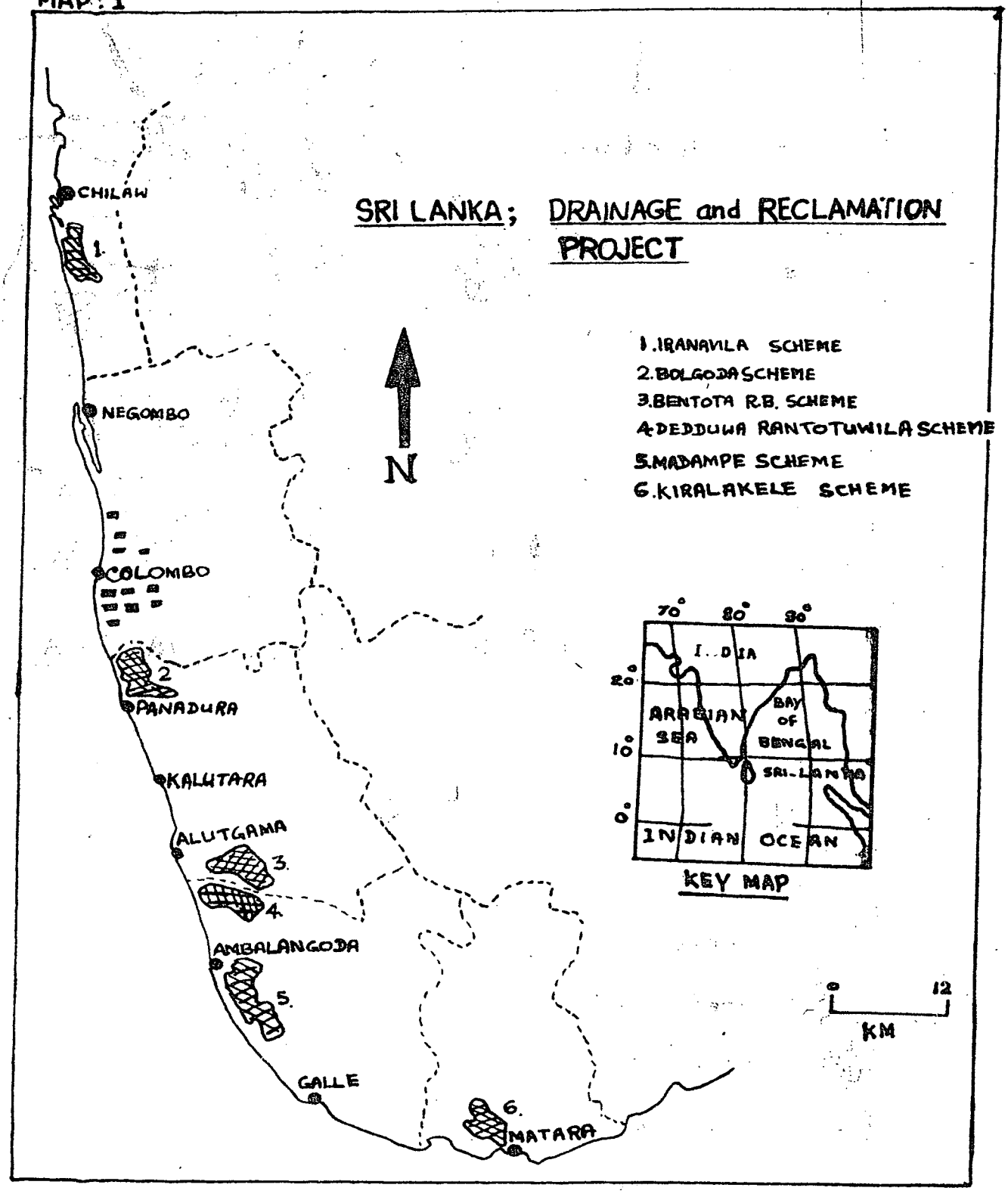
+ *hala kumburu* is very deeply sinking, formed with bogs and half bogs with no proper soil profile, submerged and fully covered with aquatic weeds.

