KURUNEGALA INTEGRATED RURAL DEVELOPMENT PROJECT:

EVALUATION OF THE IRRIGATION AND WATER MANAGEMENT COMPONENT (Phase II)

Research Study No. 74 September 1986

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

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FOREWORD

Kurunegala integrated rural development project appraisal identified several factors inhibiting agricultural production in the project area. Inefficient use of rain and irrigation water, inequitable distribution of water within existing irrigation schemes and poor maintenance of the irrigation systems are some of them. In order to improve this situation, the project adopted rehabilitation of irrigation works, supply of inputs including credit for paddy and a new model for water management. This model advocated a strategy of advancing the task of paddy planting in Maha with the first rains (dry-sowing), which will result in conserving sufficient tank water for Yala cultivation (Walagambahu model)

This study which is a part of the Kurunegala IRD evaluation programme of the ARTI, examines the validity of the assumptions behind the adoption of Walagambahuwa model, i.e. poor water management as a factor responsible for inefficient and inequitable distribution of tank water and Chena as a factor impeding paddy production. It is assumed that the farmers' involvement in Chena will be reduced through the double cultivation of paddy that could emerge by the adoption of this model. The study findings reveal that basic assumptions are faulty and that the Walagambahuwa model is not adopted by the farmers as expected.

Since activity cycle of Chena is geared to the slack times in paddy operations Chena cultivation generally do not clash with paddy in the use of land and labour resources. In fact it helps to reduce seasonal underemployment. Cash received in the sale of short-term Chena produce helps the farmers to tide over cash shortages in the paddy cultivation operations. The study indicates rainfall as a major factor to negate the benefits of dry-sowing.

The study does not find significant water distribution inefficiencies in the use of water, under existing tank based paddy cultivation but the study sees in the mud-sowing of paddy and in the Chena/paddy combination substantial inefficiencies in resources allocation, given the resource constraints which farmers face.

This study was undertaken by Miss M.L.Malalgoda and Dr.Nelson Vithanage, Research and Training Officers of the Institute. Dr. Vithanage was involved during the preliminary stages of the study and the final report is the outcome of the effort of Miss M.L.Malalgoda.

The study has raised a number of important issues which would be of interest to the policy makers as well as the implementing agencies both national and foreign. Therefore, I hope that this report would be a useful document at policy planning level when similar projects are formulated in the future.

Finally I wish to extend my appreciations and thanks to all those who made this study and publication possible.

T.B.Subasinghe
Director
Agrarian Research & Training Institute

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M.L.M.

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INTRODUCTION

1.1 Background

At the World Bank annual meeting in Manila in 1976, discussions were held between the Government of Sri Lanka (GOSL) officials and World Bank staff, concerning the possibility of obtaining World Bank support for a development project in Sri Lanka. Two missions were subsequently sent by the World Bank and based on an analysis carried out by the Development Planning Unit of the Ministry of Planning and Economic Affairs, the Kurunegala District was selected for the proposed project for the following reasons :

(a) the district is relatively densely populated;

(b) the productive potential of the district is highly relative to current levels of output and to the potential of many other areas in Sri Lanka;

(c) the district includes portions of the three major climatic zones of Sri Lanka and thus project components designed for it would have applicability throughout the country;

(d) income levels and other socio-economic indicators for the district approximate to mean levels in Sri Lanka; and,

(e) the district has received relatively little attention in terms of Government budgetary allocations over the past decade.

Separate reports were being prepared on each of the individual project component (12) by the line ministries with a core team of specialists from the Ministry of Finance and Planning. The project for the Kurunegala District was the first attempt by Sri Lanka to develop an entire district in an integrated manner.

1.2 Kurunegala Intergrated District Development Programme

GOSL is encouraging decentralization of planning, monitoring and co-ordination to encourage grassroot participation and to reduce implementation problems, at the field level. To give an operational content to the decentralization programmes, the GOSL has proposed a number of Integrated District Development Programmes (IRDP). The district projects are to emphasize low-cost, quick-yielding, labour-intensive investments, aimed at better utilization of the existing potential by relaxing critical bottlenecks and constraints. The main advantages of the district projects would be :

(a) increased responsiveness of developmental efforts to local needs and priorities;

(b) promotion of balanced regional development by enabling resources to be channeled into non-Mahaweli areas, and;

(c) an opportunity for balancing high capital intensity and long-gestation of most other development programmes of GOSL.

Kurunegala District Integrated Rural Development Project (KIRDP) is the first such project launched in Sri Lanka. It aims to evolve a replicable model of regional development for the island, for raising productivity, employment, incomes and living standards of the rural population in Sri Lanka. The main assumption underlying the project approach is that the existing economic and social infrastructure in Sri Lanka is substantially underutilized and prospects exist for a rapid and significant improvement through strengthening by modest but critical complementary investments in physical infrastructure. The KIRDP include twelve (12) different components and the overall implementation was scheduled from 1979-83 with a total investment of Rs. 465 million at 1979 price levels.

The project covers the entire administrative district of Kurunegala, one of the 25 districts in Sri Lanka. The district located in the western part of the country, has a land area of about 1,850 sq. miles and an estimated population of 1.21 million in 1981. Kurunegala is the third largest district in the country, accounting for about seven percent of the total area and 8.16 percent of the population. The district is predominantly rural and according to 1981 population census, 96.4 percent of the population was rural compared to about 78.5 percent nationally.

The project area is characterised with slight variations in temperatures but heavy, variable rainfall. The north-east monsoon (Maha season) brings rainfall to the whole district during October-January and the south-west monsoon (Yala season) brings rainfall mostly to the southern part during March-June. On the basis of precipitation, the district can be divided into four distinct zones; dry, semi-dry, semi-wet and wet zones with mean annual rainfall of below 60, 60-75, 75-90 and over 90 inches respectively. The dry zone, intermediate zone (semi-dry and semi-wet), and wet zone covers about 20, 70 and 10 percent of the district respectively.

About half of the total land area of some 1.2 million acres in the project area is covered by the permanent cultivation. About 380,000 acres, 170,000 acres, 100,000 acres are covered by coconut, paddy and Chena (slash and burn) crops respectively. Most of the coconut and rubber land is in the southern part of the district, with a wet/semi-wet climate; paddy land is distributed fairly evenly in the district, while Chena cultivation is mostly practiced in the less-densely populated northern part with a dry/semi-dry climate.

Of the total of 170,000 acres of asweddumized paddy land in the district about 16 percent is fed by nine major tanks (reservoirs which serve an area of between 100-1000 acres). There are 62 medium tanks (service area of between 100-1000 acres) providing irrigation to approximately 9700 acres. There are 3000 village tanks (service area is less than 100 acres) serving 64,100 acres and 572 village anicuts serving 14,180 acres in the district. Hence, the importance of effective use of existing irrigation schemes in the district is obvious. These tanks have non-perennial streams with catchments entirely within the project area.

1.3 Irrigation and Water Management Project Component

The rehabilitation of existing irrigation schemes accompanied by improved water management, is financially the biggest component, in the Kurunegala IRD Project (27 percent of the total project cost). Irrigation and Water Management is in fact the basis of other components of the project on which increased productivity, employment and living standards depend. The other components are extension, credit and agricultural input supplies, the expenditure of which amounts to 34 percent of the total project cost.

Based on data collected by the Cultivation Committees, the average cropping intensities in the major tanks and minor tanks command areas were only 1.31 and 1.15 during the period 1972-1977. During the same period the average yields of paddy per acre in Maha have ranged from 57 to 67 and 26 to 51 bushels on major and minor schemes respectively. The average yields per acre in Yala on major and minor tanks over the same period were ranged from 41 to 52 and 34 to 41 bushels respectively. In general, mono-crop paddy cultivation is practiced on major and minor schemes.

According to the Kurunegala IRD appraisal report, two main problems which limit agricultural production under irrigation schemes in the project area are :

(a) inefficient use of rainfall water and a wasteful use of stored water, and
(b) inequitable water distribution within the irrigation schemes.

Appraisal report points out that, a contributory reason for inefficient use of rainfall is the priority given to Chena cultivation. Continuous flooding of paddy fields, staggered cultivation, and continuous flow of water through the channels have been considered, as the reasons for wasteful use of stored water and inequitable water distribution within the irrigation schemes.

The Kurunegala IRD project aims to increase the irrigated area under cultivation, through rehabilitation and/or improvement of the existing irrigation schemes, along with better water management practices.

Once the physical rehabilitation work is done, the project intends to adopt a system of controlled use of water, as a complementary input primarily for preventing crop losses and achieving higher cropping intensities in Maha and Yala. For this purpose, the project has adopted the Walagambahuwa model, developed at the Mahailluppallama (MI) research Station, on which a brief description is given below.

Walagambahuwa Model

Concept of this model is based on advancing the date of paddy planting to mid October, with the outset of Maha rains and on using of 3-3½ months paddy varieties, in order to mature the Maha rice crop with minimum amount of water from the tank as supplementary irrigation. By adopting this model it is expected that adequate water will be left in the tank, for a rice crop in the following Yala season, or for other short termed food crops like chillie, green gram, cowpea, soya bean, vegetables etc.

This model, which has been successfully practiced at MI Research Station, was first adopted on a larger scale in the Kurunegala district in Maha season 1978/79. Along with the Walagambahuwa model, in order to introduce better water management practices under the rehabilitated tanks, certain agronomic and institutional changes are suggested by the project, which are as follows :

(a) short duration improved varieties will be grown in a manner similar to upland crops, i.e. intermittent irrigation rather than continuous flooding (dry sowing of the crop)

(b) the seed bed for the entire service area of irrigation schemes, will be prepared within a short time, preferably a significant portion of it while dry or following the first monsoon rains. This will decrease the demands on tank storage, for pre-irrigation, to soften the soil and emphasize advancing of cropping calendars.

(c) firm dates for the irrigation seasons will be established. The objective will be to compress the crop cycles over the whole area in a shorter span of time than the present 6 to 7 months (staggered cultivation is to be avoided).

(d) water distribution will be through a strictly enforced rotational delivery schedule.

(e) mobilisation of group action, through education and training, with greater reliance on rainfall for Maha cultivation conserving tank water for the Yala.

1.4 Goals Expected by the Water Management Programme

The project aims to bring all major irrigation schemes, as well as the selected 500 (330 according to revised estimates) village irrigation schemes in the district, under improved management.

