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Research Study No. 99 **April 1998**

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FOREWORD

Major irrigation schemes have been an integrate part of the development packages implemented after the independence of Sri Lanka. Without a doubt, these schemes have contributed significantly to the country's development. However, there are instances where pure engineering solutions failed to address the problems of water stress, land scarcity and human settlement. Kirindi Oya Irrigation and Settlement Project (KOISP) is one of the well known illustrations that inadequate preliminary investigations as to the optimal location of the major reservoir on the Kirindi Oya and ignoring nature's biological and environmental cycles proved to be disaster in terms of the project's success.

As set out in the report, Kirindi Oya basin in characterized by a unique farming system in the South East Dry Zone region of Sri Lanka. After the introduction of the KOISP, land use and farming systems of the Kirindi Oya basin and its vicinity have changed considerably. The traditional large scale systems of livestock and slash and burn cultivation cannot be practised any longer mainly due to the unavailability of land. The report identifies the existing types of farming systems and it goes on to analyse the economic feasibility and social viability of the farming systems in the present context.

The major findings of this study relate to the diversity and complexity of farming systems in the project area and the lack of inter-connection among these systems. The study concludes that an integrated farming system that comprised of both livestock and crops with drought resistant crop combinations, soil and moisture conservation technologies should be adopted in order to overcome the physical, environmental and social constraints of the project area.

I would like to thank Mr. P.D.J. Ananda, the Co-ordinator of this study and to all the other co-authors for their valuable contribution in carrying out this study successfully.

Dr. S.G. Samarasinghe
Director.

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AUTHORS.

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CHAPTER ONE
Introduction

1.1 The Kirindi Oya Basin

The Kirindi Oya basin encompasses the Lunugamwehera area, situated in the South-East part of the dry zone of Sri Lanka. The area is characterised by its arid conditions, especially the low rainfall and high ambient temperatures and low relative humidity. This results in high evaporation, which exceeds the rainfall during most months of the year. The North-East Monsoon is the main perennial source of water for the entire area. Water deficit is a critical problem, and a major deterrent on the farming systems practised in this region.

Historical evidence shows that the people of the Kirindi Oya area had lived in a system where a network of hundreds of small tanks existed along with an integrated farming system of paddy in lowlands, shifting cultivation in the highlands, fresh water fish, livestock and home gardens with permanent perennial crops.

The traditional farming system can be categorised as a self-sufficient system which is sustainable in most aspects and did not degrade the eco-system. But, like many other agrarian societies, the farming communities of Kirindi Oya area too were subjected to forces of market expansion, population pressure, technological development and commercialization. Consequently, these factors paved the way for implementing the largest irrigation and settlement scheme in the South-East dry zone of Sri Lanka.

1.2 The Project

The Kirindi Oya Irrigation and Settlement Project (KOISP) was designed to be a joint venture of the Government of Sri Lanka and a group of international agencies (Asian Development Bank, Kreditanstalt Fur Wiederaufbau (KFW), and International Fund for Agricultural Development) with the objective of increasing agricultural production, through a new irrigation system, generation of hydro-electric power and the projected settlement of 8400 families in two phases. The service area is about 12,900 ha. It was also expected to develop the infrastructural facilities namely irrigation channels, roads and a settlement system of hamlets and villages provided with community facilities including schools and health services. Some of the original objectives of the project including hydro-electric power generation and the opening of a new area which had to be abandoned due to miscalculations of the water inflow to the reservoir and the excessive evaporative loss from the reservoir.

The water distributory system of the Kirindi Oya Project area consists of two main canals starting from the Lunugamwehera reservoir. The Left Bank (LB) and the Right Bank (RB) main canals are 17 km and 32 km respectively in length. A separate feeder canal is provided from the Left Bank main canal to an Ellagala Diversion structure in order to distribute water to the Ellagala System and its network of canals. The Ellagala System in the old irrigation system consists of the five small tanks namely Weerawila Wewa, Tissa Wewa, Deberawewa, Pannegamuwa Wewa and Yoda Wewa. In addition, to this network, Bandagiriya Wewa exists as a separate entity.

1.3 The Study

It has been observed that the establishment of a large irrigation and settlement scheme, not only changed the existing physical environment of the Kirindi Oya basin, but also significantly altered the traditional farming system that prevailed in the area. Together with the arid climatic conditions, the water shortage of the reservoir aggravated the problems of the settled farming community and the traditional farming community.

The farming systems practised are complex due to the varying distribution of soils, water sources, crops, livestock, labour, natural resources and other characteristics. Within this environmental setting the farm family manages according to their preferences, capabilities and available technologies. Therefore, the need for a study to evaluate the existing farming systems and problems of farmers after the implementation of the irrigation project is important. The aim of this study is to collect the above information and examine the possible alternatives for improvement.

1.3.1 Objectives

The major objectives of the study are:

1. to identify the different farming systems adopted by the farmers of the KOISP,

2. to evaluate the economic feasibility of the different systems,

3. to examine institutional problems confronted by the farmers and to suggest possible improvements to the present farming practices, and

4. to recommend more appropriate policy measures that would help overcome the present problems.

1.4 Methodology

The study was based on data collected from a literature survey, rapid appraisal and a structured questionnaire survey. The study sample focused on the old developed area (Old System) and the newly developed area (New System) served by the left bank and right bank canals of the KOISP. During the rapid appraisal, field observations and discussions with farmers and key informants were held and assessments were made on the availability and the use of resources, regional variations in soils and other environmental parameters such as rainfall, evaporation, temperature etc.

The questionnaire survey was designed to gather information on the existing farming systems and the socio-economic conditions of the farming community. The stratified random sampling technique was used to draw the sample. The sample covers both the New System and the old Ellegala System and represented the locational differences in the study area. It also captures the main farming components viz. crop and livestock. The number of farmers selected randomly under each division is given below. The total sample size of 187 allottees includes a sample of 31 livestock farmers (Table 1.1).

Table 1.1: The Distribution of the Sample

System	No. of Farmers
New System-Right Bank	58
New System-Left Bank	32
Old System (5 tanks)	66
Livestock Farmers	31
TOTAL	187

Source: Survey data, 1993

The collected quantitative and qualitative data were coded and tabulated. Data analysis was done by simple tabular analysis and cross tabulation.

1.5 Limitations of the study

During the field visits, it was observed that some of the farmers were not cultivating crops for three seasons continuously due to lack of irrigation water. This unfortunate situation disillusioned a majority of farmers in the newly developed area, as they experienced poor living conditions along with severe economic hardships.

While the most critical problem of irrigation water shortage and distribution disparities continued to be unresolved, extracting the information on agronomic aspects and management practices for this survey became a major problem. Regardless of this fact, the data recorded by this study could contribute positively to solve some of the farmer problems.

1.6 Organization of the Report

This report consists of six chapters. Chapter one describes the background to the study, the objectives of the study, research methodology and limitations of the study. Demographic characteristics and social conditions of the farming community of the Kirindi Oya area are discussed in Chapter two. In Chapter three, cropping systems of the Kirindi Oya area and their agronomic aspects, cropping pattern and the cropping calendar, agricultural inputs and cultural practices are described. It also explains the physical setting of the farming environment viz. soils, climate and the salinity problem. This chapter is followed by Chapter four in which livestock farming systems are described and analyzed in detail. Chapter five consists of some economic and institutional analysis of farming systems of Kirindi Oya. The final chapter gives the conclusions of the study along with suggestions for improvement.

CHAPTER TWO

Demographic and Social Conditions of the Farming Systems of KOISP

The importance of studying demographic and social conditions prevailing in an area has been recognized as important in research as they are the vital characteristics of the household sub-system in any farming system. In this regard, based on the collected information during the investigation, household criteria such as the population structure, educational status, labour availability, tenurial arrangements and other important features are discussed and analyzed in this chapter.

In addition, an attempt is made to describe some of the key features, compared with the previously identified situation during the pre- and mid-project evaluations done by the Hector Kobbekaduwa Agrarian Research & Training Institute (HARTI).

2.1 Population Structure

Some marked differences were observed between the population structure of the two systems in population pyramids which are illustrated in figure 2.1 and figure 2.2.

The higher younger population recorded within the New System may be due to the fact that the new settlers comprised of relatively younger families (68.8%) compared with the Old System. The largest population category is 10-14 years and the majority are below 25 years of age in the New System.

Out of the families settled in the Old System 54 percent are older families comprising of middle-aged members. Therefore the largest population category is recorded in the 35-39 year segment and the majority of the population is in between 15 to 44 years age group. The percentage distribution of the population by age and sex is given in Annex Table 1.

Another variation can also be observed when comparing the two pyramids. There is a comparatively larger group in the Old System in the age category of above 65 years not only due to the older families but because a significant percentage (5%) of families have three generations.

The age dependency ratio for the overall population is 55.7% which is significantly lower than the ratio of 77.8% for the Hambantota District in 1991. The main contribution to this lower percentage is from the Old System where the age dependency ratio is 36.7% which is due to the lower young dependent population living in that system. Since the recorded population of above 65 years of age in the New System is low, the ratio (73%) of the New System is also lower than that of the Hambantota District. The data relating to the age dependency ratios are presented graphically in Figure 2.3. On the other hand, the majority of the people of the Kirindi Oya area were Sinhala Buddhist like in other irrigation and settlement projects in the country, but a few Muslim families (2.1 percent) were included in the sample.

Based on the analysis the average family size in both the new and old areas was 5.3 and 5.0 member/household respectively. However, the overall average household size in the area was 5.2 which is slightly lower than the national average of 5.6. The composition of the sample in terms of family size is given in Annex 2.

2.2 Literacy and Education

Details on literacy (Table 2.1), indicate that literacy has increased since the pre-project days in the area. The largest increase is seen among females from the Old System but overall, the males have a higher literacy rate. Majority of the older population in the Old System is not educated and therefore the literacy rate of the New System is higher than that of the Old System.

The educational level of the project population above 5 years age is given in Table 2.2 according to which nearly 4.8 and 2.8 percent from the Old System and the New System respectively did not have any type of education. The highest percentage of people who have attended school had been upto grade 5 in both areas.