++*goda kumburu* is paddy plots near highlands and between ridges at the botton of the valleys formed with mineral soils mixed with gleyic alluvials. Land preparation in these lands can be done by using tractors or draught animals.

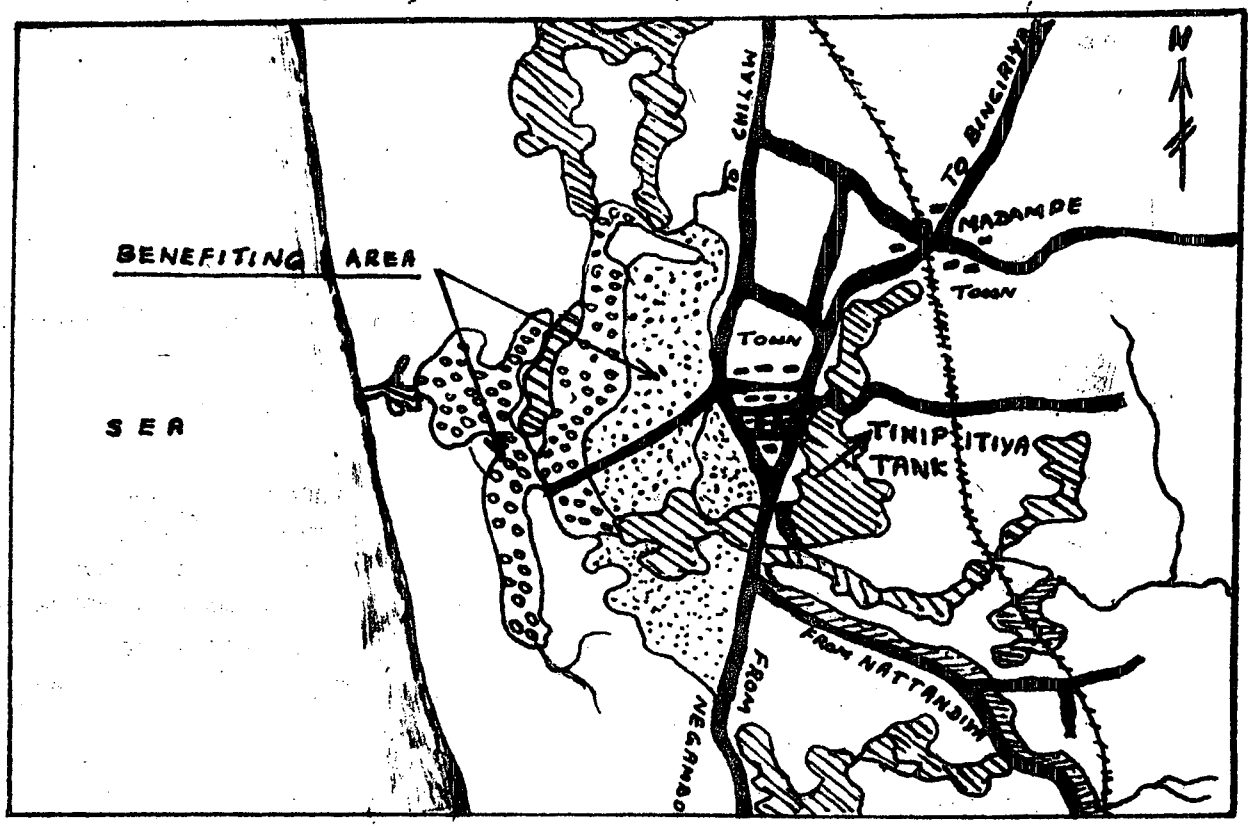
Actual land area and sown extent relating to these land types are not available. The situation of paddy cultivation relating to each scheme of the project greatly varies mainly due to inefficient drainage. It was observed that "A" type lands are almost abandoned while a half of "B" type lands are sown. In "B" type lands, all sown plots are cropped in *yala*, but in *maha* hardly cropped. In "C" type lands, all are sown and cropped in *yala* but in *maha* they are sown and partly cropped.