The ultimate goals of the Water Management Programme were increased paddy yields and increased cropping intensities. Estimated figures for both, yields and cropping intensities, are given below.

Table 1.1 Present and Future Paddy Yields and Cropping Intensities

	Major Irrigation Schemes			Minor Irrigation Schemes		
	P	$\bar{W}$	W	P	$\bar{W}$	W
Average Yield (bu/ac.) (Maha)	65	68	75	46	50	57
Cropping intensity (Maha)	92	95	95	87	90	95

P - present

$\bar{W}$ - future without project

W - future with project

* Source - Project Appraisal Report

It is expected, that, improvements made by tank rehabilitation and water management programme, will have the most important impact, bringing the above predicted increments, in paddy yields and cropping intensities while, other project components such as agricultural credit, extension input supplies also make respective contribution to incremental productivity.

1.5 Study Objectives

This study intends to examine whether,

(a) Chena cultivation would impede the development of paddy cultivation

(b) poor water management of farmers would alone be responsible for the wasteful use of stored water and inequitable water distribution

(c) the proposed agronomic and institutional changes would increase the availability of water for Yala eason, yields and cropping intensities.

The present study is divided into two sections, i.e. major irrigation schemes and minor irrigation schemes, to examine the effectiveness of proposed agronomic and institutional changes, in terms of the productivity of paddy lands, incomes and the factors that influence their successful adoption. This study will serve as a part of the evaluation exercise of the Kurunegala IRD project, and will also, assist the project management by formulating remedial measures.

1.6 Research Method

Study Localities

Rehabilitation of irrigation works under the project commenced in 1979, and at the end of 1981 there were four major tanks and 105 village irrigation schemes, where at least 50 percent of the rehabilitation work has been completed. These tanks, and those which are closest to the rehabilitated tanks, but not under the project's programme, were the study localities. To distinguish the effects of irrigation and water management, from the other components of the Kurunegala IRD project, the selection of study localities and tanks were based on the irrigation factor as follows :

(I) irrigated areas receiving assistance other than improvements to irrigation (not rehabilitated tanks - NR*)

(II) irrigated areas receiving improved irrigation facilities, plus other assistance (tanks rehabilitated under KIRDP - R)

(III) irrigated areas practicing water management programme implemented by the KIRDP and receiving other assistance (tanks rehabilitated and practising water management programme under KIRDP - R + WM)

1.7 Sampling Procedures

A stratified random sampling procedure was adopted, in selecting the sample. In the first stage of sampling of village tanks the district was divided into dry zone, semi-dry zone, and semi-wet zone, so as to examine certain features of relevance to the availability of water. Non-rehabilitated tanks were not studied in the semi-wet zone due to lack of representative

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* The three categories of tanks will be referred as NR, R, R+WM and major tanks as MT in future.

minor tanks. Thirty five farmers under five minor tanks were randomly selected for each category of the three areas discussed in the proceeding section (Table 1.2). As there are only nine major tanks, all these were grouped together. Two major tanks and thirty five farmers under these two tanks were randomly selected, for each category of the latter two areas, as shown in Table 1.2.

Table 1.2 Distribution of the Sample

	Major	Village Tank			
		Dry Zone	Semi Dry Zone	Semi Wet Zone	Total
(1) a. come under IRDProject	9	na	na	na	330
b. rehabilitated by March 1982*		30	80	65	175
(2) No. in the sample					
a. irrigated areas receiving assistance other than improvement to irrigation (NR)		3 (35)	7 (35)	-	10 (70)
b. irrigated areas receiving improved irrigation facilities plus other assistance (R)	2 (35)	3 (35)	7 (35)	5 (35)	15 (105)
c. irrigated areas practicing improved water management and receiving improved irrigation facilities plus other assistance (R+WM)	2 (35)	3 (35)	7 (35)	5 (35)	15 (35)

Note : na - not available, number of farmers selected are in parentheses.

* Based on data given by the Irrigation Department, Kurunegala.

Thirty five farmers (assuming 10 percent drop out rate) were selected from each category, to have a meaningful analysis.

b. Data Requirements, Method of Data Collection and Sources of Data

The study objectives will be realised through :

1. monitoring farmers' response to the irrigation and water management component, in terms of the principal agronomic changes envisaged.
2. identifying and analysing the socio-economic factors, contributing or constraining successful adoption of improved practises.
3. studying the improvements of the irrigation systems, in terms of their adequacy, to fulfil the agricultural needs of farming areas,
4. estimating the value of change in output induced by the project.

Documentary sources of data, i.e. monitoring information submitted by implementing agencies, minutes of meetings, research papers etc., were used to collect basic information on tanks. Supplementary data on tanks, were gathered through the cultivation officers of the respective areas, with the aid of a structured questionnaire.

A questionnaire survey was conducted at the end of 1982/83 Maha season to collect information of farming activities, farmers' problems, employment, incomes and consumption. Specific data collected were :

A. Project Output

Project Component	Project's Goals	Indicator	Sources
Rehabilitation of Irrigation tanks	Area irrigated	Paddy acreage under major and minor tank schemes	Project office data (POD) and Farm Surveys (FS) for each category of work
		a. asweddumized acreage	
		b. harvested acreage	
		c. cropped acreage by season	

Project Component	Project's goals	Indicator	Sources
	Productivity	Crop Yields	POD & FS
Water Management	Area irrigated and cropping intensity	a. asweddumised acreage	POD & FS
		b. harvested acreage (in Maha and Yala)	
	Productivity cropping pattern	Crop yields Area under paddy vs other crops Yala season	

B. Project Effects	Project's goals	Indicator	Sources
- Rehabilitation of irrigation tanks and water management	Increase in income	a. crop yields, area, prices, cost of inputs	FS
		b. Non-farm income	
		c. Marginal propensity to save and consumption pattern	

C. Guidance for Project Office

Component	Project's goals	Indicator	Source
Rehabilitation of irrigation tanks	Timing of cultivation	Constraints and contributing factors	FS and discussions with officials
and			
Water Management	Cultivation of short duration varieties		
	Dry sowing		
	Rotational delivery		
	Adoption of other improved farming practices		

1.8 Limitations of the Study

Difficulties were encountered in formulating the sample frame of tanks, on account of inadequacy of necessary information. Only a certain number of the totality of tanks scheduled for rehabilitation had been completed. How-ever, in formulating the sample, anticipating a continuous progress of re-habilitation work in the district, the entirety of tanks so scheduled were considered, in the sampling frame.

The study also did not go into the intrinsic qualities of the Chena systems-involving the edaphic influences agronomic, tenurial and other aspects of Chena cycles - since Chena - paddy relationships, and on the implementation dynamics of the Walagambahuwa model, would necessitate a separate and a detailed analysis. While being cognizant of the above, the objective of this study - a mid-project assessment of the tank rehabilitation programme under the KIRD project - did not warrent such an analysis to be undertaken at this point.

A more meaningful analysis of cropping intensities and yields would have been possible, if data on both the Maha and Yala seasons, were included in analysis. But, limited time and other resources, did not allow extension of the survey to the Yala season.

Chapter Two

LAND USE AND CROPPING PATTERNS

2.1 The Problem

According to the appraisal report* and the preliminary report**, there are several factors constraining the effective use of existing and proposed irrigation facilities, in the project area. These include, inadequate maintenance, poor water management practises, insufficient and delayed provisions on farm inputs, a largely ineffective extension system, and lack of accesss to institutional credit. The irrigation component of the project is aimed at overcoming the first two of these constraints.

These reports state, that, practices such as :

(a) delayed and/ or staggered planting (b) poor utilization of rainfall in paddy fields (c) poor land preparation (d) Widespread use of broadcast seeding, as opposed to transplanting (e) the substitution of water, for labour and capital, (in the form of weedicides and pesticides) for the control of weeds and pests and, (f) the use of inappropriate varieties of seed paddy, leads to ineffective water use.

Because of inadequate farm power for land preparation and the priority given to Chena cultivation, Maha sowing is often extended into late January, thus wasting most of the rainfall. Only when the Chena crops are secured, do the farmers transfer attention to paddy lands, resulting indelayed Maha planting and consequent waste of rainfall (World Bank, 1979, pp 10-11). The common underlying factor for such results, seem to be, the traditional way of paddy farming, which farmers have been practicing for generations. Taking into

* World Bank (1979) Sri Lanka, Staff Appraisal Report, Kurunegala Rural Development Project (March 8, 1979). South Asia Project Dept. Agriculture Division A. Washington.

** Barker,J.S. and Seneviratne, J.M.D. (1978). Kurunegala Rural Development Project. Report on the Irrigation and Water Management Components (mimeo).

consideration prevailing conditions in the district, to overcome the above problems, following major recommendations regarding paddy cultivation, has been made by the project.

2.2 Recommendations Made by the Project under the Water Management Programme

(a) shifting of cropping calendar to get the full benefit from rainfall,

(b) growing of short durated improved varieties in a manner similar to upland crops, i.e. intermittent irrigation rather than continuous flooding (dry sowing of the crop),

(c) using of accompanying measures, such as, fertilizer and agro-chemicals to new high yielding varieties, in order to increase yields

(d) tractorization of land preparation, in order to complete the operation within a short time.

It is expected that, implementation of above measures will save sufficient amount of water, to cultivate following Yala season, and as a result, both the cropping intensities and yields will be increased.

The basis of this new approach in paddy cultivation, is the advancement of cropping calendar, on which depend, the successful implementation of all the other sub-components of the programme. Also, it can be noted, that, these recommendations are interconnected.

2.3 Land Use Patterns in the Study Area

Land under agriculture in the study area is utilized in several ways. Following categories of land use can be observed in the study area.

1. paddy lands
2. Chena lands
3. home gardens
4. other highlands

Majority of the paddy lands are cultivated under minor irrigation schemes, while the rest is being cultivated under major irrigation schemes, or under rainfed conditions. Even under major irrigation schemes total available paddy area is not irrigated (Table 2.1). During the Maha season paddy is the exclusive crop cultivated in the lowlands. During the Yala season, in certain parts of the district where substantial amount of water for a paddy crop is not received, crops other than paddy, such as vegetable crops, are also being cultivated in lowlands. Both seasons of pdddy cultivation

Table 2.1 Land Use Patterns in the Study Area

	Dry Zone* (D)					Semi-dry Zone(SD)					Semi-Wet Zone SW)		
	NR	R	R+WM	Major	Total	NR	R	R+WM	Major	Total	R	R+WM	Total
1. Average size of available paddy holding (acres)	1.43	1.78	1.41	2.41	1.67	1.42	1.64	1.10	1.98	1.55	1.23	1.14	1.18
2. Percentage of paddy area cultivated under irrigation	39.52	95.0	44.14	97.5	70.0	100.0	99.3	86.3	88.3	93.5	94.3	78.9	86.4
3. Average size of chena holding (acres)	1.ol	1.38	1.66	0.53	1.40	0.68	0.88	0.27	-	0.45	0.04	-	0.02
4. Average size of other highland holding (acres)	1.43	1.94	1.84	2.47	1.85	1.o3	2.65	1.92	1.26	1.76	3.0	1.28	2.12

* The three agro-climatic zones will be refered as D, SD and SW in future

can be recognized towards the wetter parts of the district, and in the lowlands under major irrigation schemes.