Figure 2-1 Population Pyramid of the Old System

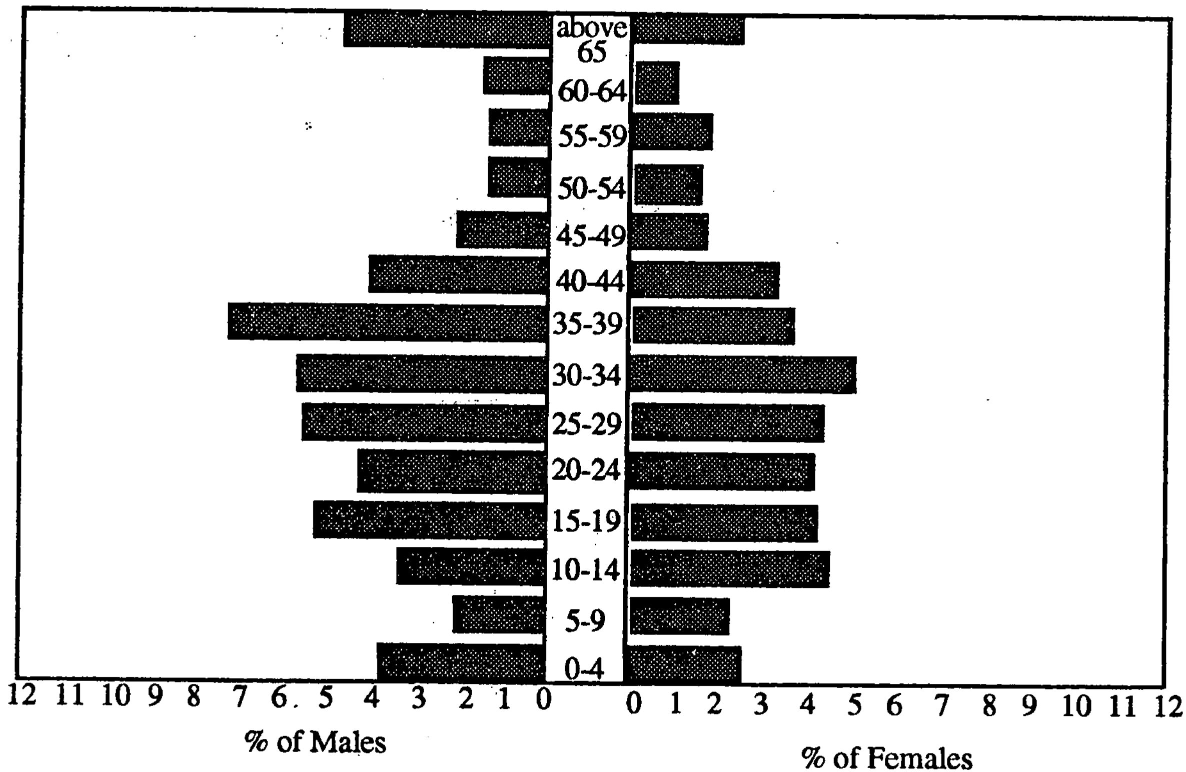


Figure 2-2 Population Pyramid of the New System

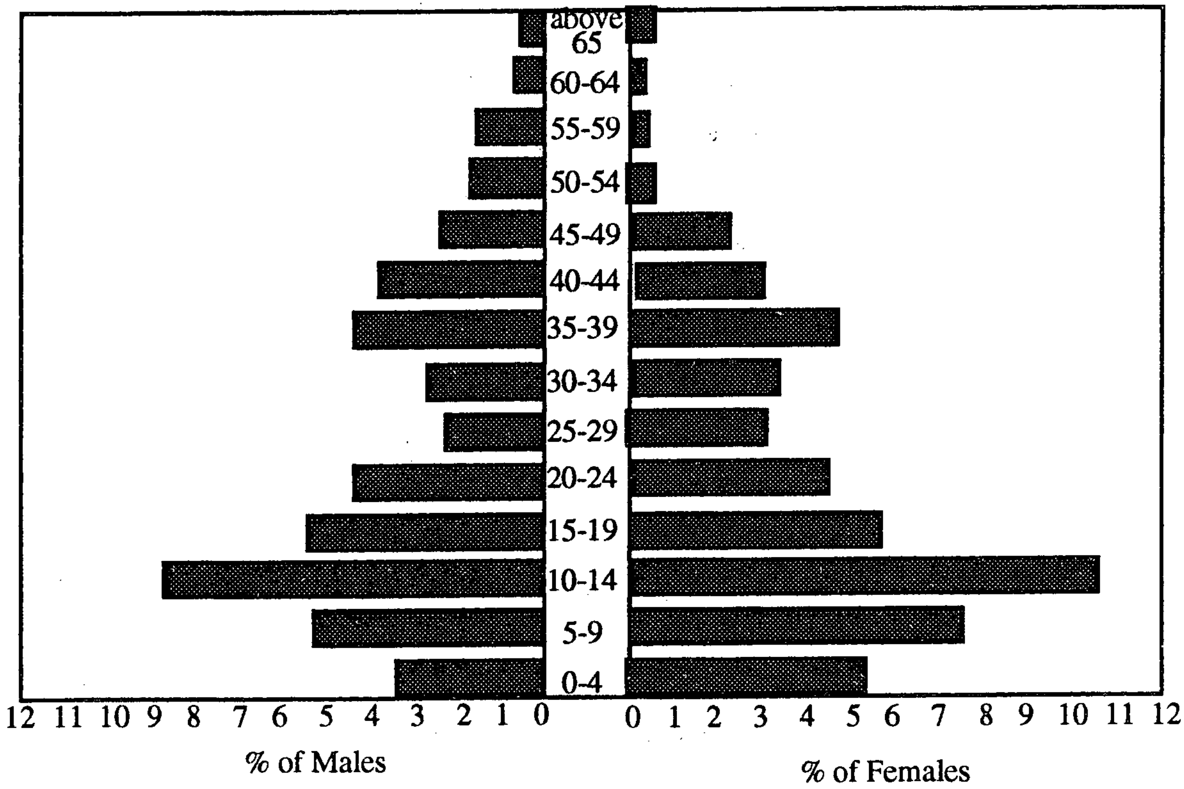
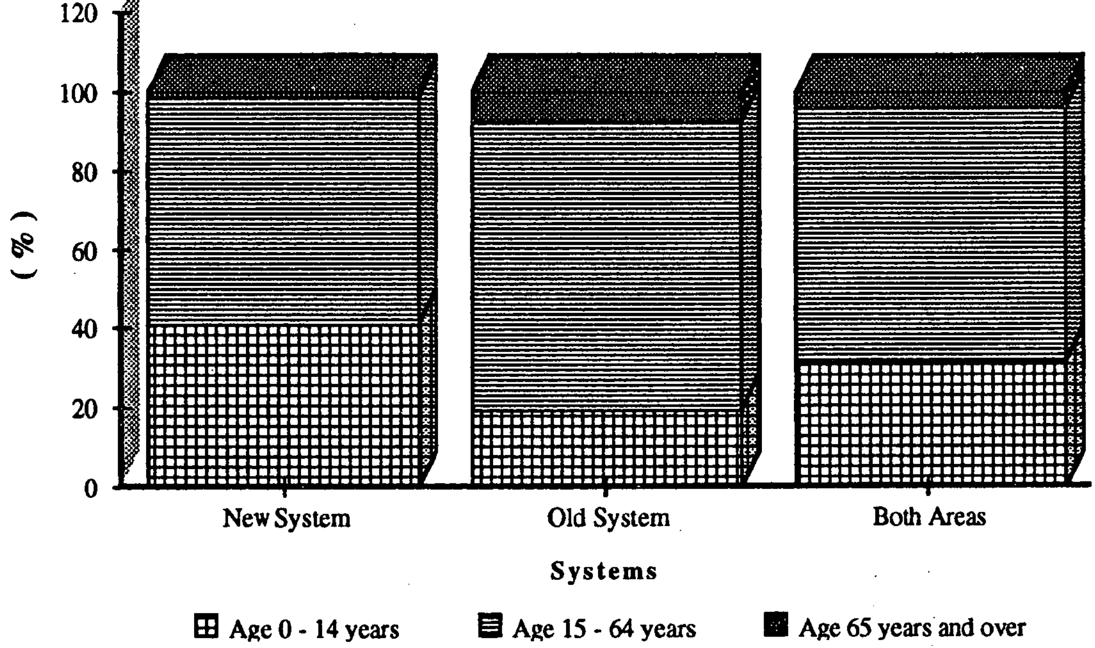


Figure 2.3 : Age Dependancy Ratio



$$\text{Age dependancy ratio} = \frac{\text{Age group (0-14 yrs.)} + \text{Age group 65 yrs. and over}}{\text{Age group (15 - 64 yrs)}}$$

Table 2.1: Literacy Rates in the Project Area

	Pre-Project		Mid-Project		Present		Overall
	Male	Female	Male	Female	Male	Female	
Old System	92.2	79.1	98	81	97.5	91.3	94.7
New System	88.7	79.4	94	88	97.9	95.9	96.8

Source: 1. Wanasinghe, A, et.al (1984) KOISP Pre-project Socio Economic . conditions
2. Gamage, D., et.al. (1988) KOISP Mid-Project Evaluation
3. Survey data, 1993

Table 2.2: Educational level of the Population above 5 yrs of age

Type of Education	New System				Old System			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
No schooling and illiterate	5	2.1	11	4.0	5	2.4	15	8.6
No schooling and literate	3	1.2	-	-	10	4.8	6	3.5
Up to Grade 5	104	42.4	113	42.0	67	32.2	47	27.0
Grade 6-9	88	35.9	81	30.1	61	29.3	46	26.4
G.C.E. (O/L)	30	12.3	51	18.9	42	20.2	38	21.8
G.C.E (A/L)	15	6.1	12	4.7	20	9.6	19	10.9
Undergraduate	-	-	1	0.3	-	-	2	1.2
Graduate	-	-	-	-	3	1.5	1	0.6

Source: Survey data, 1993

Further, an attempt was made to examine the present situation of school participation of the compulsory school going age groups. Table 2.3 illustrates the age specific school participation rates which refer to the number of school going children in a particular age group per 100 in that group.

The present school participation rates of the 5 - 9 years age category of both systems are generally higher than in the previous years. One reason is the availability of better facilities such as more schools developed after the implementation of the irrigation project. However, there is a significant decrease in the rates of other age categories compared to the pre- and mid-project evaluations. The reasons for this situation could be due to the drop outs from schools joining farming activities or financial distress or both. However it should be mentioned here, that the total number of children in the sample falling into these categories is extremely small.

Table 2.3: Age Specific School Participation Rates

Age category (yrs)	1981 Old System	1981 New System	1986 Old System	1986 New System	1993 Old System	1993 New System
5 - 9 M	82.8	71.1	74.5	78.2	100	100
F	74.0	71.8	77.1	79.0	90	95.3
10-14 M	86.8	84.4	93.4	88.1	78.5	81.2
F	81.2	91.5	93.3	93.5	78.9	75.0
15-19 M	50.8	49.9	42.6	47.0	59.0	36.6
F	41.7	40.3	65.0	53.3	23.5	28.0

Source: 1. Wanasinghe, A. et al. (1984). KOISP Pre-project Socio-economic Conditions
2. Gamage, D, et al. (1988). KOISP Mid-project Evaluations

2.3 Labour Availability

The details relating to the labour force, which is defined here to include all those in the age group 15 - 64 years, is given in Table 2.4 and according to which 64 percent of the population in the project area is in the labour force. The Old area is characterized by having a comparatively larger labour force due to the higher middle aged population living in that area. Although the higher younger population in the New System contributes to the decrease in the labour force, it is clear that there is a large number of potential entrants to the labour force in the future. The sex composition of the labour force indicates that 47 percent are exclusively females.

The number of the total available mandays is calculated taking into consideration the available labour force for agricultural activities which is 86.9% and 92.3% respectively for the old and new systems, which could be totally available for farming. However, 31 percent of the total available labour force is comprised of housewives whose participation in farming activities is lower than the percentage calculated. Therefore the calculated levels of family labour availability, which are 2.8 mandays and 2.4 mandays respectively for the Old and new systems, further decrease. Another important indicator reflecting the labour scarcity prevailing in an area is the land-labour ratio, which accounts for 0.96 ac. per manday for both areas.

Table 2.4 : Characteristics of the Labour Force in the Sample

	Old System	New System	Both areas
Percentage of the labour force	73.1	58.0	64.4
Percentage of females in the labour force	44.8	49.8	47.4
Size of the total labour force[1]	299	327	626
Available labour force for agricultural activities[2]	260 (86.9)	302 (92.3)	562 (89.7)
Total available mandays[3]	230.5	264	494.5
Labour availability/family	2.8	2.4	2.6 md
Land labour ratio (land area/labour mandays)[4]	0.96 Ac/md	0.96 Ac/md	0.96 Ac/md
Land labour ratio (Total land area/labour mandays)	1.53 Ac/md	1.25 Ac/md	1.4 Ac/md

Source: Survey data, 1993

According to these calculations, it can be concluded that the labour force available in the area is insufficient to develop the total land area alloted to the beneficiaries and due to this situation the crop diversification programme implemented in the area is also affected. For instance, it affects timely land

1 All those in the age groups of 15 to 64 years
2 Excluding students in the age grops of 15-64 years and permanent employees
3 One male was counted as 1 unit and one female was counted as 0.75 unit
4 Only for paddy lands

preparation and other labour intensive activities. Therefore the resultant situation has lead to uncultivated paddy lands and migration of the owners of these lands to other areas to work as casual labourers. Details of this seasonal migration of the labour force is discussed in Chapter five.

One other important characteristic tied up with the labour force is masculinity ratio (the number of males per hundred females). The masculinity ratio for the New System is 88.2 which is comparatively low due to the variation in male to female ratio (1:1.3) of under 14 years of age category in the New System. With regard to the Old System, the masculinity ratio is 121 and this has been largely due to the number of males being slightly higher than the number of females in the majority of the age categories. However, the masculinity ratio for the overall population is 100.8 which is generally lower than the ratio of 104 for Hambantota District in 1981.