APPENDIX : 4

MAP : 1



MAP: 2 A GENERAL SKETCH OF PHYSICAL LAY-OUT OF A DRAINAGE SCHEME IN UPPER WEST COAST OF THE INTERMEDIATE ZONE.



TOPO INSET SHOWING IRRANNAVILLA SCHEME

0 ½ 1 2 KM

ROAD

RAILWAY ROAD

STREAMS

WATER SPREAD AREA

UPPER PADDY TRACTS

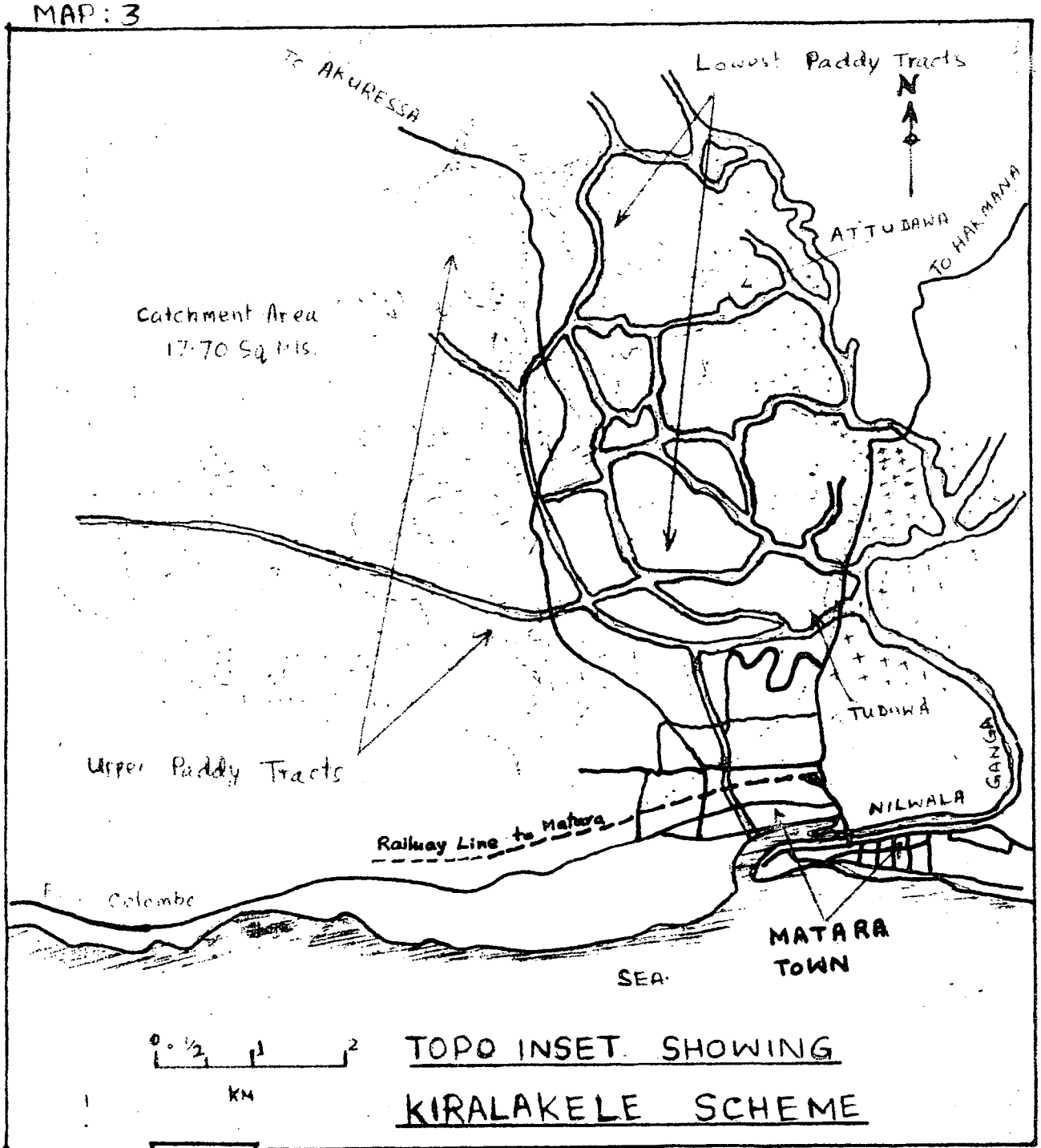
LOWEST PADDY TRACTS

HIGH LANDS

SOURCE: IRRIGATION DEPARTMENT

A GENERAL SKECH OF PHYSICAL LAY-OUT OF A DRAINAGE SCHEME IN THE SOUTH-WEST COAST, WET-ZONE

MAP : 3



SOURCE : IRRIGATION DEPARTMENT

Table 1 – INPUT OUTPUT ANALYSIS - PADDY CULTIVATION, PER 0.4 HECTARE (ONE ACRE) (in lowest paddy tracts below 0.91 m of elevation)

INPUT Activities	(1) Family labour used (mandays)		(2) Value of family labour used	(3) Hired labour used (mandays)		(4) Value of hired labour used	(5) Value of meals consumed by hired labour	(6) Other costs (seeds, fertiliser, and chemicals)		(7) Charges for animals, machinery, equipment & sprayers	
	M	F	Rs.	M	F	Rs.	Rs.		Rs.		Rs.
Herbicide application before land preparation	1	-	-	-	-	-	-	Crama-zone	-	Spra-yer	-
1st land preparation	3	-	- 75	5	-	- 125	- 50	-	-	-	-
2nd land preparation	-	-	- -	-	-	- -	- -	-	-	-	-