Chena is the slash and burn system of cultivation. This system of cultivation has both satisfactory and unsatisfactory features. On the one hand, land is used inefficiently, and crops are not grown systamatically, while on the other hand Chena cultivation requires only a very low capital cost, and avoid risk in most cases. Chena forms, an important element in the system of agriculture, in the dry zone part of the district.Table 2.4 shows, that, more than 97 percent of farmers under the minor tanks of dry zone part of the district have cultivated Chena. Most common Chena crops are chillies, green gram, maize, cow-pea etc.

Both in highlands and in home gardens crops cultivated vary according to the agro-clomatic regions. These lands are unirrigated and seasonal differences show, hardly any changes in the crops cultivated.

Average sizes of holdings vary accordingly with the climatic zones. Dry zone shows the highest average sizes for both paddy and Chena lands. Average extent of Chena operated shows a significant difference between dry, semi-dry and semi-wet zones(Table 2.1). Also it is observed, that, when the farmers under the four different categories of tanks are compared, major tank category cultivate less acreage of Chena. Size of Chena cultivated by a farmer, seem to have a negative ralationship, with the assurance of water supply for a successful paddy crop.

2.4 Cropping Calendar

Introduction

Advancing of cropping calendar to get full benefit from rainfall is identified, as the main contributor to the water saving strategy of the Walagambahuwa model. By starting paddy cultivation with onset of Maha rains, instead of waiting for the tank to fill, crop can mature with rainfall partly, thus, requiring tank storage only for supplementary irrigation. Water saved in the tank would permit the cultivation of the following Yala season.

Current Practice

The farmer attitudes towards the date of cultivation, are intimately linked up with the availability of an adequate water supply, for a successful paddy crop. Consequently, the evolved system of cultivation, tends to prescribe the initiation of paddy operations, when the tank is full or "nearly full". This survey considers:

(1) the preference given to Chena involvements vis-a-vis the involvement in paddy and,
(2) the risk factor involved in getting an adequate water supply for a successful paddy crop, (as likely determinents of the particular cultivation dates adopted by farmers).

At the base, both agro-ecological and economic consideration, underlie the above determinents, as also, the decisions taken by farmers. Chena as a system of cultivation uses a minimum of labour, financial inputs and is essentially rainfed. In its pure form, it is considered in certain writings, (Bosemp : 1965; Geertz: 1966 Leach:1968) to be in complete harmony with the physical enviroment and the socio-economic setting of resident population. As an important element in the system of agriculture prevailing in the dry zone part of the Kurunegala district, the above relationship is linked up with three factors :

(a) relative availability of forest land for Chena cultivation in the dry zone part of the district.
(b) exploitation of first Maha rains to sow Chena crops, while tanks get filled.
(c) anticipating paddy crop failure, a consequent dependence upon a supplementary income source - a phenomenon quite common in the dry zone part of the district.

In semi-dry and semi-wet parts of the district a less number of farmers cultivate Chena (Dry zone - 81 percent; semi-dry zone 27 percent; semi-wet zone 7 percent). The acreage under Chena is also less compared with the "dry" parts of the district. Out of the total Chena area cultivated in the sample, seventy percent is done by dry zone farmers, while semi-dry and semi-wet zone farmers do only 30 and 0.7 percent respectively. In the former areas of the district, Chena is considered as a supplementary source of cash income, in addition to paddy; in the later "dry zone" parts, and with paddy crop failures, *Chena* may be the only source of income. Even within the dry zone part of the district, in locations where water supply for paddy is more assured, the situation seem to be different regarding *Chena* cultivation. This can be clearly seen in major schemes both in dry and semi-dry parts of the district. For both *Maha* and *Yala* seasons, *Chena* practice is less when compared with the situation under minor tanks (Table 2.4).

We conclude therefore, that, preference for *Chena* is guided more by a tendency among farmers to settle for strategies dealing with economic uncertainties generated by hazardous environemental conditions, with resources available to them, than, by a profit motive, *per se*, guided by relative factor and product prices.

At the end of the *Yala* season small tanks are almost dried up and these get filled only with *Maha* rains, which begin in September. An assurance of an adequate water supply for a successful crop, prior to the initiation of paddy cultivation operations, is a *sine qua non* consideration among the farmers, as the risk in terms of capital expenditure is high in case of a paddy crop failure. Farmers consider, that without a reliable water supply, it is a waste to apply labour and other resources to a paddy crop. This seems quite logical however, when the resource limitations faced by small farmers are taken into consideration. The cultivation dates of the paddy crop in the study area indicated in Table 2.2 reveals that, the project's attempt to advance the date of cultivation had not received popular acceptance by farmers. In 82/83 *Maha* season, by end of October, more than 50 percent of the farmers planted the paddy crop in semi-wet zone; by mid-November in semi-dry zone; and by end of December in the dry zone. These time periods coincide with the times, that tanks are full or nearly full. It is therefore obvious, that the cropping calendar varies in accordance with the agro-climatic conditions of the district, the crucial factor being the water availability on which the date of cultivation depends.

A comparison of land preparation dates that occurred in *Maha* 79/80 (pre-project situation) and *Maha* 82/83 shows a significant difference. A chisquare analysis ($X^2 = 58$) identified a significant difference between the land preparation dates of two *Maha* seasons, with *Maha* 82/83 land preparaton occurring much later than *Maha* 79/80 (See Table 2.3).

Table 2.2 Cultivation Dates of the Paddy Crop in the Study Area (Maha 1982/83)

<table>
<tr><th></th><th colspan="4">Sept.</th><th colspan="4">Oct.</th><th colspan="4">Nov.</th><th colspan="4">Dec.</th><th colspan="4">Jan.</th><th colspan="4">Feb.</th><th colspan="4">March</th><th colspan="4">April</th></tr>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>50% of the farmers planted paddy crop by date</td><td colspan="32"></td></tr>
<tr><td>SW / R</td><td colspan="2"></td><td>x</td><td colspan="29"></td></tr>
<tr><td>R+WM</td><td></td><td>x</td><td colspan="30"></td></tr>
<tr><td>* Monthly rainfall for the semi-wet zone (m.m.)</td><td colspan="4">36.6</td><td colspan="4">537.8</td><td colspan="4">542.7</td><td colspan="4">148.5</td><td colspan="4">1.0</td><td colspan="4">17.0</td><td colspan="4">1.2</td><td colspan="4">72.0</td></tr>
<tr><td>SD / NR</td><td colspan="11"></td><td>x</td><td colspan="20"></td></tr>
<tr><td>R+WM</td><td colspan="11"></td><td>x</td><td colspan="20"></td></tr>
<tr><td>M</td><td colspan="6"></td><td>x</td><td colspan="25"></td></tr>
<tr><td>Montly rainfall for the semi-dry zone (m.m.)</td><td colspan="4">29.4</td><td colspan="4">357.9</td><td colspan="4">381.7</td><td colspan="4">149.0</td><td colspan="4">0.1</td><td colspan="4">0.00</td><td colspan="4">0.00</td><td colspan="4">32.2</td></tr>
<tr><td>D / NR</td><td colspan="14"></td><td>x</td><td colspan="17"></td></tr>
<tr><td>R</td><td colspan="14"></td><td>x</td><td colspan="17"></td></tr>
<tr><td>R+WM</td><td colspan="11"></td><td>x</td><td colspan="20"></td></tr>
<tr><td>M</td><td colspan="12"></td><td>x</td><td colspan="19"></td></tr>
<tr><td>Monthly rainfall for the dry zone (m.m)</td><td colspan="4">42.0</td><td colspan="4">265.5</td><td colspan="4">243.3</td><td colspan="4">145.9</td><td colspan="4">5.7</td><td colspan="4">0.00</td><td colspan="4">0.00</td><td colspan="4">74.3</td></tr>
</table>

* Sources - Dept. of Meteorology

Semi wet zone - Location - Kurunegala
Semi dry zone - Location - Wariapola
Dry zone - Location - Mahailluppallama

When the suggestions are made to change an existing cropping system, it is necessary to analyse factors which contribute to such a system. From the farmers perspective, current farming practices are the best they can afford within given circumstances. Their major concern is to avoid risks of paddy crop failures. However, it is felt that, this vital fact is not given due consideration in the Walagambahuwa model, and as our data reveals, this is the major reason for opposing the adoption of the said model by farmers.

With water as the key factor influencing decisions on the data of cultivation, it is felt that to advance the date - in other words, to change the traditional farmer attitude, as the project expects, a mere introduction of the Walagambahuwa model is not a sufficient condition. Survey revealed that most farmers were unaware of the nature of the Walagambahuwa model, as how it operated, and, how it would save water for the Yala season. In areas where the Walagambahuwa model is applicable, the study considers that, a practical demonstration of the model and training seasion through the extension service, may have a reasonable effect in a wider adoption of the programme.