2.4 Farm Size

The total agricultural land area in the sample is 716 ac. which is operated by 187 households having a 4 ac. per household. Further details pertaining to the land use categories of agricultural land and the size distribution of the holdings are given in the Table 2.5.

As summarized in the foregoing Table, a great diversity can be observed in the farm size of the farmers of both areas.

One of the main economic resources given to the project beneficiaries was land comprising of 1/2 ac. homegardens and 2 1/2 ac. as paddy lands per household. However these figures have varied due to the inequality in land allotment among the households and therefore, the size of homegardens and paddy lands has varied to the average of 0.58 ac. and 2.4 ac. respectively in the New System. Chena (upland) cultivation is practiced by a small number of new settlers encroaching on the surrounding forest lands and therefore the size of upland allotment has been varied depending on the farmers' resource availability for chena cultivation.

Being an old settlement area the size distribution of farms in the Old System is significantly different from that of the New System. While some farmers have no paddy lands, others have different sizes of lowland allotments ranging from 1/2 ac. to 8 acres. Settling many generations in the same area for a longer period has been the reason for this variation. Sometimes a limited land area has been distributed among the generations decreasing the farm size to smaller acreages. On

Table 2.5 : Distribution of Households by Size Groups of Operated Lands (ac)

Size groups of operated lands	Paddy Lands				Home Gardens				Chena (Upland)			
	New System		Old System		New System		Old System		New System		Old System	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
No land	-	-	4	4.9	-	-	-	-	-	-	-	-
< 0.5	-	-	-	-	-	-	10	12.3	-	-	-	-
0.5 - 1	-	-	2	2.5	98	92.5	17	21.0	3	20.0	2	12.5
1 - 2	6	5.7	10	12.3	5	4.7	31	38.3	2	13.3	3	18.8
2 - 3	100	94.3	21	26.0	3	2.8	21	25.9	9	60.0	5	31.2
3 - 4	-	-	6	32.1	-	-	2	2.5	1	6.7	5	31.2
4 & over	-	-	18	22.2	-	-	-	-	-	-	1	6.2
Total land area	263.25		250.50		62.00		78.25		25.50		36.50	
Average land size	2.48		3.0		0.58		0.96		1.7		2.28	

Source :Survey data, 1993

the other hand, better economic stability of some farmers enhances the purchasing power, further increasing the size of homegardens and paddy lands of the Old System.

However, according to the observed information, it can be concluded that the Old System farmers are in a better position than the New Systems farmers with regard to the land size.

2.5 Land Tenure

One of the social factors, which has highly affected the farmers' circumstances, has been the tenurial situation existing in the project area. Therefore, when an attempt was made to examine this situation, ten types of tenure patterns could be identified regarding all allotments of both systems. Among the identified tenure arrangements, the most common type was owner cultivator system in which farmers had complete ownership of their land, while there were two or more share owners for the same land area with regard to jointly-owned system. Cultivation in the reserved common lands without permission was referred to as the encroached system. *"Ande"* system was another identified tenure pattern in which four types could be categorized as "taken *Ande*" and "given *Ande*" not only for short periods but also for long periods. The proportion given to the landlord depends on the nature of the agreement between the landlord and the cultivator in this system. In addition, two types of leasing patterns were also identified as "leased out" and "leased in" and the rate of leasing also varied with the farmer and the owner. Two other tenure types rarely observed were "deed not yet given" and "cultivation under permits". These types of arrangements could be identified throughout the project area. However a vast difference could be observed specially in the Old System regarding lowland, upland and chena separately. In many instances chena cultivation had been carried out on encroached lands in the forest reserves by the farmers of both systems.

All of the homegardens in the New System were under the owner cultivator system, but in the Old System, the other two types such as "jointly owned" and "encroached" were also identified.

Despite the prevalence of other types of tenurial patterns like "leased out", the majority (95.2%) of the New Systems' farmers had their own paddy lands. However, clear differences could be observed in the Old System, being an old settlement area characterizing various types of other tenurial arrangements, except owner cultivator system, due to land scarcity.

Table 2.6 Land Tenure

Type of Tenure	New System						Old System					
	LL		HG		HL		LL		HG		HL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Owner cultivator	101	95.2	106	100	-	-	45	55.5	66	81.4	-	-
Jointly owned	-	-	-	-	-	-	-	-	-	04	4.9	-
Encroached	-	-	-	-	13	86.6	02	2.4	05	6.1	15	93.7
Taken Ande (1 season)	01	0.9	-	-	01	6.6	01	1.2	-	-	-	-
Taken Ande (Long period)	-	-	-	-	-	-	31	38.2	04	4.9	-	-
Given Ande (Long period)	-	-	-	-	-	-	01	1,2	-	-	-	-
Leased in	-	-	-	-	-	-	01	1.2	-	-	-	-
Leased out	-	-	-	-	-	-	-	-	-	-	-	-
Deed not yet given	01	0.9	-	-	-	-	-	-	-	-	-	-
Permits	-	-	-	-	01	6.6	-	-	02	2.4	01	6.2

Source: Survey data, 1993

For instance, out of the farmers of the Old System, nearly 38% were cultivators under the "*Ande*" system and 43% of them were not the owners of lowlands. The "jointly owned" pattern was observed only in the Old System because more than one family lived together in the same house due to the existing land scarcity among a few families.

Therefore, the given situation shows that the land tenure pattern is more heterogenous in the Old System than in the New System. Details relating to the tenurial arrangements in both systems are indicated in Table 2.6.

2.6 Land Use Pattern in Agriculture

It is evident from Table 2.7 that the most common combination of land use was lowland cultivation together with homegardens, in both systems. Despite these two components of the land use pattern, a considerable percentage (15.0%) of farmers of both areas are still practising the traditional three fold pattern of land use which accounts for 14.2% and 16.1% respectively in the new and Old Systems. No other types can be observed in the New System except the above mentioned. In the case of the Old System, nearly 4 percent of farmers are having one component farms comprising only a home garden. Another small percentage contributes to the category of two component farms not having a home garden or a lowland. Therefore, according to the foregoing situation, it can be concluded that the land use pattern also gradually varied with time, from the settlement.

Table 2.7: Physical Structures of Farms in KOISP

	New System % of Farmers	Old System % of Farmers
HG only	-	3.8
HG + HL	-	1.2
LL + HL	-	2.3
HG + LL	85.8	76.6
HG + HL + LL	14.2	16.1

HG - Home garden
HL - Highland or chena
LL - Paddy land (Lowland)
Source: Survey data, 1993

CHAPTER THREE

Cropping Systems of KOISP

3.1 Introduction

In this chapter the natural environment and physical characteristics of the project area and the cropping systems of the project area are discussed.

3.2 Climate of the Kirindi Oya Project Area

Kirindi Oya Irrigation and Settlement Project is located in the southern tip towards the south east of the island in the district of Hambantota. The project area comes within the tropical arid zone DL_5 agro-ecological region where the average year round temperature is 26-28°C. The highest maximum temperature is recorded in the month of July (35-36° C) and the lowest minimum temperature occurs during the month of January (26° C). The average pan evaporation is highest in the region with a daily evaporation rate of 7-8 mm/day. Rainfall in the project area shows a bimodal pattern with the major peak experienced during Maha season (September to February) and a minor peak during the Yala season (March to September) with a total annual rainfall of less than 1000 mm. The most notable characteristic of the project area is that the cumulative evaporation exceeds the total rainfall received during the year (Figure 3.1). However rainfall exceeds the evaporative demand only during the months of November and December (Figure 3.2). Solar radiation received is also very high in the region. Therefore, the project area is blessed with the ideal climatic parameters for good agricultural production provided the moisture deficit could be counter balanced by irrigation water from the reservoir.

3.3 Soils of the Project area

The topography of the project area is characterized by rolling to gently undulating slopes and lies mostly below the 200 feet contour line. The region as a whole has scattered areas of erosion and rock outcrops are common on hill crests

(Soil Survey Report 19). The soils of the project area are composed almost entirely of four types with predominant five soil series mainly in Ranna, Nonagama, Ellagala, Siyambala and Thissa. The four soil types are:-

a) Well drained, dark brown to reddish brown soils (RBE) on the coast and upper slopes (Rhodustalf, order Alfisol)

b) Imperfectly drained, slightly darker and usually slightly finer brown to reddish brown soils (Haplustalf, order Alfisols)

c) Poorly drained finer dark brown to dark grey soils and pseudo-gley to gley horizons low humic gley (LHG), (Ochraqualf, order Alfisols)

d) On existing cropped (paddy) areas irrigated by tanks are the alluvial soils (Haplaquent, order Entisol)

The reddish brown earths consist of deep to moderately deep soils with textures varying from sandy clay loam to sandy clay and under natural conditions which are covered with shrubs and a two-storey forest. These are best suited to upland crops.

The low humic gley soils of the project area are those which are found in moderately flat lands or bottom lands which drain the peneplained land surface. They are characteristically greyish in colour and the sub soil consist of calcium carbonate concretions. These concretions begin to appear in small amounts as hard small "nodules" at depths starting from about two feet and increase with depth, forming some sort of a whitish calcic horizon. Texturally they are sandy clay loam to sandy loams. Occurrence of these concretions, high evaporative demand for moisture and lack of adequate irrigation water for flushing off the soils can build up salinity in these areas after several cultivation seasons. The Siyambala series of this soil group has been also identified as solodized solonetz and is generally unsuitable for most types of cultivation except for paddy under very good management.

The alluvial soils in the project area can be categorised into three groups according to their occurrence.

1) Soils found in the bank of the Kirindi Oya when the river is about 20 feet below the surrounding rice land,

2) Soil found in the flood plains below the reservoir at Tissamaharama tank, and

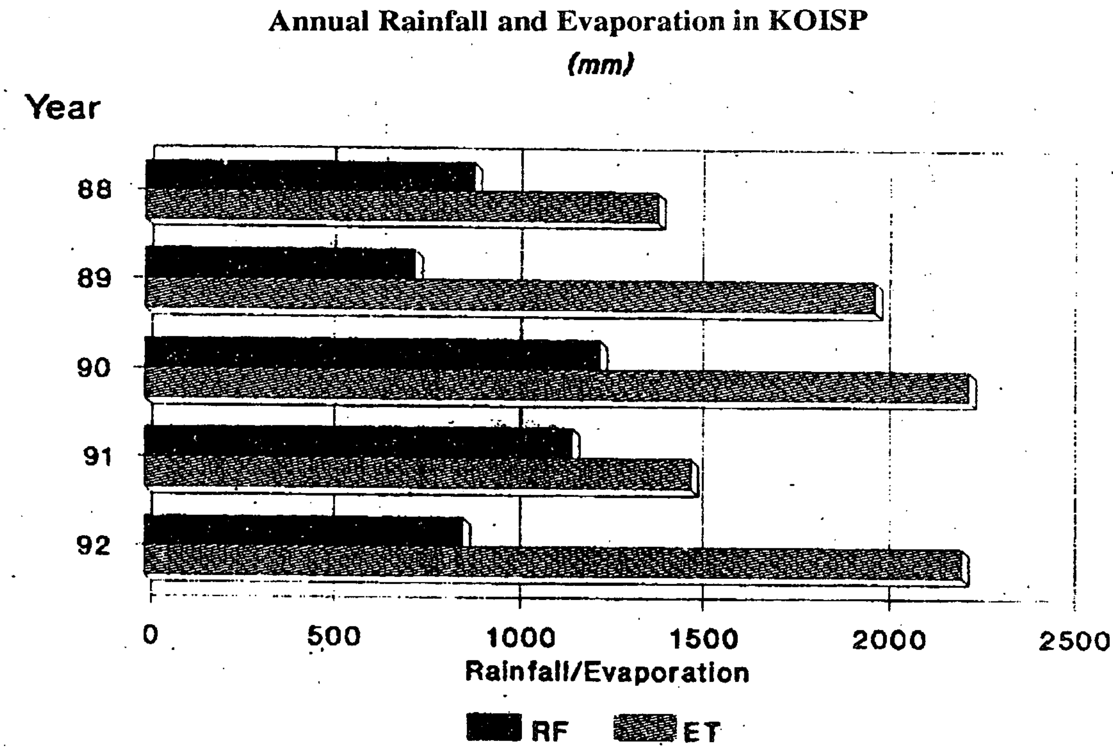

Annual Rainfall and Evaporation in KOISP
(mm)
Year
88
89
90
91
92
0
500
1000
1500
2000
2500
Rainfall/Evaporation
RF
ET