Mudding, levelling and broadcasting	3	-	- 75	5	-	- 125	- 50	seeds	150	-	-
Transplanting	-	-	- -	-	-	- -	- -	-	-	-	-
Fertiliser application	2	-	- 50	-	-	- -	- -	Bonemeal	110	-	-
Weeding	-	-	- -	-	-	- -	- -	-	-	-	-
Pesticide application	1	-	- 25	-	-	- -	- -	Pesti-cide	90	Sprayer	45
Water control	5	-	- 125	-	-	- -	- -	-	-	-	-
Harvesting	2	4	- 90	-	4	- 80	- 40	-	-	-	-
Threshing	3	-	- 75	4	-	- 100	- 40	-	-	-	-
Winnowing	-	2	- 40	-	-	- -	- -	-	-	-	-
Transport	1	-	- 25	-	-	- -	- -	-	-	Cart	45
Total :	21	6	- 605	14	4	- 430	- 180	-	425		135

Note : Based on the data relating to *yala*, 1980.

Abstract

Yield in kg per 0.4 ha	: 420		
Family labour used		Total value Rs. 605	Total cash input Rs. 1170
Hired labour used (with expenses of meals)		Total value Rs. 610	Total value of input Rs. 1775
Other costs (seeds & chemicals)		Total value Rs. 425	Gross farmgate value of production Rs. 1200
Charges for animals, machinery-equipment and sprayers		Total value Rs. 135	Cost of production per 21 kg(1 bushel) Rs. 89
			Cash input per 21 kg (1 bushel) Rs. 58

Appendix Five

Table 2 - **INPUT OUTPUT ANALYSIS - PADDY CULTIVATION; PER 0.4 HECTARE (ONE ACRE) (in higher paddy tracts above 0.91 m of elevation)**