Table 2.3 Commencement of Land Preparation

Month	Number of Farmers Starting Land Preparation		
	79/80 Maha *	82/83 Maha	Total
July - August	31 (16.1) **	1 (0.4)	32 (7.3)
September	40 (20.7)	35 (14.4)	75 (17.2)
October	91 (47.1)	122 (50.4)	213 (48.9)
November-January	31 (16)	84 (34.7)	115 (26.4)
T o t a l	193	242	435

Source - * an analysis of the pre-project situation
Chisquare = 58

Table 2.4 Involvement of Farmers in Different Cultivation Patterns

Percentage of farmers	Major tanks		Minor tanks					
	SD	D	SD			D		
			NR	R	R+WM	NR	R	R+WM
1. Paddy cultivation (Maha)	97.2	94.1	71.4	71.0	90.9	45.1	37.1	55.8
2. Paddy cultivation (Yala)	55.5	100.0	46.4	42.0	81.8	0.0	11.4	0.0
3. Chena cultivation	36.1	23.5	53.5	55.2	36.3	100.0	97.1	100.0

Table 2.5 Average Income from Chena - Rs. (82/83 Maha)

Degree of Water Availability for Paddy Cultivation	Agro-climatic Zone			Total
	D	SD	SW	
R+WM	2750	270	20	1000
R	2460	1140	28	1230
NR	1930	1200	-	1660
M	570	130	-	270
Total	2130	660	25	1060

2.5 Possible Clashes in Chena - Paddy Relationship

As the apprasial report points out, one of the major reasons for delayed paddy cultivation, is preference given to Chena cultivation. Where traditional three fold (paddy, Chena, other highlands) or two-fold (paddy, Chena) land use pattern is being practised, certain elements may be uppermost in deciding the competitive standing of the different cropping systems, important to the direction of allocation of limited resources.

A possible factor which may clash between paddy and Chena cultivation is in the allocation of the labour. The paddy cultivator engaged in Chena has to divide his labour and that of his family, and his cash resources, between the two systems. The question which arises, therefore, is whether such a division, has any adverse effects on paddy cultivation.

In tank based paddy cultivation, as mentioned before farmers suspend initial paddy operations until tanks receive sufficient water. Tanks in the dry zone take several months to fill up - usually from October to about mid December. Meanwhile, farmers take on to Chena to plant crops taking advantage of first Maha rains. In Chena these initial rains of the Maha season are enough for germination purposes. When the tanks have adequate water, heavy work in Chena is over and farmers then begin with paddy operations. As operations do not overlap, it is clear that there may not be a clash in labour allocation between Chena and paddy.

Apart from the above, it is also relevant to consider the Chena-paddy relationship at depth, not only because of the changes that have taken place within the Chena system over the past years*, but also because that, paddy cultivation had been subjected to technological changes and had become more intensive in response to such changes, as also, in response to enlarging subsistence demands and the relative factor - food products considerations.

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* With the change from long cycle to short cycle of Chena under a condition of static technology less labour is necessary for land preparation etc. over the time land availability/man ratio has declined and consequently labour application is comparatively less than would be the case of technological change accompanying the Chena cycle change.

Our survey reveals that, more often, for Chena operations only family labour is used. By contrast, in paddy, exchange (attam) labour as well as hired labour is used to supplement family labour, when peak labour demand conditions associated with specific operations need to be completed within a specific period of time - and cannot be completed by family labour alone. Farmers have expressed an opinion, that, sufficient labour can be found to do paddy operations in time, if tank water is made available and cultivation operations could be conducted without interruption.

Consequently, as in Chena, so also in paddy, inadequacy of stored water supplies and therefore a dependence upon an uncertain rainfall for crop cultivation, pushes the farmers towards maximising the use of family labour as a least cost strategy in labour use. However, the dictates of intensification, use of HYV technology, an adherence to a cropping calendar subsistence pressure and so on, exerts contrary pressure towards seeking higher yields, extra lbour and more stable water supplies.

In the study area, usage of rain water for paddy cultivation is minimal, while an almost total dependency on tank water storage for paddy cultivation throughout the study area appears to be the norm. In contrast, rainfall is the only source of water for Chena cultivation and therefore, dry zone farmers tend to make a maximum use of rainfall for Chena operations, leaving paddy operations until a substantial amount of water fill is realised in the tank. Consequently, the situation in the study area indicates that as far as farmers are concerned it is not a question of giving preference to Chena cultivation, but it is the best way farmers can allocate their resources under the given circumstances.

Minimization of the risk of the paddy crop failures due to unreliability of rainfall, underlie the most decisions taken by farmers. Therefore, water availability for a successful paddy crop is the key factor, in deciding the date of paddy cultivation.

Survey results confirm, that, even in semi-dry and semi-wet zone parts of the the district, where Chena is not being practised intensively, paddy cultivation has not been started with first Maha rains as expected by the project (Table 2.4). It is therefore reasoned, that, if an adequate water supply is assured, Chena would not impede paddy cultivation.

Chapter Three

ADOPTION OF RECOMMENDED PRACTICES

3.1 Introduction

As already indicated, under the Water Management Programme, several practises regarding paddy cultivation, has been recommended by the project. This Chapter examines farmers response to these principal agronomic changes envisaged, after three years time the project has been started.

3.2 Dry Sowing of the Paddy Crop

Dry sowing as means of harnessing rain water is generally recommended for areas where irrigation is not assured. Traditional farmer attitude, towards dry sowing, seem to be based upon certain technical problems involved with this practise. These are mainly : (a) the erratic nature of rainfall, and (b) heavy weed-growth. Dry Sowing involves ploughing and broadcast sowing, in anticipation Maha rains. Following the Walagambahuwa model, the KIRD project has recommended dry sowing for the district. Though the practicability of dry sowing had been demonstrated at Mahailluppallama, as an experimental model, and on two operating projects in Sri Lanka, the information gathered during the survey reveals that, only a few farmers practised it in the study area. The two major technical problems mentioned above were quoted by farmers, as hindering the adoption of dry sowing, as a practical method of optimising the available water resources. (The farmer response to the dry sowing in the study area is indicated in Table 3.1).

The highly erratic nature of rainfall in the dry zone part of the district often result in crop failures. This is the major reason for farmers to oppose dry sowing. Gunawardena(1981) states "in the case of larger tanks (with command area of more than 20 acres), with a relatively more assured crop, farmers' prefer to mud-sow even if somewhat late, as higher returns could be expected from a mud-sown crop compared to a dry-sown crop under present levels of management.

Apart from this, recent research findings at the Mahailuppallama Research station show that, in dry sown fields, the amount of weeds per unit area has increased while their composition also has changed weeds line Echinocolia, Ischeamum and Cypras which are difficult to control thrive well in these fields. Our survey data analysis indicate that, across the rehabilitation variable, there is no significant difference between the supporting/opposing dry sowing, while the recommendation for dry sowing is significantly sensitive to climatic conditions. (Pl. refer to the Tables No. 1,2 given in the annex No. 3). Under experimental conditions at Mahailuppallama, where water table is relatively high, cultivating paddy in a manner similar to upland crops may show good results, yet on the basis of our findings it appears that under the field conditions this is not so.

Apart from above, problems involved with land preparation under dry condition also contribute to poor practise of dry sowing. Our field experience suggests, that ploughing in order to do dry sowing require tractors, as land could be very hard after a long fallow period. Inadequate access to tractors during peak period of land preparation and limited cash resources to hire tractors, do not promote ploughing under dry conditions.

No positive acceptance was observed on dry sowing of the crop throughout the study area. A recommendation like dry sowing may be accepted positively in certain agro-climatic zones, such as the semi-wet sone part of the district under a more reliable rainfall; but as our observations reveal, that, it is not practicable to generalise this recommendation for the entire district.

Table 3.1 Farmers Attitudes Towards Dry Sowing in the Study Area

	D				SD				SW	
Percentage of farmers	NR	R	R+WM	MT	NR	R	R+WM	M	R	R+WM
1. Factors hindering the adoption of dry sowing										
a) erratic rainfall	100	100	100	100	39.2	52.6	15.2	8.3	26.4	11.1
b) difficulties involved in weed control	0	0	0	0	10.7	22.2	54.5	22.2	47.0	61.1
2. Preferred dry sowing	0	0	0	0	7.	2.7	0	2.7	17.6	8.3
3. Percentage of dry sown acreage	0	0	0	0	0	1.6	3.6	0	7.6	12.9

3.3 Short Duration Varieties

Use of short duration improved paddy varieties is suggested by the project, in support of advancing of cropping calendars, and minimizing usage of tank storage. Almost all the farmers in the study area, have responded positively to the recommendation on growing short duration high yielding varieties. 97 percent of farmers used new improved or combination of new improved and old improved paddy varieties, irrespective of the different agro-climatic zones (Table 3.2). Also, there is no significant difference between different tank categories in adoption of new high yielding varieties. The most commonly practiced in the study area are Batalagoda rice varieties, i.e. BG 90-2, BG 11-11, BG 400-1, BG 34-8 etc. These varieties are more sensitive to moisture stress, than the traditional avarieties so that, the argument converges on a need for a reliable and adequate water supply if the high yielding varieties are to be grown. This indicates that, if dry sowing is to be practiced relying on Maha rains, these new high yielding varieties may not prove suitable. In practice, farmers wait until mid-Maha for the tanks to be filled, to a level adequate enough to ensure full irrigation. They always cultivate short duration varieties which use water more effeciently,and in consequence gross production for the irrigation system as a whole, could be higher than with early dry sowing.

Table 3.2 Usage of Paddy Varieties in the Study Area

Percentage of Farmers	R+WM	R	NR	M	Total
1. Used new improved varieties	90.6	94.5	100	78.4	97.1
2. Used old improved varieties	3.4	2.7	0	3.9	2.8
3. Used combination of new and old improved varieties	5.8	2.7	0	17.6	6.5

3.4 Use of Fertilizer

The projects recommendation to grow new high yielding varieties has to be linked up with application of necessary dosages of fertilizer, as these varieties demand higher requirement of nutrients.

In the study area, usage of fertilizer is a common practise. Basal mixture at land preparation and two top dressings are being applied, though not up to recommended levels. Information regarding fertilizer application given in Table 3.3 and Tables 3 and 4 in Annex 3.

Our analysis show that, there is a significant difference in application of both basal mixture and top dressings, between the agro-climatic regions. To the wetter parts of the district tendency to apply fertilizer seem to be more. Apart from this, according to the degree of rehabilitation, major tanks show the highest level of fertilizer application (see Table 4 Annex 3). Even in the dry zone part of the district, where application levels are lowest, major schemes show a comparatively high level of application. These survey results again confirm the fact, that, farmer decisions on resource allocation, are made on the basis of minimisation of risk of crop failures, due to unreliability of water supply. More reliable and adequate water supply would have promoted more cash inputs for fertilizer.