Figure 3.1

Monthly Rainfall and Evaporation in KOISP

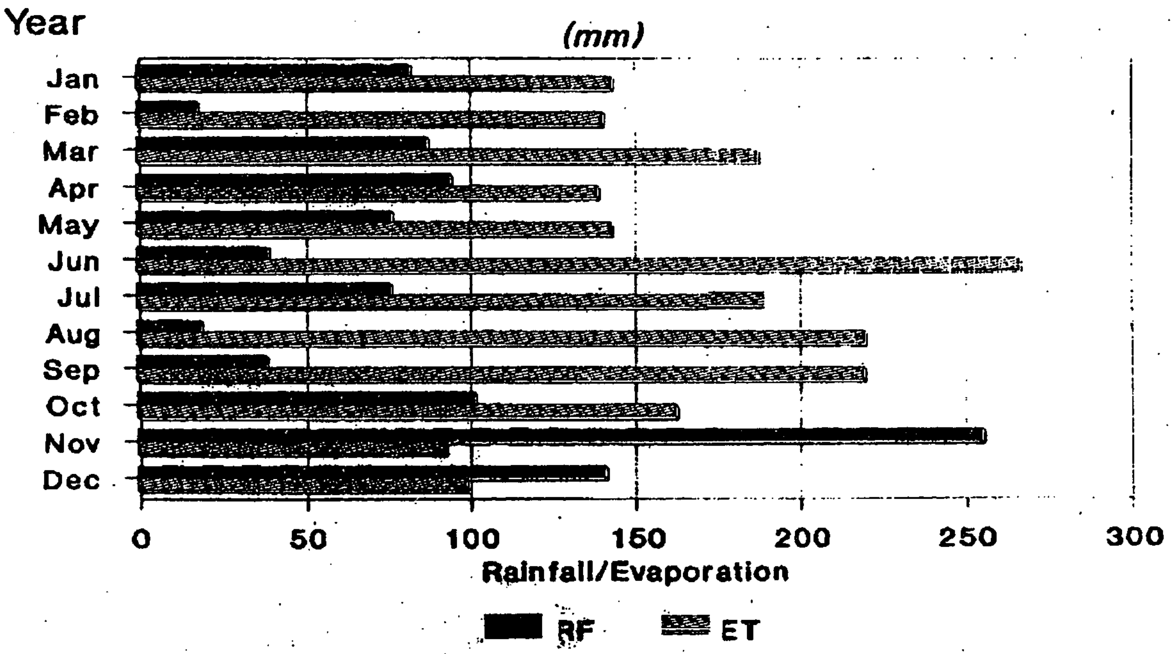


Figure 3.2

3) Heavy textured alluvial soil found in the area below the Ellagala anicut.

Naturally these soils vary from loamy sand to loam, sandy clay loam to clay loam. Most of these soils are planted with to rice.

3.4 Salinity Problem

As indicated above, the salinity problem in the project area is spreading. Occurrence of salinity in different tracts is shown in Figures A-1 to A-4. The highest occurrence in salinity is found in Tract 5 of the right bank in the newly developed area. Developing new lands and the construction of Lunugamwehera reservoir above the Ellagala Anicut curtailed the water supply for the Ellagalla five tank system namely, Weerawila, Yoda, Tissa, Pannegamuwa and Deberawewa. Thus the feeder channel is provided from left main canal to feed this system. In addition, the drainage water from the newly developed area also empties into these five tanks increasing the problem of salinity in the Old System (Ellagala). The drainage water from the newly developed area normally carries the flushed out salts; thus the electrical conductivity (EC) concretions level of this water is high. This is further aggravated by the presence of calcium carbonate at fairly low depths in Low Humic Gley (LHG) soils. Drainage water with a heavy load of salts once fed to the five tank system, increase the conductivity levels thus threatening a salinity build up in the Old System. The EC change of the five tanks and Lunugamvehera during 1992 is given in (Figure A-5). The salt concentration of water of the five tank system fluctuates over a wide range whereas the water in Lunugamwehera reservoir is at the upper margin of class I irrigation water (EC 0.25 milli mhos /cm). The data from tank water quality of Ellagala system monitored over the last three years shows that salt concentration of tank water differs appreciably from that of Lunugamwehera (Quarterly report, 1992). In the case of Weerawila tank, its catchment area is completely developed for irrigated cultivation under the Lunugamwehera reservoir, causing drainage and seepage water collecting into this tank, hence recording a consistently higher EC value in the reservoir water. Thus the old Ellagala system has become more prone to salinity build up than the newly developed system.

The soil salinity in the irrigated area under the Weerawila tank during the period June to December 1992 is given in Figure A-6 (Roonage, 1993). This illustration shows that high EC values during drier months (June to Sept.) especially in poorly drained soils and a sharp drop in the values with the onset of Maha rains but still remain at the lower limit of low salinity level (0.2 m. mhos/cm). The same trend is observed in the other four tanks of the Ellagala system (Roonage, 1993).

3.5 Cropping Systems in KOISP

The project started in 1982 with the construction of Lunugamwehera tank. While land development and channel construction were in progress, the settlement of farmers was also started simultaneously and in 1986, 3600 families were settled. However, the reservoir operation was commenced in 1986 even though the tank was not filled to the projected level. Crop diversification with Yala Other Field Crops, (OFCs) within the project area could not be achieved because of the farmers preference to rice cultivation and the project management played to the tune of farmers due to reasons beyond the control of the management. Therefore right from the beginning of the project, neither the irrigation water issues could be carried out as scheduled nor the tank was filled to its capacity at any one time. Thus a water deficiency was always created in the system and in some seasons crop failures were also observed.

3.5.1 Cropping Area

The cropping area under KOISP consist of three groups based on the hydrological and other important characteristics

(1) Ellagala Irrigation System (EIS)
(2) Newly Developed Area (NDA) (left and right banks)
(3) Bandagiriya

Ellagala Irrigation System which is an ancient settlement scheme was receiving its water supplies through interconnected tank systems, diverted from the Ellagala anicut of the Kirindi Oya. After the construction of Kirindi Oya reservoir a feeder canal was constructed from the left bank canal to meet the water requirement of the Ellegala system. In addition, Ellagala system receives water from

(1) Return flow from about 2500 ha. of NDA
(2) Run off from its own catchments

Farmers in this system enjoyed two crops of rice in Yala and Maha seasons and continued to claim and enjoy two rice crops. However, due to shortage of water they shifted from 4-month varieties to 3 1/2-month varieties.

Bandagiriya Wewa which is located south of Kirindi Oya is in the Malala area basin. The right bank main canal of Kirindi Oya reservoir was extended to this reservoir with the intention of releasing excess water to the tank, but later farmers fought for their right and ended up receiving water for their two-season cultivation on the condition that they do 70% paddy and 30% OFCs respectively in Yala and no water will be issued to them to commence Maha cultivation.

The new land area was provided with irrigation facilities, but due to insufficient water, development of some tracts was delayed and development work is still in progress in Tract 3 of LB at the time of termination of Kirindi Oya Project.

3.5.2 Suggested Cropping Systems

Water issues from the Lunugamwehera tank was commenced in 1986 even though expected water inflow to the reservoir and the expected water storage was not fulfilled. Thus, water shortage was foreseen by the planners and several cropping systems were suggested by several agencies. The ADB Appraisal Team in 1977 suggested the following cropping patterns:-

	Maha Season	Yala Season
Lowland	Rice	Rice
Upland	Other field crops (Pulses and cereals)	Cotton and other Pulses

The ADB Appraisal Team in 1982 after studying crop preferences by settlers, economic returns, and crop water requirements suggested the following cropping patterns:-

Table 3.1: Farming Systems Suggested by ADB, 1982

Season	Ellagala	Newly Developed Areas(NDA)		
		Upland	Intermediate	Lowland
Maha	Rice	Upland Rice	Rice	Rice
Yala	Rice	OFC	OFC	Rice

Source: Survey data, 1993

This was again reviewed in 1986 as follows.

Table 3.2: Revised Farming System of ADB, 1986

Season	Ellagala	Newly Developed Areas(NDA)		
		Upland	Intermediate	Lowland
Maha	100% Rice	60% Upland rice 20%	80% Rice OFCs	100% Rice 20% Rice
Yala	50% Rice 50% OFCs	100% OFCs	20% Rice 80% OFCs	50% Rice 50% OFCs

Source: Survey data, 1993

Water management consultants for the Department of Irrigation in 1987 suggested the following:-

Table 3.3 : Farming System by Water Management Consultants

Season	Ellagala	Newly Developed Areas(NDA)		
		Upland	Intermediate	Lowland
Maha	100% Rice	60% Rice 40% OFCs	20% Rice 80% OFCs	20% Rice 80% OFC
Yala	50% Rice 50% OFCs	50% Rice 50% OFCs	100% OFCs	100% OFCs

Source: Survey data, 1993

None of these suggestions could be adopted in the KOISP due to various reasons, some of which were beyond the control of the Project Management. The Technical Assistance Study (1990) indicates that the cropping patterns in the past could not be implemented for many reasons. These include the farmer organizations not being strong and effective, institutional support arrangements, lack of adequate credit and marketing facilities and lack of strong overall project leadership among others. The survey revealed that the major constraint was the institutional problems associated with political influence. Another problem was the fact that Ellagala farmers were allowed to enjoy two rice crops as before, which the farmers of NDA also wanted even though they were aware of the fact that the reservoir's storing capacity cannot cater to that type of water demand. A classic example of institutional problems highlighted above where the project Management Committee (PMC) and the Irrigation Department was overpowered by other elements of power was seen in Yala 1992.

The dry weather that prevailed during Maha 1991/92 which continued into Yala 1992. The storage position in the Lunugamwehera reservoir was low and water issues for late Maha rice crop in the RB system and OFCs in LB Tract 3 continued till May which utilized a part of Yala inflow received in the reservoir. At this time where tanks were dry except Weerawila tank, which was full due to drainage water, started issuing water for Yala starting on 1st March 1992. When farmers of other tanks saw this they insisted on water issues and in spite of Irrigation Department's warning them of a deficit of 30,000 ac. ft. for the season, farmers were allowed water and Lunugamwehera reservoir water level dropped down steadily as there was no inflow to the tank. However, the gates were closed after the water level reached 152 ft. As a result, farmers faced crop failure in Ellagala system except those at Weerawila tank.

A similar situation, where farmers overpowered the decision making institution in the NDA was observed in Maha 1992/93 season, where an appreciable hectarage was planted with OFCs, mainly ground nut, due to shortage of water for rice cultivation. Later in the season unexpected rainfall due to a depression in the south sea brought in a large inflow to the Lunugamwehera tank and a decision to issue water for rice cultivation was enforced on the PMC by the farmers during mid-season. The decision came at a time when OFCs were at the bearing stage. As a result OFC cultivation was completely destroyed by excess moisture due to this decision.

Even though there was no established cropping system in the area due to irregular water issues, the survey of four seasons starting with Yala 1991 revealed that it was not possible to implement any of the cropping systems hitherto suggested though several pilot OFC programmes were implemented at different times.