INPUT	(1) Family labour used (mandays)		(2) Value of family labour used	(3) Hired labour used (mandays)		(4) Value of hired labour used	(5) Value of meals consumed by hired labour	(6) Other costs (seeds, fertiliser, and chemicals)		(7) Charges for animals, machinery, equipment & sprayers	
Activities	M	F	Rs.	M	F	Rs.	Rs.		Rs.		Rs.
Herbicide application before land preparation	-	-	- -	-	-	- -	- -	-	-	-	-
1st land preparation	3	-	- 90	-	-	- -	- -	-	-	animals	90
2nd land preparation	2	-	- 60	-	-	- -	- -	-	-	animals	60
Mudding, levelling and broadcasting	2	2	- 100	4	-	- 120	- 40	Seeds	150	animals	30
Transplanting	-	-	- -	-	-	- -	- -	-	-		-
Fertiliser application	4	-	- 120	-	-	- -	- -	Fertiliser	215		-
Weeding	-	-	- -	-	-	- -	- -	-	-		-
Pesticide application	-	-	- -	-	-	- -	- -	Pesticide	90	Sprayers	45
Water Control	8	-	- 240	-	-	- -	- -	-	-		-
Harvesting	2	2	- 100	-	5	- 100	- 50	-	-		-
Threshing	2	-	- 60	4	-	- 120	- 40	-	-	animals	120
Winnowing	-	2	- 40	-	-	- -	- -	-	-		-
Transport	-	-	- -	-	-	- -	- -	-	-	cart	45
Total	23	6	- 810	8	5	- 340	- 130	-	455		390

Note : Based on the data relating to *yala*, 1980.

Abstract

Yield in kg per 0.4 ha : 1260

Family labour used	Total value Rs. 810	Total cash input Rs. 1315
Hired labour used (with expenses of meals)	Total value Rs. 470	Total value of input Rs. 2125
Other costs (seeds & chemicals)	Total value Rs. 455	Gross farmgate value of production Rs. 3600
Charges for animals, machinery-equipment & sprayers	Total value Rs. 390	Cost of production per 21 kg(1 bushel) Rs. 35
		Cash input per 21 kg (1 bushel) Rs. 22

YIELD TARGETS - Acreage, Yields and Production "with" and "without" Project

	Without Project			With Project			Increment		
(a)	*Maha*	*Yala*	Total	*Maha*	*Yala*	Total	*Maha*	*Yala*	Total
ACREAGE - Lands									
Above 3'	3,103	3,103	6,206	3,423	3,423	6,846	320	320	640
Between 3'-2'	2,100	2,100	4,200	2,501	2,501	5,002	401	401	802
Between 2'-1'	-	4,445	4,445	7,279	7,279	14,558	7,279	2,834	10,113
Total cropped acreage	5,203	9,648	14,851	13,203	13,203	26,406	8,000	3,555	11,555
YIELDS - Lands				(bushels/acre)					
Above 3' (b)	36.0	36.0	-	72.0	72.0	-	36.0	36.0	-
Between 3'-2' (c)	21.0	21.0	-	72.0	72.0	-	51.0	51.0	-
Between 2'-1' (d)	-	18.0	-	21.0	21.0	-	21.0	3.0	-
PRODUCTION - Lands				(in '000 bushels)					
Above 3'	111.7	111.7	223.4	246.5	246.5	493.0	134.8	134.8	269.6
Between 3'-2'	44.1	44.1	88.2	180.1	180.1	360.2	136.0	136.0	272.0
Between 2'-1'	-	80.0	80.0	152.9	152.9	305.8	152.9	72.9	225.8
Total production in '000 bushels/paddy	155.8	235.8	391.6	579.5	579.5	1,159.0	423.7	343.7	767.4
PRODUCTION EQUIVALENT IN TERMS OF									
Paddy	3.3	4.9	8.2	12.1	12.1	24.2	8.8	7.2	16.0
Rice	2.3	3.3	5.6	8.3	8.2	16.5	5.9	4.9	10.9

(a) *Maha* is season of North-east monsoon October to March; *yala* is season of South-west monsoon April to September.

(b) Changing from existing improved varieties to newly improved varieties with increased use of fertilisers, pesticides and weedicides.

(c) Changing from (native) 4-1/2 month varieties to newly improved varieties and use of inputs as (a) above.

(d) Changing from single crop (native) 5-1/2 month varieties to double crop (native 4-1/2 month varieties. Deatils are given in Annex 2.

(e) Of this total increment 41% is attributable to increase in crop area and 59% is increase in yields. Both of these increases are a result of the project.

Source : Douglas *et al* (1969) Ceylon Drainage and Reclamation Project, Memeographed, P. Annex 6.