Table 3.3 Usage of Fertilizer and other Agro-chemicals in the Study Area

	D				SD				SW	
	NR	R	R+WM	M	NR	R	R+WM	M	R	R+WM
1. Percentage of farmers used chemical fertilizer										
a) at land preparation	3.0	0	5.8	70.5	64.2	71.0	81.8	97.2	88.2	77.7
b) at tillering	38.7	12.5	14.7	76.4	64.2	71.0	81.8	97.2	82.3	86.1
c) at panical stage	41.9	43.7	5.8	41.1	64.2	13.1	78.7	97.2	41.1	97.2
2. Percentage of farmers applied recommended dose of basal mixture	0	0	100	66.6	72.2	18.5	55.5	42.8	23.3	39.2
3. Percentage of farmers used chemical weedicides	32.2	28.1	76.4	38.2	17.8	26.3	24.2	33.3	47.0	30.5
4. Percentage of farmers used pesticides	45.1	37.1	94.1	58.8	35.7	63.1	57.5	36.1	76.4	61.1

Regarding recommended levels of fertilizer, there are two important factors.

a) farmers perceive fertilizer as a costly item,

b) most of them do not know what the recommended levels of fertilizer are.

According to survey data only 32 percent of farmers applied as much or more than 66 percent of the amount of fertilizer recommended. Lack of sufficient cash is the most probable reason for this : The average amount of fertilizer applied per acre was 54.8 kgs of basic paddy mixture and 37.6 kgs. of urea (66.8 percent of the fertilizer recommendation).

3.5 Application of other Agro-chemicals

With adoption of new high yielding varieties,weed and pest control emerges to be important prpblems; increased use of fertilizer is also considered adding up to this. In this context, main objective of the project,beside promoting usage of weedcides was to reduce the substitution of water as a mean of weed control. Survey results showed that weedicides are applied only in 1/3 of paddy area cultivated, leaving substantial extents effected by weed growth. (Table 3.4); However, a comparatively high usage of chemical weedicides was observed in the dry zone part of the district - probably due to high costs associated with manual weeding in broadcast sown fields. In weed control, manual weeding throughout the study area, is often seen combined with chemical weedicides as a strategy to reduce weedicide costs.

Situation regarding pesticides is somewhat different: pesticides are used in half of the paddy area cultivated; that it was noted that, the area under pesticides increased according to the rehabilitation variable (see Table 3.4) In the R+WM tanks category a large area is under pesticides use. However, information on usage of weedicides and pesticides do not show any marked improvement from the pre-project situation. In the above context, this study considers three factors, as exerting the highest influence on the usage of agro-chemicals.

(1) Knowledge of their effectiveness,
(2) Knowledge on when and how to use them,
(3) Cost which farmers have to bear in using them.

Most farmers interviewed during the field survey were ignorant of aspects such as the suitability of available chemicals for a particular disease or weed. Improvement of extension network seemed to be the solution for this kind of problems.

Table 3.4 Area Under Weedicides and Pesticides

Tank Categories	Area Under Weedicides	Area Under Pesticides
R+WM	39.5	69.7
R	24.5	54.8
NR	38.1	44.3
MI	37.7	44.4
Total	33.3	54.2

3.6 Farm Power

The IRD project has provided medium term credit for farmers to purchase 200 four-wheel and/500 Two wheel tractors, in order to facilitiate the preparation of the seed beds, making use of first Maha rains for the entire command area of the tank.

Traditional farmer attitudes towards the selection of the mode ofpower predominantly depend on the nature of the operation. For ploughing, predominantly animal power being used through out the Kurunegala district, leaving the dry zone part of the district as an exception. There may be several reasons for this kind of an exception. Comparatively harder nature of soils, following a long dry period in Yala involve more difficulties in using animal power for land preparation.

In semi-wet and semi-dry parts of the district, predominant mode of power for ploughing is buffaloes. Availability of buffaloes more in these parts, compared with the dry zone. Gunawardana et.al 1981 state that, milder climate and the availability of grazing land (such as coconut land) in the intermidiate zone (particularly in the southern semi-wet zone) favour rearing the buffaloe. This probably facilitate the use of buffaloes in these parts of the district. High cost for -hiring the tractors for land preparation also may be one of the reasons, to avoid use of tractor power, when the same operation can be done with a less cost.

Table 3.5 Type of Power Used for Paddy Operation

Percentage of farmers	D				SD				SW	
	NR	R	R+WM	M	NR	R	R+WM	M	R	R+WM
1. used tractors for ploughing	-	2.8	52.9	82.3	3.5	10.5	3.0	-	17.6	11.1
2. used animal power for ploughing	41.9	34.0	2.9	-	57.1	35.2	87.8	91.6	82.3	88.8
3. used animal power for Puddling	45.1	34.2	58.8	94.1	60.7	60.5	90.9	91.6	85.2	97.2
4. used tractors for threshing	29.0	8.5	29.4	94.1	29.4	71.0	69.6	86.1	94.1	88.8
5. used animal power for ploughing	12.9	-	32.3	-	21.4	-	-	5.5	2.9	8.3

For puddling, predominantly animal power is used (Table 3.5), as animal power is more suitable for this operation. Quite an opposite picture to this can be seen with regarding thresing, being done by using tractors predominantly. Comparatively the less cost and the less pressure on draught power during harvesting period, due to staggering of the operation, are in favour for using tractors for threshing.

However, an incraase in using tractors both for ploughing and threshing can be observed when compared with the pre-project situation (Table below shows the pre-project situation) Gunawardena et.al 1981.

Table 3.6 Type of power used for paddy operation (pre-project situation)

	For land preparation		For threshing	
	dry zone	Intermediate zone	dry zone	Intermediate zone
	%	%	%	%
Buffaloe	30	83	14	57
4 wheel tractor	49	10	78	47
2 wheel tractor	8	3	8	1

The facilities provided by KIRD project to purchase tractors may have had an impact on this. Analysis of the situation regarding farm power, shows that, both tractor and animal power is necessary for paddy operations, depending on the nature of the operation and climatic conditions. Therefore, at the same time while introducing more tractors, it will be useful to facilitate conditions to improve animal population as well. According to the survey carried out, about 34 percent of farmers have their own buffaloes and a large number of buffaloes are available in the district. According to the Department of Census and Statistics (1982), the total buffaloe and cattle population in the project area was 175340 and 21060 animals respectively.

Therefore, it is felt that, arrangements towards improvements of harmonious use of both modes of power, should be made taking into consideration multiple nature of operations in paddy cultivation.

3.7 Planned and Actual Completion of Irrigation Schemes

According to the appraisal report rehabilitation of 500 village tanks was to have been completed by end of 1983 and according to the preliminary report on the irrigation and water management component (Barker and Seneviratne, 1978) 154 tanks would have been completed in the first year. According to revised estimates in 1983, the project has reduced the target to 330 tanks. Rehabilitation of 0,23,78 and 154 tanks were completed by 1979, 1980,1981 and 1982 respectively (see Table 3.7). Delays in calling for tenders, shortage of qualified staff, breakdowns of equipment, etc. may have caused the delays in achieving the target. It is felt that, appropriate consideration on above mentioned facts should have been given, in fixing the time of completion and on the number of tanks.

The delay on project implementation and other factors have increased the total project cost. Civil works alone have costed 19.06 million rupees for 500 tanks at 1979 prices. Planned civil work cost for 100 tanks (to be completed by 1982) was 12.8 million rupees . Average time over run is 200 percent while average civil work cost have over run by 150 percent. Therefore, adequate consideration should be given to the factors, which have delayed implementation and caused cost over run, during the project implementation period.

Regarding the water management programme, only 13 rehabilitated tanks have some under the water management programme of the Department of Agrarian Services. These 13 tanks have been completed by 1980. The time lag between the completion of the irrigation scheme and handing over to the Department of Agrarian Services is about 2 years. This is due to certain administrative problems regarding taking over procedures, according to the Agrarian Services Department and in 1982 Water Management Division has been set up, after which the situation has improved.

An important fact found in the survey was that, most of the farmers did not know much information about the rehabilitation and water management programme of their own village tanks, which feeds their lowlands and on whom the success or failure of the project to a great extent depends. Besides, one objective of the IRD programme is to encourage grassroot participation and to reduce implementation problems at the field level.

It is felt that, farmers involvement from the very begining of the programme would have brought better results in water management programme, specially if their ideas were given due consideration in rehabilitation of tanks. More planning information to the beneficiaries would produce more involvement and better monitoring in project implementation. Moreover, in addition to paying attention to physical and financial progress, the emphasis should be shifted towards monitoring, whether the completed investments is being used by the expected beneficiaries. This would encourage the involvement of rural community, and specially by including the programme intended beneficiaries, into the monitoring and evaluation process.

Table 3.7 Planned and Actual Completion of Irrigation Schemes*

	1979	1980	1981	1982	1983
Major Irrigation Schemes					
Planned					
a. Completed Rehabilitated Work	-	-	2	7	9
b. Water Management Programme (No. of tanks)	1	3	5	7	9
Actual					
a. Completion of Rehabilitation Work	-	-	-	1	2
b. Water Management Programme	-	-	-	na	na
Minor Irrigation Schemes					
Planned-					
a. Completion of Rehabilitation Work	20	100	250	350	500
b. Water Management Programme	10	100	250	400	500
Actual					
a. Completion of Rehabilitation Work	-	23	78	154	259
b. Water Management Programme	-	-	-	60	46

* Source - Quarterly progress reports - by project office Kurunegala

3.8 Major Problems Encountered in Implementing the Water Management Programme

If the implementation of the Walgambahuwa model is to succeed, two essential aspects need to be perfected.

(1) the physical structure of the tanks (bund, sluices, etc.),

(2) farmer organisations to control and maintain the water delivery systems of the tanks, in active collaboration with implementing officials.

(1) The Physical Structures

It was observed that, even in tanks where the water management programme is to be practised, structures necessary for proper water management was inadequate, with most of the available structures largely disfunctional. Farmers often complained about the "bad" quality of even the new constructions. Leakages in bund, broken sluice gates, badly constructed poles, are the most common defects, mentioned by farmers in almost every tank.

It is clear from the discussion before, that, for an effective implementation of the Walagambahuwa model of water management proper structures in tanks are essential. Our observations suggest that, available structures are not up to the standards required in operationalising such a system of water management. In addition, the physical system of water distribution promoted through the model, does not seem to meet the current technological level of the farmer and farmer organisational structure.

(2) Farmer Organisations

Farmer organisation is a vital component of the Walagambahuwa model, particularly since the success of this programme depends upon group actions of farmers. In minor tanks, at the beinging of each cultivation season, a 'Kanna Meeting' is called by the Cultivation Officer (CO) and the Vel-vidane, to discuss the cultivation schedule for the season. All the farmers who cultivate land under the tanks are called for this meeting, but their attendance at 'Kanna' meetings differs greatly from tank to tank.