3.6 Identified Cropping Systems in NDA and Ellagala

The cropping systems thus identified by the survey can be classified as follows:

Ellagala System

(1) Maha rice followed by Yala rice
(2) Maha rice followed by OFC (a very small fraction) in Yala

NDA

(1) Maha rice followed by Yala fallow
(2) Maha rice followed by Yala OFCs on residual moisture
(3) Maha rice followed by Yala OFCs under irrigation
(4) Maha rice followed by Yala OFCs under shallow wells

Table 3.4 (crops grown in lowland during the past four seasons) clearly shows the above classification of cropping systems. During Yala season only 0.61% of the land area was cultivated with rice, which could be a sampling error in this survey. The Yala season OFC cultivation in the NDA is 5-6% of the sample area whereas in the Ellagala System it is only 1-4%. The low extent of OFC cultivated in the Maha season was totally due to farmer preference to rice cultivation. Yala 1992 water issues were made early in the Ellagala System and reduced the OFC extent to 1.9%. In the Ellagala System, Maha extent of rice cultivation is higher than the Yala extent which was due to the low availability of irrigation water.

This table also shows that in terms of this cropping system, Maha rice followed by Yala fallow seems to be the dominant system in the NDA. During Yala 1992, the OFC programme was under rainfed and shallow dug well system since no irrigation water issues were made. However, the economic performance of OFCs under rainfed and dug-well programme was unsatisfactory during this season.

An unirrigable highlands, the cropping system is perennial crops such as Jak, Breadfruit, Coconut, Mango while in Maha season rainfed OFCs and vegetable are grown as intercrops. The permanent crops available in homegardens are shown in Table 3.5. During the four seasons during which the survey was conducted pigeon pea was also introduced as an intercrop in the homegardens.

Table 3.4: Extent of Crops Grown During Past Four Seasons

Season	Paddy				OFCs			
	New System		Old System		New System		Old System	
	Acerage	%	Acerage	%	Acerage	%	Acerage	%
1992/93 Maha	215.75	66.30	231.25	70.30	21.50	6.60	12.50	3.80
1992 Yala	2.00	0.61	189.25	57.60	16.00	4.90	6.25	1.90
1991/92 Maha	230.25	70.80	238.75	72.60	17.25	5.30	7.50	2.20
1991 Yala	2.00	0.61	156.25	47.50	14.25	4.40	11.50	3.50

Source: Survey data 1993

Table 3.5: Permanent Crops Available in Homegardens

Crop	% Farmer reporting	Average No. of trees per holding
Coconut	41.66	09
Mango	9.58	02
Jak	11.25	02
Banana	3.33	09
Orange	2.50	08
Lemon	5.41	04
Cashew nut	5.83	03
Pomegranate	3.33	07
Woodapple	0.41	03
Papaw	0.83	04
Breadfruit	0.83	02

Source: Survey data, 1993

3.6.1 Crops Grown

Crops grown in the NDA of KOISP include 3 - 3 1/2 month paddy during Maha season and OFCs in the Yala season which include pulses, oil seeds and vegetables. Among the pulses green gram is the most popular while a few farmers grow cowpea, blackgram and pigeon pea. The commonest cereal is the finger millet, while other small grain cereals are grown on very limited extents in the chenas or homegardens. The most popular oil seed crop is ground nut while sessame comes next, ground nut grow very luxuriously in the highland where the soils are sandy loams. The main constraint in OFCs is the lack of true to type seeds and farmers invariably use their own seeds or through seed exchange among farmers. The true to type seed supplier, the Department of Agriculture (DOA) also helpless due to two reason. One reason is that the DOA cannot supply the full requirement of seeds and secondly the seed requirement cannot be foreseen before-hand because of the uncertainty of cultivation due to the uncertainty of inflow to the reservoir.

Among vegetables Pumpkins, Okra, Brinjal, Tomato and Green Chilli are the common varieties whereas Long beans, Luffa, are less common. Here again the true to type seeds are the major constraint and farmers use their own seeds season after season. Because of the lack of proper seed materials, the care for vegetable crops was also minimal. Apart from these, during the four seasons of the survey, we observed an increasing tendency of growing red onions and big onions by the KOISP farmers.

Ellagala System 3 - 3 1/2-month paddy is grown mostly in both seasons. (Commonly grown paddy varieties are given in Table 3.6). Here again, the major constraint is the seed paddy where the DOA Seed Division is committed to supply. However, the DOA up to now has not been able to supply the full requirement of the different varieties in any one season. The Annex Table 3 shows the picture of seed paddy provision by the DOA for Maha 1992/93 season. This clearly shows that farmers are forced to grow their own varieties and some varieties of rice forced on the farmers by the DOA may or may not be against the farmers' wishes.

Table 3.6: Commonly Used Paddy Varieties in the Project Area

Variety	No. of Respondents	%
1. BG 350	53	28.3
2. BG 300	31	16.7
3. BG 380	18	9.6
4. AT 76/1	09	4.8
5. AT 69/2	08	4.3
6. Other	21	11.2

Source: Survey data, 1993

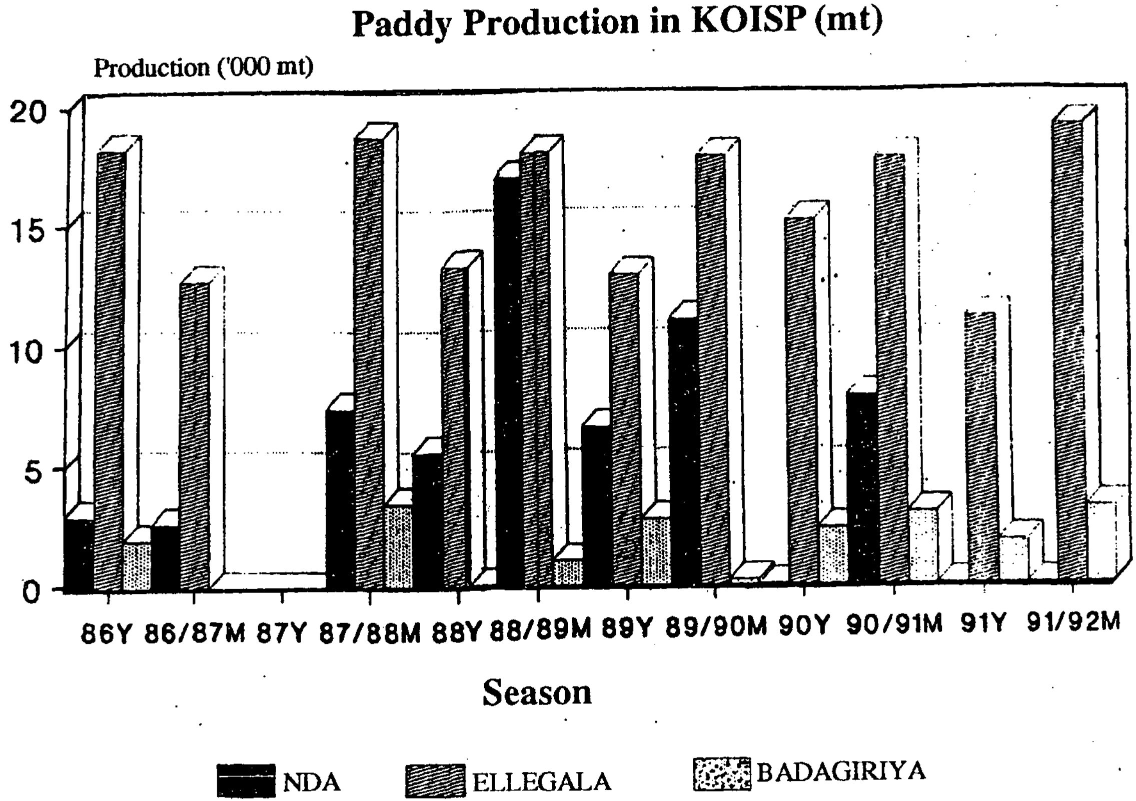

Paddy Production in KOISP (mt)
Production ('000 mt)
20
15
10
5
0
86Y 86/87M 87Y 87/88M 88Y 88/89M 89Y 89/90M 90Y 90/91M 91Y 91/92M
Season
NDA
ELLEGALA
BADAGIRIYA

Figure 3.3

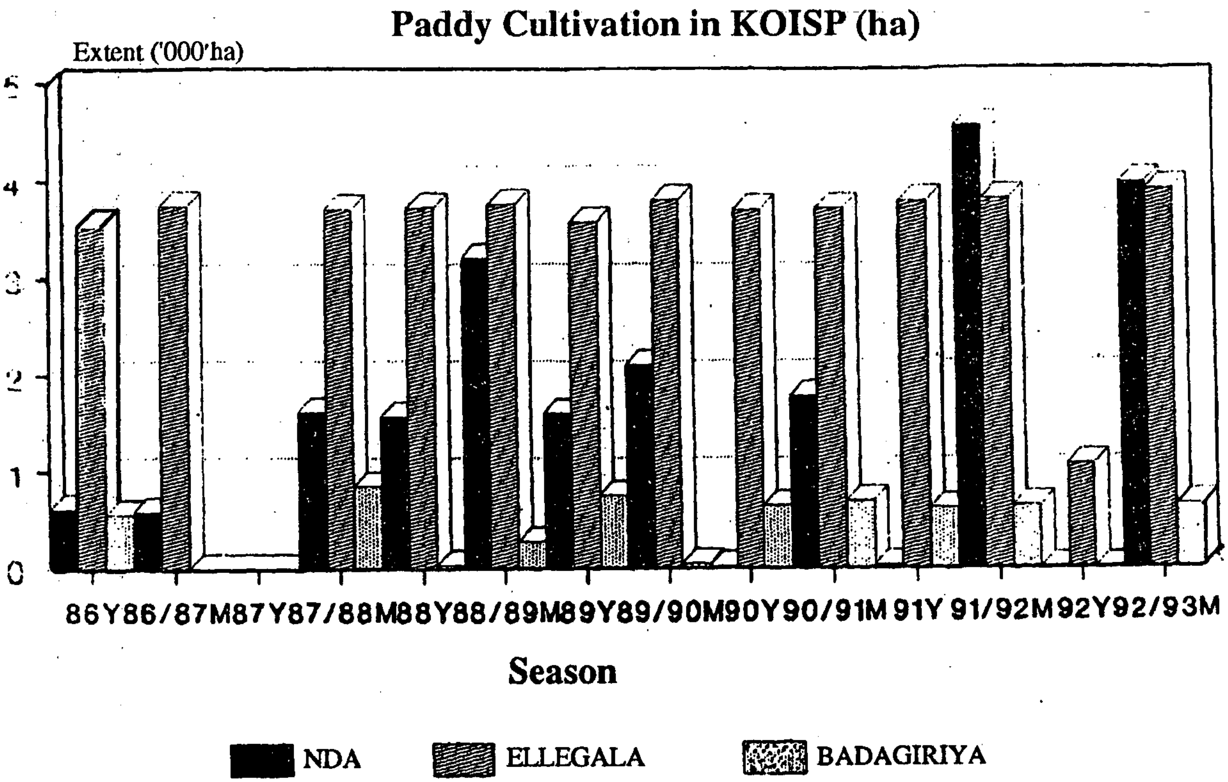

Paddy Cultivation in KOISP (ha)
Extent ('000'ha)
0
1
2
3
4
5
86Y86/87M87Y87/88M88Y88/89M89Y89/90M90Y90/91M91Y91/92M92Y92/93M
Season
NDA
ELLEGALA
BADAGIRIYA

Figure 3.4

3.7 Irrigated Hectarages

The KOISP was planned to have 12,900 ha of irrigable land developed for agriculture. However due to problems encountered while implementation, only 9,900 ha were developed. Due to the shortage of water in the reservoir the entire hectarage is not irrigable at any one time up to date. The extent of paddy cultivation in the KOISP under the three systems is given in the Annex Table 4. It shows that the irrigated hecterage was constant in Ellagala System, where the majority of the hectarage was cultivated with paddy, whereas in the NDA the irrigated hectarage was very small in the Yala season, whereas it is high in the Maha season as the majority of farmers grow rice. The extents of paddy cultivation and production are shown in Figures 3.3 and 3.4. This preference of the farmers to grow rice whenever there is water is due to the following reasons:-

1. Staple food of the farmers,
2. Ready market for the product and comparatively less price fluctuations,
3. Storage is possible if necessary,
4. Less labour intensive and ideal for migratory settlers,
5. Technology is well developed, and
6. Is risk-free compared to other crops.