Farmer attendance at Kanna meetings reflects on the relative popularity of decisions taken and being implemented, the unity among farmers themselves, and the relationships among farmers, the cultivation officers and Vel Vidanes.

Major decisions taken during a Kanna meeting are as follows :

(1) date of clearing the field channels,
(2) date of first water release for the season,
(3) date by which the land preparation should be over,
(4) variety of paddy to be cultivated during the season,
(5) date by which harvesting should be over.

In practice, the situation in most minor tanks of the district could be much different. Instances were recorded, where individual farmers make use of tank water as they please, either by force or through bribing the cultivation officer or the Vel vidane.

Generally, water management patterns in the observed minor tanks may be divided into three main categories.

(1) tank water being used according to Kanna-meeting decisions*, whereby every farmer gets a satisfactory water supply.
(2) Kanna meeting decisions are not observed, with surreptitious agreements between farmers, Vel Vidanes and cultivation officer to effect a sectoral-bias in the issue of water. In this case too, every farmer generally received a satisfactory water supply, though not timely for all cases and consequently, wasteful of the resource.
(3) Kanna meeting decisions are not observed. A few farmers make use of tank water as they please, at the expense of the majority of users.

Kanna meeting is the only occasion in which farmers get together to discuss issues related to the tank. Unfortunately, in certain tanks even the Kanna meeting is not conducted properly, with very poor farmer attendance. Besides the Kanna meetings no other farmer organisations were observed in the survey area.

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* Kanna meeting decisions taken in most minor tanks did not relate to the Walagambahuwa model. Often these decisions represented traditional cultivation practices.

As was mentioned earlier, the success of the Walagambahuwa model depends upon collective action among farmers. In a few tanks selected farmer representatives were trained on the new water management programmes. These programmes were conducted by the Divisional Officers (DOs) of the Agrarian Services Department. Yet, the farmer response was generally poor. The absence of good farmer organisations to maintain and control the system is a major factor for the failure of the Walagambahuwa model in the district.

One of the most important problems in implementing the Walagambahuwa model is in the needed co-ordination between several government departments. Delays in co-ordination have caused consequent delays in the implementation of the water management programme. The appraisal report proposed several agronomic and institutional changes in order to increase the availability of water in the tanks during the Yala season, which will enable double cropping. Consequent upon the implementation of these institutional changes, net incomes and on-farm employment were expected to increase. The core of the proposed institutional change, the implementation of the Walagambahuwa water management model, in our reckoning, has failed to attain the expected results. Our observations suggest that, the model remains largely unadopted, due to reasons discussed before.

A further issue of note in this context is that no alternative strategy had been proposed to replace the Walagambahuwa model which had proved to be failure-prone. The failure of the model should have dynamised a policy re-formulation with regard to the water management programme, because the Walagambahuwa strategy was the fundamental gynamic of the project. This has apparently not been done and therefore, it has let to multi-faceted problems identified by this study, in implementing the water management programme.

Chapter Four

PRODUCTION, CROPPING INTENSITIES AND COSTS

4.1 Cropping Intensities and Yields

As it was stated before, the impact of the water management component will reflect in cropping intensities and yields. Situation on 82/83 Maha regarding these two indicators is shown below in the Table No. 4.1.

Table 4.1 Cropping Intensities and Yields

	D					SD					SW		
	NR	R	R+WM	M	Total	NR	R	R+WM	M	Total	R	R+WM	Total
Cropping intensity (%)	39.5	65.8	44.1	97.5	61.1	50.0	69.1	86.2	88.2	78.2	74.0	78.8	86.5
Yield bu/ (acre)	37.8	11.8	53.9	28.1	29.3	62.8	44.4	93.2	64.7	64.7	63.5	94.4	79.4

Cropping intensity for major tanks 91.63

Cropping intensity for minor tanks 66.7

The target cropping intensity figure expected by the project is 95 percent (both for major and minor tanks) after the completion of the project. A comparison of this with figures given above show that after 3 years of project, a reasonable improvement regarding cropping intensities cannot be seen both in major and minor tanks.

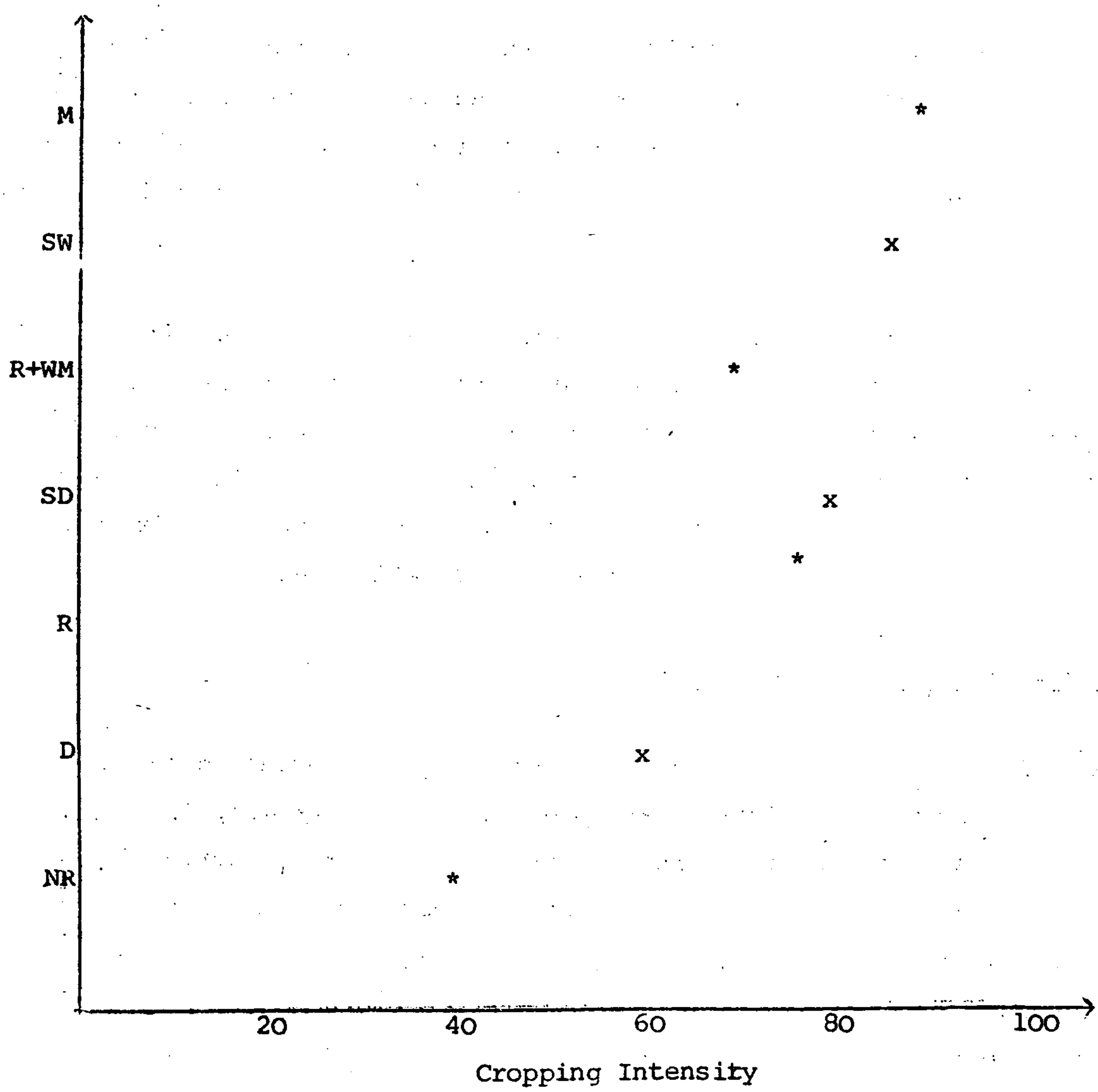
The above figures show the reflection of facilities provided in the district on improving cropping intensities. The expected target of 95 percent seems to be bit high, for the dry zone conditions. In semi-wet zone, where a cropping intensity of 86.5 is reached only after 3 years of the project, and further improvements towards the target can be expected by the completion of the project. The project has predicted an increase of cropping intensities in the Yala season as a result of early cultivation, and reducing staggared cultivation. But, our observations show that farmers are reluctant to adopt dry sowing, and they continue to do staggared cultivation. As a result of this, a marked increase of the cropping intensities for the Yala season, would not be possible under present circumstances.

The situation regarding yields somewhat differ from this. Average yield, in minor tanks which comes up to 59.5 bu/acre is slightly higher than at the completion of project. This achievment even at low cropping intensity is probably due to use of fertilizer and proper paddy varieties. Though minor tank farmers have reached the target yield there are variations within the rehabilitation variable(Table 4.1). Loss of potential yield can be observed in the category of rehabilitation tanks(in the dry zone part only 11.8 bu/acre - see Table 4.2). This figure is exceptionally low for a Maha season. This was probably due to the fact that only 33 percent of tanks under the survey were able to do cultivation during Maha 82/83, due to non availability of adequate water (Table 4.2).

Yields in major tanks have not improved, compared to pre project situation. A marked decrease of yields can be observed in the dry zone part during Maha 82/83 (See Table 4.1). This is primarily due to unusually dry weather conditions, particularly during this season. If the tank storage is not sufficient for a successful crop, fear of crop failures, make farmers reluctant to put essential cash inputs such as fertilizer etc. Further more, they feel that any amount of inputs would not give proper results without an adequate supply of water.

There is one very important fact which we should take into consideration, in evaluatin progress on cropping intensities and yields. That is , weather conditions prevailing in the district during the project implementation period. From 1979 to 1982 weather has been unusually dry for the Kurunegala district, which probably has effected the anticipated project targets adversely. Maha 82/83 was comparatively favourable to semi-wet zone and semi-dry zone, still the dry zone part of the district did not have sufficient rains to start cultivation till December - January months.

Trends in Cropping Intensities According to Climate and Water Availability Variables (Maha 82/83)



* Water availability variable
x Climate variable

D - Dry Zone
SD - Semi-dry Zone
SW - Semi-wet Zone

NR - not rehabilitated tanks
R - rehabilitated tanks under KIRDP
R+WM - rehabilitated and practising water management programme under KIRDP
M - Major tanks

A summary of cultivation practices and general outcome of these practices during 82/83 in the tanks under the survey is given in Table 4.2.

4.2 Production Costs and Income

The principal items of the production expenses for paddy cultivation are presented in the Table No. 4.3. It can be seen that, of all the components highest cost is on labour (this is including family labour). But as usage of hired labour is minimal, cash expenditure on labour is a relatively small amount.

Cash expenditure on agro-chemicals (fertilizer, herbicides and pesticides) is highest in semi-wet zone while comparatively less amount is spent on the same items in dry zone. As it has been discussed in earlier chapters the main cause for this, is the risk situation which is due to insecure water supply. As a result of this, the lowest production expenditure is observed in the dry zone farms, among the three agro-climatic zones.

4.3 Production and Disposal of Crops

Patterns in production and disposal of crops in 3 different agro-climatic areas of the Kurunegala district are presented in Tables 4.4, 4.5, 4.6. Dry zone shows a marked difference compared with other two agro-climatic areas. Farmers in this part of the district get more than 5 percent of their cash income from Chena, which indicates the importance of Chena for dry zone farmers as a source of cash income. At the same time paddy production brings him about 54 percent of his gross income, which is only 10 percent less compared to semi-dry and semi-wet parts of the district. As it has been discussed in earlier chapters till the tanks get filled with adequate amount of water, dry zone farmers cultivate Chena by making use of first monsoon rains, which gives him a reasonable amount of cash, The disadvantage of this cropping calendar is, it is not possible to cultivate Yala season due to lack of tanks storage and time. Contribution of highland component to gross income is more in semi-wet and semi-dry parts, as to compensate with the less income from Chena compared with the dry zone.

Except for the dry zone, where yields are low, there is no marked difference in income from paddy production between the other two zones. This again, disqualifies the assumption made by the appraisers, that farmers neglect paddy cultivation by giving preference to Chena.

Table 4.2 Farming Practices Prevailing in the Tanks Under the Survey

	Minor Tanks								Major Tanks	
	SW				SD				SD	D
	RW	R	RW	R	NR	RW	R	NR	RW	R
1. 50% of the farmers planted paddy crop by-date	15/10	20/10	10/11	15/11	12/11	28/11	20/12	20/12	12/10	16/1
2. % of farmers transplanting	78.37	76.42	86.66	68.56	72.22	47.3	0	35.7	51.42	56.25
3. Time taken to cultivate whole scheme (days)	15	10	25	26	15	10	20	25	30	18
4. % of farmers cultivate NHYV	97.0	94.0	100.0	100.0	100.0	100.0	96.0	97.0	94.2	100.0
5. % of farmers used fertilizer	82.35	86.11	100.0	61.05	76.55	5.28	0	3.22	97.22	65.0
6. Fertilizer / acre	66.59	61.98	61.21	45.65	54.41	48.38	0	50.00	57.57	62.96
7. Yield (bu/ac)	94.4	63.0	93.2	44.8	62.8	53.9	11.8	37.8	64.7	28.1
8. % of area cultivated	66.33	58.73	56.84	41.64	25.89	16.73	16.0	18.16	86.93	28.69

Table 4.3 Production Expenditure of Paddy (Surveyed Farmers) Kurunegala District Maha 82/83

	Semi Wet Zone		Semi Dry Zone		Dry Zone	
	Production Expenditure per farm		Production Expenditure per farm		Production Expenditure per farm	
	Rs.	%	Rs.	%	Rs.	%
1. Labour	1381.00	39.63	1375.00	39.71	1431.00	44.29
2. Tractors	638.00	10.15	518.00	14.96	429.00	13.26
3. Buffaloes	252.00	7.22	536.00	15.48	393.00	12.55
4. Seed Material	174.00	4.98	234.00	6.75	293.00	9.06
5. Fertilizer	863.00	24.74	663.00	19.15	589.00	18.21
6. Herbicides	85.00	2.43	78.00	2.25	52.00	1.60
7. Pesticides	63.00	1.80	58.00	1.67	45.00	1.39
Total	3487.00	100.00	3462.00	100.00	3233.00	100.00

Table 4.4 The Production and Disposal of Crops : Dry Zone

	Gross Income per farm		Cash Receipts	
	Rs.	%	Rs.	%
1. Agriculture				
A - Lowland Paddy	7506.00	53.9	1010.00	16.09
B - Highlands				
a. Coconut	673.00	4.83	130.00	2.07
b. Banana	399.00	2.86	221.00	3.52
c. Others	508.00	3.64	456.00	7.2
C - Chena				
a. Green Gram	1356.00	9.73	1134.00	18.0
b. Cowpea	1556.00	11.17	1442.00	22.9
c. Others	660.00	4.73	615.00	9.8
D - Livestock				
a. Selling out of cattle	1267.00	9.0	1267.00	20.19
b. Milk, Ghee, Poultry	-	-	-	-
Total	13925.00	100.00	6275.00	100.00

Table 4.5 The Production and Disposal of Crops - Semi Dry Zone

	Gross income per farm		Cash Receipts	
	Rs.	%	Rs.	%
1. Agriculture				
A - Lowland Paddy	8569.00	63.63	1844.00	35.04
B - Highland				
a. Coconut	944.00	7.0	650.00	12.35
b. Banana	232.00	1.72	240.00	4.56
c. Others	476.00	3.53	359.00	6.82
C - Chena				
a. Green Gram	581.00	4.3	444.00	8.43
b. Cowpea	607.00	4.5	449.00	8.53
c. Others	1092.00	8.1	359.00	6.82
D - Livestock				
a. Selling out of cattle	834.00	6.19	834.00	15.84
b. Milk, Ghee, Poultry	133.00	0.98	83.00	1.57
Total	13466.00	100.00	5262.00	100.00

Table 4.6 Production and Disposal of Crops - Semi Wet Zone

	Gross income per farm		Cash receipts	
	Rs.	%	Rs.	%
1. Agriculture				
A - Lowland Paddy	8222.00	63.76	1300.00	25.00
B - Highland				
a. Coconut	1934.00	14.99	1443.00	28.30
b. Banana	219.00	1.69	130.00	2.55
c. Others	636.00	4.93	422.00	2.27
C - Chena				
a. Green Gram	-	-	-	-
b. Cowpea	-	-	-	-
c. Others	327,00	2.53	266.00	5.21
D - Livestock				
a. Selling out of cattle	1431.00	11.09	1431.00	28.06
b. Milk, Ghee, Poultry	124.00	0.96	106.00	2.07
Total	12894.00	100.00	5098.00	100.00

Chapter Five

CONCLUSIONS AND RECOMMENDATIONS

In the study area, water availability appears to be the major factor which has an effect on every decision the farmers make. Preference for paddy or Chena, date of cultivation, amount of input use, etc. is mainly decided on the availability of water for a particular season.

No advancement of cropping calendars could be seen in the district during Maha 82/83. Planting dates varied from last week of October in Semi-Wet zone, to last week of December in the Dry zone. Comparison of time of commencement of land preparation operations with 1979 Maha results (pre-project situation) disclosed that, the 1982 Maha planting occured significantly later than the 1979 planting. Land preparation with first Maha rains has not taken place as expected by the project.

Emphasis on dry sowing making use of first Maha rains, under the water management programme, has not shown any significant impact on saving water for Yala season. Where rainfall is of erratic nature, farmers tend to minimize the risk of a crop failure by delaying sowing, till tanks get sufficient storage. Within the study area only a few farmers practised this method of cultivation. Total rejection of dry sowing by dry Zone farmers is reported. Results in the other two climatic zones of the district (Semi-Dry and Semi-Wet) vary slightly. Analysis confirm that adoption of the recommended dry sowing technique, is significantly sensitive to climatic conditions.

Farmers major concern is to avoid risk of crop failures. This vital fact is not given sufficient thought in recommending Walagambahuwa model. Apart from this, defects in physical structures of tanks have also contributed to failures in implementing the water management programme. Essential structures for water release and control are lacking in most tanks.

Importance of Chena cultivation is much more significnt to **Dry** Zone farmers, when compared with other two climatic zones, with Chena accounting for more than 50 percent of their net income.

But, this is not the reason for farmers to delay paddy cultivation as the appraisal report points out. Our field experience suggest that, Chena does not impede with paddy cultivation.

Lack of proper farmer organizations to give an insight to farmers, of the new water management programme, is one of the major reasons for the largely unadopted position of the Walagambahuwa model in the district. Formulation of farmer organizations and training of farmers by the implementing officials, would help greatly in implementing any water management programme.

A system approach is more suitable in understanding and resolving the issue on clashes between paddy and Chena cultivation. Most asweddumized paddy lands available are in the Dry Zone part of the district. Therefore, a better water supply which could eliminate risk of crop failure, would increase cropping intensities and yields, in spite of farmer involvements in Chena cultivation.

Successful adoption of certain recommendations made by the project has been observed in the study area. Adoption of new improved paddy varieties is quite high. Ninety seven percent (97%) of the sample used new improved varieties or combination of new improved and old improved varieties. Variations in climate within the district or different degrees of water management has made no difference to the adoption of new high yielding varieties. This achievement can be attributed to the T & V extension system.

Rates of application of both fertilizer and agro-chemicals (Insecticides and Weedicides) appears to be sensitive, to the risk mechanism regarding water availability in paddy cultivation. In the Dry Zone part of the district, where the comparative risk is higher, farmers seem reluctant to invest more on paddy, other than the minimal requirements. Fertilizer application is significantly different, by both climate and degree of tank rehabilitation and water management variables. Across the rehabilitation variable, an increased use can be observed by tanks practising water management showing the highest mean acreage under agro-chemicals. Across the climatic variable Semi-Wet Zone part of the district shows the highest acreage under insecticides and pesticides. But, compared with the pre-project situation, usage of agro-chemicals generally has decreased. The comparatively high cost of the agro-chemicals is the most probable reason for this situation.

In spite of the project's recommendation to tractorize the land preparation, a dominance of animal power could be observed. Modes of power is selected by farmers according to the operation. In the analysis of survey data, the preference given to different modes of power (animal and tractor) in different operations has proven significant. Multiple nature of operations in paddy cultivation demands usage of both animal and tractor power. In project recommendations no measures are taken to improve animal population in the district.