Farmers not only prefer rice cultivation, they also treat officers who attempt to convince them for crop diversification as traitors or enemies. Thus crop diversification with regard to Yala OFCs is a herculean task for the Agriculture Extension Officers in a democratic system. The extent of OFC cultivation during Maha 1992/93 is shown in Annex Table 5.

3.8 Cropping Pattern and Cropping Calendar

The cropping calendar more than the cropping pattern is the most uncertain thing in the KOISP. This is because these two factors depend on the water inflow to the reservoir. This is true for the whole system except for the command area under Weerawila tank where the tank reservoir run-off and drainage water from its own catchment and the NDA respectively are the inflow sources. Cropping calender is decided by a meeting called the "*kanna*" meeting represented by the farmer organizations, Project Management, Irrigation Department and the Agriculture Department. At this meeting cropping calender for a particular season will be decided depending on the availability and the expected inflow to the Lunugamwehera reservoir. Due to the above reason the cropping calender for any two Yala or Maha season will never be the same.

Even if the cropping calendar was decided by the "*Kanna*" meeting this schedule cannot be strictly observed by the farmers due to the unavailability of tractors for land preparation, seed material, fertilizer, agro-chemicals and, above all, the liquid cash availability of the farmers.

The cropping pattern during the four seasons surveyed is shown in Figures 3.5 and 3.6. As described therein the the pattern is different between Ellagala and NDA and also from season to season. Further due to input unavailability a 3-3 1/2 month crop of rice from 1st cultivation to the last harvest takes 5 1/2 - 6 months. This also constraints the irrigation issues and the water use efficiency of the available water. Farmer uncertainty also contributes to this since the settlers cannot be certain whether they will have a cultivation in the coming season in the course of the present season so that they could plan ahead of the season. Another contributory factor is the migratory nature of the farmers which again due to the uncertainty of the future cultivation.

3.9 Paddy Yield

The avearge paddy yields per hectare obtained during the 1992/93 Maha season in the New and Old Systems of the project area were 3.9 MT and 4.3 MT respectively. This yield is above the national paddy yield (3.5 MT) for 1992.

3.10 Agricultural Inputs and Cultural Practices

The survey analysis indicate that except for hired labour other inputs are available in abundance (53 - 82%) (Table 3.7) and most of these are obtained from the private sector (Table 3.8). The Agrarian Service Centre's involvement in input supply is 15-22%. Further, private sector agriculture inputs are not reliable as there are many complains regarding their inefficacy. This indicates that even though they feel that inputs are in abundance, the real situation is that they are not getting quality inputs. Thus reaping the full potential of agricultural crops cannot be achieved by the farmers. Fifty six percent of the farmers in the sample survey indicated that seeds are always in abundance, but the fact remains that most of the farmers are using low quality seed materials (both paddy and OFCs) either supplied by themselves or through exchange. In the case of paddy, the DOA is unable to provide the required

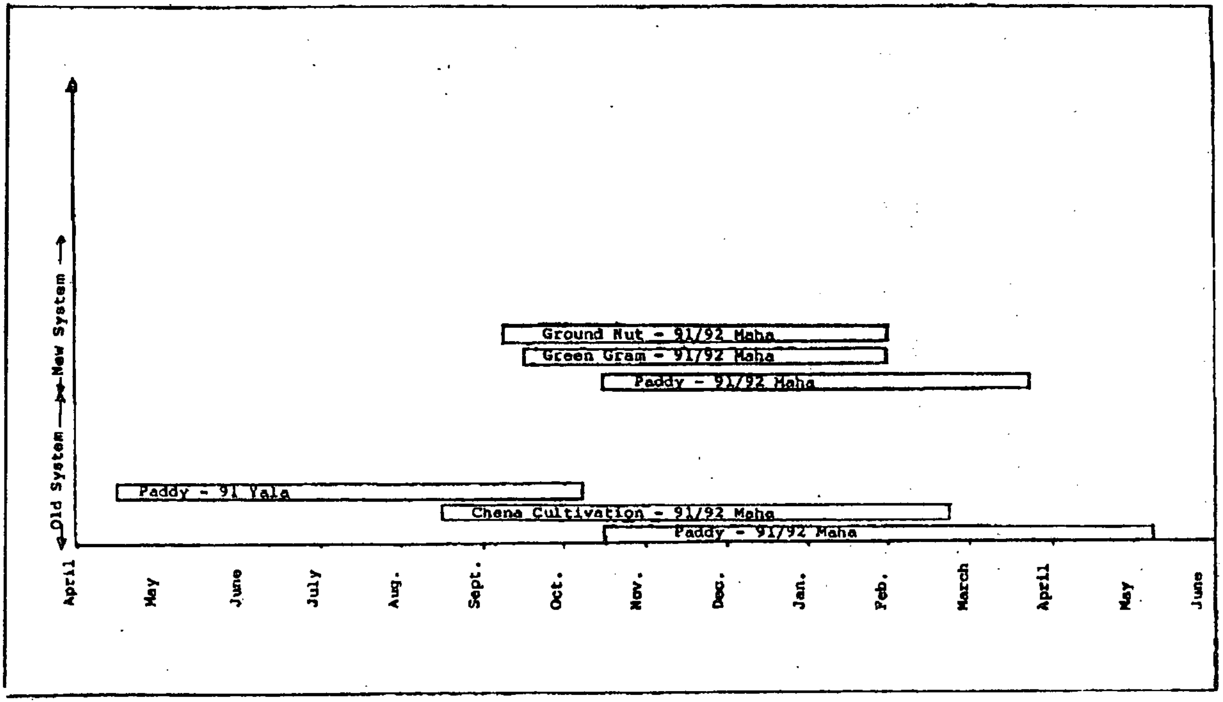


Figure 3.5 : Cropping Pattern 91 Yala and 91/92 Maha New and Old Systems

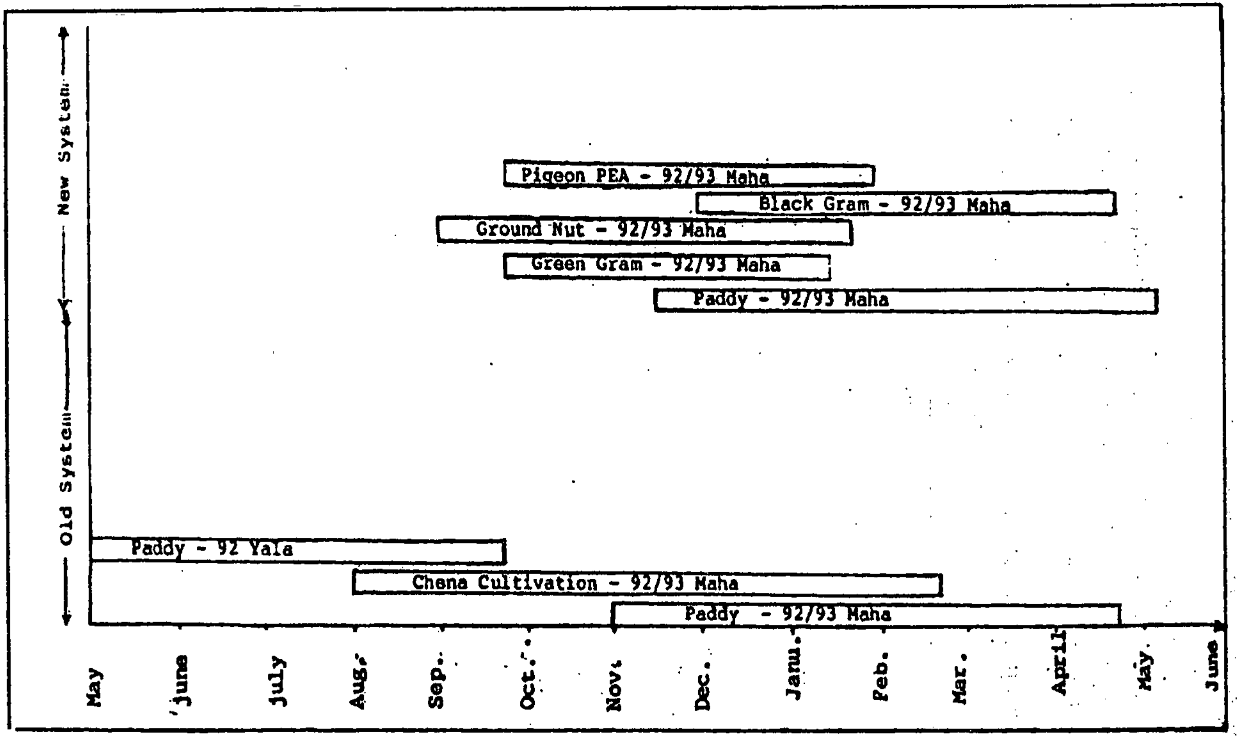


Figure 3.6 : Cropping Pattern 92 Yala and 92/93 Maha

amount of seed paddy for the project area which means that farmers are using their own seed paddy or exchange materials with other farmers. This leads to the lowering of paddy yields consequently. Since the DOA has no sound seed production programme for OFCs to produce the total requirements of the country, the farmers are handicapped for OFC seeds and private vendors sell low quality seed materials which are almost forced on to farmers, thus reducing their potential yields.

Table 3.7: Respondents' Evaluation on Input Availability in the Project Area

Evaluation	Fertilizer	Agro-chemicals	Seeds	Machinery	Hired Labour
Always in abundance	140 (80.0)	145 (82.4)	98 (56.3)	92 (53.5)	67 (39.0)
Not always in adequate quantities	25 (14.3)	25 (14.2)	46 (26.4)	14 (8.0)	19 (11.6)
Inadequate during the season	9 (5.1)	5 (2.8)	29 (16.7)	48 (28.0)	71 (41.3)
Not available during the season	1 (6.6)	1 (0.6)	1 (0.6)	18 (10.5)	15 (8.7)

% in parenthesis
Source: Survey data, 1993

Table 3.8: Respondents Evaluation on Source of Input in the Project Area

Input \ Source	A.S.C.	Private Sector	Relatives	Co-op	Own
Fertilizer	40 (22.1)	126 (69.7)	- -	15 (7.8)	- -
Agro-chemicals	34 (19.3)	131 (74.4)	- -	11 (6.2)	- -
Seeds	28 (15.7)	70 (39.3)	26 (14.6)	- -	54 (30.3)

% in parenthesis
Source: Survey data, 1993

During Yala 1992 farmers blamed the DOA for not providing adequate seed paddy. Our analysis revealed that they have made requests to the DOA just prior to the water issues without giving adequate time. Neither the farmers nor the DOA can be blamed for this because they cannot make prior arrangements for the seeds due to the unreliability of sufficient inflow into the reservoirs.

Kirindi Oya farmers use the two wheel tractor for land preparation work and 53% of the farmers felt that it is in abundant supply during the season. However, these tractors are brought from Tissa, Ambalantota, Hambantota areas during cultivation and non-overlapping of land preparation in these areas made farmers to think that tractors are available in abundance. However if land preparation coincides, there will be a short supply of machinery for the project areas. Purchase of tractors by the farmers with ADB loans can ease out the problem in the future.

Cultural practices and crop care by the Kirindi Oya farmers are very poor which can be attributed to the lack of cash with farmers. Farmers who adopt proper cultural practices are those who could obtain credit facilities either from the bank or from private lenders. Proper cultural practices and better crop care could be adopted by the farmers through institutional involvement in getting the inputs necessary for them and thereby help to increase yields. Thus poor cultural management can be attributed to lack of finance for the farmers and the uncertainty of irrigation water right through the season.

3.11 Pest and Disease Problem

Pest and disease problem in the Kirindi Oya area is much less compared to surrounding areas and the Ellagala System. The use of pesticides by the NDA farmers is below the recommended rates (the use of pesticides, weedicides and fertilizer by the farmers is shown in Tables 3.9, 3.10 and 3.11) which can be attributed to the low liquid cash with the farmers. Further, credit facilities from banks do not include an item for the purchase of agro-chemicals. Low incidence of pests and diseases in the NDA can be attributed to vary harsh climatic conditions as well as to the fallowing of the majority of the cropped land during Yala season, thus breaking the continuation of the life cycles of the different pests. Under the Ellagala System pests and diseases are more prevalent because of two-season cultivation, mostly the same crop (paddy). Control measures adopted by farmers in the case of pest and diseases are adequate and at recommended dosages in the Ellegala Irrigation System.