Adoption of recommendations made by the Water Management Programme depends upon the primary condition of risk-aversion Dry-Zone part of the district showing the lowest rates of implementation of the recommendation confirm the above fact. Our observations suggest that general recommendations made for the entire Kurunegala district, do not really suit the specificities in the Dry Zone conditions. Therefore, it should be emphasised that the the project's recommendations need to be geared towards specific climatic zones. The three climatic zones of the Kurunegala district is a case in point to determine the difference in effects of degrees of water availability on cropping intensities and yields. Delays in completing the rehabilitation work, and implementing the water management programme, may also affect the realisation of a chartable progress in water supply.

One of the most important issues is the relationship between the recommended irrigation techniques and farmers perception of these techniques. Farmers current behaviour in a cropping system is based on the knowledge gained through many generations and, from their perspective, current farming practices are the best they can afford within the given circumstances. In making recommendations, it is felt -that farmer interests and resources limitations within which they can operate should be a accorded due consideration.

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Annex I : TANKS COMPLETED UNDER KIRDP PERIOD ENDING 30th September 1982 (Sample Frame)

A. REHABILITATED TRNKS UNDER KIRDP

I. Dry Zone

1. Mahathammenna Wewa
2. Daralugama Wewa
3. Gurulupitigama Wewa
4. Elabodagam Wewa
5. Peella Wewa
6. Panagama Wewa
7. Amagammana Wewa
8. Kekulu Wewa

II. Semi Dry Zone

1. Kothalakimiyaya Wewa
2. Amagaha Wewa
3. Kohombakodavala Wewa
4. Pahalawewa Daladagama
5. Wewelgedera Wewa
6. Maragas Wewa
7. Aluthagamanegodagama Wewa
8. Nugampola Wewa
9. Monnekulama Wewa
10. Malaththa
11. Manalembuwathalakotuwa Wewa
12. Panawewa, Unawewa
13. Madula Mahawewa
14. Mandapola Wewa
15. Nunthelembuwa Wewa
16. Denthella Wewa
17. Mirihanegama Wewa
18. Kekirawa Wewa
19. Pannithawa Wewa
20. Kithulwehera Wewa
21. Ethawa Wewa
22. Pallehepitiya Wewa
23. Bayava Wewa
24. Vepathange Mahawewa
25. Tennekoongama Wewa
26. Tissawa Mahawewa
27. Belava Mahawewa
28. Handvelpola Wewa
29. Hirigolla Wewa
30. Vilgam Dematava Wewa

III. Semi Wet Zone

1. Galkissa Bema
2. Navakada Wewa
3. Kotakimbulakada Bemma
4. Hathpola Wewa
5. Moonamaldeniya Wewa
6. Nelumkanuwa Wewa
7. Buluwewa, Ellewela Wewa
8. Galagedara Udapitiya Wewa
9. Doowa Bemma
10. Pansal Oya Bemma
11. Kepumgoda Bemma
12. Masurankotte Wewa
13. Monaravilampitiya Wewa
14. Kanugala Wewa
15. Wewahena Wewa
16. Panavahilla Wewa
17. Helenawatta Wewa
18. Heelavagedara Wewa
19. Kiriuthurana Wewa
20. Bulupitikande Wewa

B. TANKS REHABILITATED AND PRACTISING WATER MANAGEMENT UNDER KIRDP

I. Dry Zone

1. Mudiyanegama Wewa
2. Kande Wewa
3. Ihala Wewa
4. Ihala Maradankadawela Wewa
5. Ihalagama Wewa
6. Ihalapothana Wewa
7. Ihaladavulu Wewa
8. Pothanegama Wewa
9. Pothane Wewa

II. Semi Wet Zone

1. Thaligama Wewa
2. Lepola Wewa
3. Medawelehe Bemma
4. Lewlawa Wewa
5. Anukkane Wewa
6. Diyadora Wewa
7. Diyamalankawa Wewa
8. Nelum Wewa
9. Welauda Wewa
10. Dunukelanda Wewa

III. Semi Dry Zone

1. Thalagama Wewa
2. Thimbiri Wewa
3. Dadapolagama Wewa
4. Angulugama Wewa
5. Anukkane Wewa
6. Dambhera Wewa
7. Bakemeekctuwa Wewa
8. Dehigaha Kumbura
9. Pothu Wewa

Annex II : Criteria for Selection of Schemes

(a) Minor Tanks

(i) Command area under each tank should not be less than 20 acres. If the tanks considered is one in a cascade in the same catchment and requires improvements to provide safety for the tank down-stream, then a reduction of the command area for such a tank, will be permissable.

(ii) The useful storage of the tank should not be less than 3 ac.ft. per acre in the command area in the Dry Zone and 2 ac.ft. per acre in the Intermediate Zone. The Dry Zone is defined as the area where the average south-West monsoon reinfall is below 10 inches and the Intermediate Zone as that in which the rainfall is between 10-20 inches.

(iii) The annual water requirements for the tank computed for the Maha season at the duties in item 2 above and for the Yala season on an assumption of cultivation of 25% of the Maha extent at duries of 3.9, and 2.6 for dry and Intermediate Zones should not exceed 70% of the yield potential computed from iso-yield curves of the Irrigation Department.

(iv) The tank should directly benefit at least 10 families.

(v) The incremental area brought under direct irrigation should be at least 10 times, the privately irrigated lands submerged, or 5 times other cultivated lands submerged.

The incremental area is defined as below :-

A_1 = area cultivated for Maha befire project
A_2 = area cultivated for Maha after project
$A_3 5\ A_2$ = area cultivated for Yala after project
A_3 = rainfed paddy for Maha before project
A_4 = rainfed paddy for Maha submerged in tank bed after project

$$\text{Incremental Area} = (A_2 + 0.5A_2) - A_1 - \frac{A_3}{2} - \frac{A_4}{2}$$

$$= 1.5A_2 - A_1 - \frac{A_3}{2} - \frac{A_4}{2}$$

NOTE :

It is assumed that there is no Yala cultivation from tank before project and that after project it could be possible to cultivatc 50% of the Maha extent for Yala, due to water amangement practices to be adopted. Rainfed cultivation is usually limited to the Maha season only.

(vi) The rehabilitation costs should be within the limits of Rs. 8500/= acre of incremental area and Rs. 5000/= per acre of total command area. Such cost should include all civil works and physical contingencies valued at mid 1980 prices but exclude price contingencies, engineering and administration. Minor schemes which exceed the cost per acre and/or supply criteria may be included in the project after consultation with IDA, provided they are economically justified with an economic rate of return of at least 15 percent.

(b) Minor Anicuts

(i) Hydrologic data and studies for an independent anicut should demonstrate that the base flow in the stream will not be less than at a duty of 35 acres per cuse in the Dry Zone, 40 acres per cusec in in the Intermediate Zone and 45 acres per cusec in the Wet Zone during the cultivation season.

(ii) The command area to be irrigated by the anicut should not be less than 20 acres.

(iii) The anicut would directly benefit at least 10 families

(iv) This will be the same as criteria (iv) for Minor Tanks

(v) The incremental area brought under direct irrigation should be at least 10 times, the privately irrigated land submerged, or 5 times other cultivate land submerged.

The incremental area is defined as below :-

A_1	= area cultivated for Maha before project
A_2	= area dultivated for Maha after project
A_3 $5A_2$	= area cultivated for Yala after project
A_3	= rainfed paddy for Maha before project
A_4	= ranfed paddy for Maha submerged in tank bed after project

$$\text{Incremental Area} = (A_2 + 0.5A_2) - A_1 - \frac{A_3}{2} - \frac{A_4}{2}$$

$$1.5A_2 - A_1 - \frac{A_3}{2} - \frac{A_4}{2}$$

<u>NOTE</u> :

It is assumed that there is no <u>Yala</u> cultivation from tank before project and that after project it could be possible to cultivate 50% of the <u>Maha</u> extent for <u>Yala</u> due to water management practices to be adopted. Rainfed cultivation is usually limited to the <u>Maha</u> season only.

(vi) The rehabilitation costs should be within the limits of Rs. 3500/= per acre of incremental area and Rs. 5000/= per acre of tatal command area. Such cost should include all civil works and physical contingencies valued at mid 1980 prices but excluded price contingencies, engineering and administration. Minor schemes which exceed the cost per acre and/or supply criteria may be included in the project after consultation with IDA, provided they are economically justified with an economic rate of return of at least 15 percent.

<u>Alternate Cost Criteria</u>

Let A = Existing command area before project
B = percentage increase if any in command area after project
C = A cost factor related to additional construction

Then pro-rata cost in Sri Lanka Rs. per ac. of command are

$$(5000A + \frac{P}{100} \times A \times C) - (A - \frac{P}{100} \times A)$$

Where C = 10,000 for Kurunegala and Puttalam District
= 15,000 for Matale District

The pro-rate cost for rehabilitation of breached tanks would be Rs. C/- per acre of command area.

Annex XII

Table 1 : Performance given for Dry Sowing (Climatic Variable)

Percentage of farmers	D	SD	SW	Total
1. Preferred dry sowing	(0)	2.96 (4)	12.86 (9)	4.04 (13)
2. Opposed dry sowing	100 (117)	97.04 (131)	87.14 (61)	95.96 (309)
3. Total	100 (117)	100 (135)	100 (70)	100 (322)

chi-square = 19.380, with D.F. = 2

Table 2 : Preference given for Dry Sowing (Rehabilitation Variable)

Percentage of Farmers	R+WM	R	NR	M	Total
1. Preferred dry sowing	2.91 (3)	6.54 (7)	3.39 (2)	1.89 (1)	4.04 (13)
2. Opposed dry sowing	97.09 (100)	9.46 (100)	96.61 (57)	98.11 (52)	95.96 (309)
3. Total	100 (103)	100 (107)	100 (59)	100 (53)	100 (322)

chi-square = 2.765 with D.F. = 3

* Figures in paranthesis show number of farmers.

Table 3 : Application of Basal Mixture - Different Agro Climatic Region

Percentage of Farmers	D	SD	SW	Total
1. Not applied	76.07	22.22	48.57	47.52
2. Applied up to recommended level	8.55	35.56	25.71	23.60
3. Applied, not up to recommended	15.38	42.22	25.71	28.88

Chi-square = 73.750 with D.F. = 4

Table 4 : Application of Basal Mixture (different categories of tanks)

Percentage of Farmers	R+WM	M	NR	M	Total
1. Not applied	46.6	55.14	69.49	9.43	47.52
2. Applied up to recommended levels	27.18	11.21	22.03	93.40	23.60
3. Applied not up to recommended level	26.21	33.64	8.47	47.17	28.88

chi-square = 55.615 D.F = 6