Table 3.9: Fertilizer Usage for Paddy and Cost per Hectare

	V mixture Kg	Urea Kg	TDM Kg	Total Qty/ha(Kg)	Total Cost per ha (Rs)
New System	90.8	127.3	110.3	328.3	3582.50
Old System	141.8	233.5	136.3	511.5	5102.50

Source: Survey data, 1993

Table 3.10: Weedicide Use per Hectare

	3 4 DPA Lts.	MCPA Lts.	Hedonal Lts.	Total Qty/ha (Rs)	Total Cost /ha (Rs)
New System	2.8	3.0	2.0	9.5	2470.00
Old System	4.5	4.0	2.3	10.8	3452.50

Source: Survey data, 1993

Table 3.11: Pesticide Use per Hectare

	Monocroto -phos	Dimethoate Lts.	B.P.M.C. Lts.	Total Qty/ac (Rs)	Total Cost/ac (Rs)
New System	1.73	1.10	1.83	4.65	1104.00
Old System	1.98	1.38	2.28	5.45	1347.50

Source: Survey data, 1993

3.12 Institutional Support

Single season cultivation and the lack of adequate capital to use agricultural inputs adequately are the two main factors that preclude the Kirindi Oya farmers from getting high incomes from their agricultural crops. Therefore institutional support for the farmers is vital. Our survey shows that 44.9% of the surveyed farmers in the NDA obtained credit but only 36.5% of them repaid their loans

(Annex Table 6). Those who failed to pay the loans cannot enjoy the credit facilities in the next season. Thus, season after season, defaulters increased and institutes become helpless in providing loan facilities. Thus, farmers started renting their lands to non-residential farmers. This could also lead to a drop in production.

The Ellagala System farmers are economically more stable probably because of the available facilities for two-season paddy cultivation. Only 22% of farmers obtained credit and 20% of these repaid the loans.

Agricultural insurance also followed a similar trend in the case of both the NDA and Ellegala farmers where 51% the farmers in the NDA insured their crops because of the uncertainty of irrigation water whereas in the case of Ellagala farmers only 14% insured their crops. This drop in the percentage insured in the Ellagala System is probably due to the certainty of irrigation water for both seasons.

As much as institutional support for agricultural production process is necessary, such support for marketing facilities is also important. Since there is a glut of production during the peak season, prices become low and farmer profits decrease. Thus institutional involvement for value addition to the products and streamlined marketing channels is of vital importance in order to maintain higher profits from agricultural products of the KOISP farmers.

3.13 Marketing System

There is no organized marketing system developed for the KOISP farmers. Thus their marginal profits decreases either due to higher production, lowering unit prices or unprofitability of the products. Generally OFC production involves more risk and uncertainty than in marketing rice. This is mainly due to price uncertainty, pests and diseases affecting stored products and other variations in physical conditions. During 1991/92 different chilli farmers sold chillies at different prices on the same day. Local buyers offered a higher price for chilli varieties because the local demand for local chillies is higher. On the other hand, during the same season green gram price changed though less frequently. During the early season the price was Rs.10-22 per kilo and it rose up to Rs.24-27 per kilo towards the latter part. This was really due to the quality factor where the early crops were affected by heavy rains at harvest.

There appears to be three kinds of buyers in the KOISP areas:

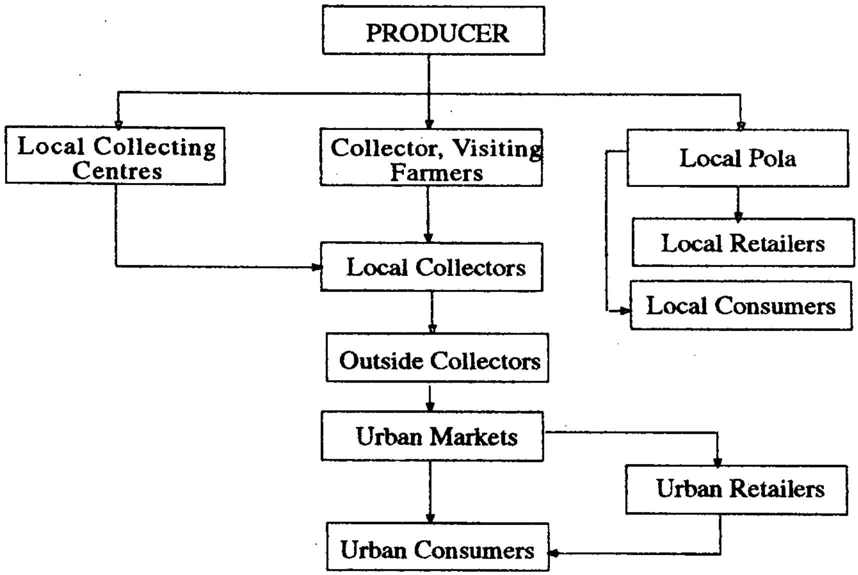
(a) collectors who come to the farmers fields

(b) buyers who operate at the local market at Pannegamuwa and
(c) buyers who have their permanent places in the area.

The third category purchase legumes and the 2nd category vegetables and legumes. These people seems to have a good control over the market.

Due to the lack of a proper marketing system and the dominant role played by local buyers, farmers tend to get discouraged. Therefore a streamlined marketing system should be developed with the institutional involvement. Thereby farmers are able to sell their products at a reasonably higher price. At the moment the local buyers who are the middlemen for the outside buyers dominate the market and fix the prices of the products and this trend is followed by all the buyers at the public fair. If this can be streamlined, especially for OFCs the income of the farmers could be increased so that they could be better cultivators' in the next season, with the help of the higher capital gained during the season. Entry of outside buyers which is now disallowed by the local buyers should be forced into the markets through the intervention of the institutes which will invariably increase the price per unit product thereby increasing the farmer incomes. A flow chart of marketing of agricultural produce in Kirindi Oya area is presented in Figure 3.7.

Figure 3.7 : Flow Chart of Marketing Agricultural Produce in KOISP



CHAPTER FOUR

Livestock Farming System in KOISP

4.1 Introduction

The study reveals that at present, livestock production is yet based on the extensive system and practised as a secondary enterprise. It is poorly integrated with crop production. The crop producers are often in conflict with cattle owners. The livestock is often referred to as "stray animals". Of the total of 187 farmers encompassed by this study, 31 farmers rearing livestock (16.5% of the sample) were interviewed to assess the present livestock farming system. The study revealed that, of the farmers only 15.1% in the new settlements, and 12.3% in the old settlements, are involved in both crop and livestock production. However, cattle rearing remains as a principal income source only for 2.6% of farmers, who are the traditional cattle farmers in the Kirindi Oya basin. These traditional cattle farmers are fast disappearing and are the descendants of the indigenous cattle owners or "*Gambarayas*" in villages who owned large herds, from the ancient times.

Reference to livestock husbandry systems under the ancient dry zone farming systems dates as far back as the 4th and 5th centuries B.C. The ancient chronicles "*Maffhims Nikayayo*" and "*Papanca Sudani*" provide ample evidence on the strict adoption of specific strategies on cattle husbandry management without over grazing causing damage to crop and watering / wallowing procedures.

Therefore it has been established that before the advent of the KOISP, under the traditional farming systems, a well integrated and an interdependent, complex and environmentally friendly farming system involving upland homesteads, livestock, forests, permanent crops, chena, and lowland paddy, including tank fish farming, existed in the Kirindi Oya basin. However this traditional production system came under severe stress since the mid-20th century with the introduction of tractors for farm power. The dependency of agriculture on cattle and buffaloes disappeared, and depleted the redundant livestock population with an increased off-take for meat. The rapid conversion of grazing scrub lands, forest reserves and ancient small tanks for other development activities accelerated this process.

The KOISP transformed 6000 ha of forest shrub lands or common property resources used by cattle into irrigated agricultural lands and another 4000 ha for other development work. It is obvious that the use of common property resources by livestock owners who did not own land had been omitted during the planning stage of this project. A common tendency of traditional cattle owners observed during this study not to divulge the actual cattle numbers owned by them had placed the cattle population of Kirindi Oya at a severe disadvantage since the common property resources and grazing reserves allocated for cattle were totally inadequate. The lack of understanding on the critical resources for extensive traditional livestock management systems was a major deterrent for crop production.

Damage to crops from cattle is often highlighted and effectively resolved by a system of payment of fines and detention of animals. However the social injustice of depriving common property resources and grazing reserves to hungry cattle herds, which also constitute the country's national herd, had not received any attention and hence requires to be highlighted. The major emphasis placed on crop production with the allocations of lands only for crops and the influx of technological inputs undoubtedly increased farmer incomes from crop production. However, a parallel development with land distribution and technology packages for cattle raising did not take place resulting in an uneven delivery of inputs into the Kirindi Oya basin. The critical resources in the dry zone viz. forest shrub lands, pasture growth and water, follow a bimodal pattern and the restriction of the grazing areas in favour of irrigation and agricultural pursuits, which can have direct implications on the indigenous cattle genetic resources of Sri Lanka. This study reveals that the cattle herds in the Kirindi Oya basin are losing body weights and body conditions throughout the cultivation season when the pasture growth is deemed inadequate, as well as during the dry periods when cattle feeds are naturally scarce. The livestock farmers have therefore adopted several cattle farming systems as short term measures in view of the conditions imposed by the advancing irrigation and agricultural lands.

Based on the findings of this study sample, this Chapter discusses the livestock husbandry systems in the project area and suggestions for improvements, with recommendations for possible implementation.

4.2 Livestock Husbandry Situation

Livestock farming has been identified as a lucrative activity in the Kirindi Oya basin. However, as shown in Table 4.1, the major emphasis is on paddy cultivation.

Table 4.1 : Types of Farming Activities

Activity	New System No. of respondants	%	Old System No of respondants	%
Crop Farming	90	84.90	66	81.48
Livestock Farming	-	-	05	6.17
Crop and Livestock Farming	16	15.10	10	12.34

Source: Survey data 1993

As can be seen, both livestock and crop farming are major income sources for farmers in the new settlements. Although the farmers in the *Purana* villages or old settlements have traditionally maintained fairly large herds of livestock, primarily as a means of financial security the present trend appears to be more towards the sale of fresh milk and live animals from relatively small herds. At present the use of animals for draught power and manure shows a marked decline. The study sample showed only 3.2% of farmers using cattle for draught power mainly due to mechanization.

A majority of farmers showed a preference towards neat cattle rearing (48%) and 35% preferred keeping both cattle and buffaloes. Goat and poultry rearing is not popular (3.2%). Table 4.2 shows the percentage distribution of animal numbers as reported by the farmers which reflects a wide variation and preference on the animal types.

4.3 Husbandry Systems

Four major husbandry systems were observed among the cattle owners (Table 4.3).

(a) Traditional System

Animals are extensively grazed on common property resources within the villages and forest reserves during the cultivation periods with the use of both family labour and hired labour. The hired labour component is usually high. As much as 67.7% of farmers rear animals under this system. The herd sizes are variable, as reported by the farmers averaging around 95 heads of cattle per herd (60 cattle + 35 buffaloes). The wide herd variation 1-203 for cattle and 4-222 for buffaloes is a notable feature and reflects the traditional tendency of not divulging the actual herd number owned by a farmer even up to date.

(b) Village-Based System

The grazing of animals is usually confined to villages. The hired labour is limited and the herd size averages around 40 heads (31 cattle + 9 buffaloes). This type of husbandry management is practised by 12.9% of the farmers.

(c) Traditional and Tethered Grazing

A combination of traditional husbandry and tethered grazing is practised by 3.2% of farmers. Family labour is principally used. The herd sizes stands at an average of 15 animals per household.

(d) Tethered Grazing

About 12.9% farmers adopt this system. Free roaming by the animal is effectively prevented. Animals are stall-fed during the night and it is a semi-intensive system as the herd sizes are considerably smaller around 5 per household.

Table 4.3: Distribution of Livestock Husbandry Systems and Their Characteristics

System	No. of Farmers	%	Average Herd Size		
			Cattle	Buffalos	Overall
Traditional	21	67.7	60	35	95
Village-based	04	12.9	31	9	40
Traditional and Tethered Grazing	01	3.2	15	-	15
Tethered Grazing	04	12.9	5	-	5

Source: Survey Data, 1993

4.4 Land Use in Livestock Farming

The land use pattern for livestock indicates that the land extent owned and used by the farmers for cattle rearing is relatively small. Therefore, the animals are

Table 4.2: Herd Composition (as reported by the farmers)

	Cattle					Buffalo					Goat				
	Male		Female			Male		Female			Male		Female		
	No.	%	No.	%	Total	No.	%	No.	%	Total	No.	%	No.	%	Total
Cattle/Buff/Goat	244	94.9	1053	97.5	1297	182	96.3	545	100	727	10	100	8	100	18
Stud animals	10	3.9	-	-	10	6	3.2	-	-	-	-	-	-	-	-
Castrates	3	1.2	-	-	3	1	0.5	-	-	-	-	-	-	-	-
Unproductive	-	-	27	2.5	37	-	-	-	-	-	-	-	-	-	-
Total	257	100	1080	100	1347	189	100	545	100	727	10	100	8	100	18

Source: Survey data, 1993

solely dependent on the extensive use of common property resources for grazing and feed supply depending on the availability from the biomass. The effective use of marginal lands is a positive feature of the farming system.

4.5. Feeding and Watering Patterns

The feeding system is based on the availability of roughage (43.3%) and water in the common properties as determined by the monsoonal rains. The use of concentrates is minimal (6.6%). Straw grazing on fallow lands is done by all farmers. However use of straw as a feed supplement is limited to 6.6%.

4.6 Calf Management

The body weight of calves is low, ranging between 10-11 kg for both cattle and buffaloes. The calves are allowed the first milk or colostrum by a majority of farmers. However 26% did not understand its importance, or why it should be given soon after birth to sustain the health of the new born calf. Calves below 3 months are kept in shelters, while those above 3 months are made to graze and separated in the evening until the end of the lactation period. Weaning periods are highly variable from 6 months to 4 years.

Table 4.4 : Milk Production and Marketing

Type of Animal		Days/Lactation Period	Milk Productivity
Cattle	Average	170.7	2.06
	Minimum	90	0.62
	Maximum	270	10.0
	Standard Deviation	53.84	1.79
Buffalo	Average	170	1.85
	Minimum	90	0.75
	Maximum	270	5.25
	S.D.	53.92	1.12

Source: Survey data, 1993

In the sample area, there is no problem for the farmers to dispose of fresh milk. A steady competition for the marketing of milk is obvious by the presence of two milk processing plants, with established chilling centres, Nestles at Pannegamuwa and Milco at Deberawewa. The capacities for storage range from 3000 to 6000 litres. In addition, private curd producers collect buffalo milk at a higher price. The milk producers are, however, not satisfied with the poor purchase price Rs.7-8 per litre. Certain anomalies inherent in the payment system for fresh milk on the bulk fat content continues to affect milk producers of Kirindi Oya and elsewhere in Sri Lanka. At present the farmers are not deriving incomes out of manure and draught power as there is no market demand. The milk producers are unable to fix the farm gate price of milk according to their respective costs of production and have no means of independently testing the quality of milk for sale as fresh milk or for curd production.

4.7 Production Costs (PC)

The details of production costs are given in Table 4.5. The major expenses are for hired labour, ropes, milk cans, transport and water during the drought. Farmers do not spend money on livestock feeds. Grazing is the principal means of food for the animals on available common property reserves. However in considering the productive herd average, the lowest PC is seen with the traditional system of husbandry management. This indicates that it is very profitable to the farmer and a good system provided the threats on the use of common properties are removed or minimised, as cattle graze only marginal lands unsuitable for crop production. The village-based system gives medium returns while the tethered traditional system provides only marginal returns. The tethered grazing system is generally a loss to the farmer as evidenced by the high PC.

4.8 Milk Production and Marketing

The common practice is to milk the cows only once a day in the morning. This system ensures an adequate quantity of milk to the calves thereby ensuring low mortalities and also saves labour inputs for milking. The recorded annual yields are 350.2 litres/milk cow/lactation of 170.7 days and 314.5 litres/buffalo/lactation of 170 days. 50% cross-bred cows (local x cross-bred Scindi Short Horn of one farmer) are seen to produce up to 4.5 litres of milk daily feeding on grass alone. Therefore, upgrading from to 35 to 50% levels can have a positive impact on increasing milk yield (Table 4.4) and lactation lengths.

Income sources indicate that 83% are from the sale of fresh milk to Nestle/ Milco and 10% by the sale of curd. Prices obtained for milk sales range from Rs.7.50 - 8.00 per litre of milk. A milking cow or a buffalo has the potential of bringing in

Rs.2512/- to 2800/- per lactation length. Curd packed in one-litre pots is sold between Rs.32/- to 40/- per pot. About 13.7% cattle and 12.8% buffaloes are sold annually and the average sale prices are Rs. 1597/- for cattle and Rs.3,492/- for buffaloes.

4.9 Breeding and Fertility

Selection of bulls for breeding is practised by 25.9% of cattle owners. Random mating to unknown bulls is therefore common for 29.6% cattle and 46.6% buffaloes. Seasonal breeding and calving patterns are observed particularly in the case of buffaloes during the monsoonal period. The fertility levels are assessed at 54.7% for cattle and 47.2% for buffaloes. The calving interval is 12 months and the age at first calving indicates a period of four years. These parameters indicate the ability of low producing indigenous herds utilizing marginal lands effectively for milk and meat production.

4.10 Diseases

Mortalities are assessed around 15.7% for both cattle and buffaloes. Seasonal incidence of Pneumonia and Haemorrhagic Septicaemia (H.S.) appears to be a major problems. As much as 76.6% of animals are vaccinated indicating better availability and use of veterinary services. Indigenous treatment (36.6%) and moxibustion (burning of skin) are commonly practised (46.6%). The sudden disappearance of animals from herds seems to be a greater problem than diseases and is attributed to underground but an active cattle trade for the illicit slaughter of cattle. Farmers do not utilize the existing livestock insurance scheme and it appears to be unpopular.

4.11 Integration of Crop/Stock

The present level of integration between crops and livestock is very low and limited to free grazing of crop residues in harvested paddy lands and uplands. The recycling of farmyard manure for crop production is also limited. Since water deficit is a major constraint at Kirindi Oya, it has now become essential to develop a low cost sustainable farming system in water deficit lands by integration with ruminant livestock. The use of short cycle species such as goats will be of value as it does not require labour as with the cattle husbandry.

4.12 Institutional Support Mechanisms

The study reveals that livestock farmers avail themselves of the numerous support services given by the government. The Department of Animal Production and Health (DAPH) and the Mahaweli Draught Animal and Dairy Development Project (MDADDP) are responsible for livestock health, extension and cross breeding programmes, including the provision of stud bulls for breeding. The National Livestock Development Board at Weerawila farm has a similar programme for nearby cattle herds. Milk collection is through primary cooperatives to the Chilling Centres maintained by MILCO and NESTLE. The non-development of a mechanism for the sale of live animals is a major obstacle along, with mini-dairy meat technologies to add value to livestock products in order to enhance the cash incomes of farmers. Exploitation of farmers yet continues, but the formation of the *Ruhunu Gavahimi Govisanvidanaya* (RGG) with primary organizations in remote areas in villages and with apex bodies at Beralihela, Weerawila, Magampura is responsible for the main organization. The integrated RGG, since the latter part of 1990, requires to be highlighted. The RGG has stepped in to obtain additional grazing/water reserves for the cattle and to minimize the conflicts due to crop damage by direct collaboration with the paddy farmer organizations. It has also helped by making arrangements with chilling centres for the sale of fresh milk. This organization is responsible for the socio-economic upliftment of cattle and buffalo farmers at Kirindi Oya and has now emerged as a powerful body.

The majority of farmers make use of indigenous veterinary medicines and treatments, including moxibustion. However, there is no system to institutionalise this knowledge or register the practitioners. This is a cheap system of medication always within reach of the farmers encompassing both spiritual and material medication, using the in-depth traditional knowledge on the use of resources from the ecosystem as remedies at hand.

The livestock insurance facilities are not popular among farmers due to a poor understanding of the insurance system for livestock. Training and skill development of livestock farmers will therefore be advantageous to improve the traditional husbandry system.

Table 4.5 : Cost of Production (Rs)

Expenses	Traditional System N = 95	Village Based System N = 40	Traditional & Tethered N = 15	Tethered Grazing N = 05
Ropes	726.21	344.95	1500.00	583.33
Hired labour/wages	20737.00	-	-	-
Hired labour/foods and huts	1015.68	-	-	-
Travelling	94.79	1100.91	-	-
Maintenance	399.50	220.18	1800.00	-
Compensation for crop damage	947.96	1229.35	-	-
Veterinary	582.32	1871.55	900.00	250.00
Feeds	335.17	110.09	-	500.00
Other expenses	-	146.78	-	-
Milking equipment	48.05	56.32	80.00	67.00
Milk transportation equipment	2232.00	1559.74	50.00	265.00
Cost/average herd/yr.	27118.68	6639.87	4330.00	1665.33
Family labour	34893.75	41725.00	36500.00	38825.00
Total COP/average herd/yr	62012.43	48364.87	40830.00	40490.33
Cost Rs./Animal yr (Including family labour)	652.76	1209.12	2722.00	8098.06
Excluding family labour	285.45	165.99	288.66	333.06

Source: Survey data, 1993

4.13 Advantages of Present Livestock Farming

The advantages of the present livestock farming systems are many and can be summarised as follows:

- It is a low input-output system giving an additional income to farmers
- Allows the free use of unproductive marginal lands
- Milk and curd are cheap sources of proteins to improve human nutrition
- The indigenous cattle have a high fertility and survival rate under difficult geographical conditions.
- The indigenous cattle are multipurpose in nature with the potential of providing milk, meat, draught power and manure.
- Productivity could be improved by the application of correct cross breeding practices, selection and feed improvements.
- Farmer incomes could be further enhanced by increasing the sale of value added products locally
- The developments could be channelled through *Ruhunu Gavahimi Govisanvidanya* (RGG).

4.14 Problems and Solutions

- Crop Damage	Liason with RGG, effective fencing of crops
- Threats on the use of common properties	Provide additional grazing/water reserves + wallowing and channel crossing points for the cattle.
- Condemnation of the traditional husbandry system	Not a solution as it is profitable to farmers, reduction of herd numbers, and intensive methods are long term goals.

- Increased mortality, cattle theft	Skills development, improve husbandry, traditional and modern veterinary service and liaison with RGG.
- Reduced feed in the dry season and wet season	Improve feeding skills, provide alternatives - rice straw, molass, leguminous tree fodder crop by product integration into the feed system
- Low technology	Transfer only appropriate technologies
- Low productivity	Cross breeding to go side by side with feeding systems and improved management within the traditional system
- Extensive grazing of large herds	Integrated farming with crops/stock - short cycle species and fish

CHAPTER FIVE

Economic Aspects and Institutional Mechanisms in KOISP

5.1 Introduction

The economic aspects of any farming system have a vital importance in sustaining the system and determining the income of the farm families and their purchasing power. One of the main criteria in adopting any farming system is its economic viability. In this Chapter income and profitability and other economic indicators of the farming systems identified in the Kirindi Oya area are discussed. Settler migration, off-farm activities, farmers' perceptions of different issues and farmer organizations in the Kirindi Oya area are also discussed in this Chapter.

5.2 Cost of Cultivation

Cost of cultivation of paddy is calculated excluding the imputed cost of family labour, farmer-owned draught and machine power and material inputs. Therefore, the actual economic cost of cultivation can be higher than the financial cost. Paddy cultivation is the main economic activity of the people in the study area. The farmer community of the Kirindi Oya area has a higher affinity to growing paddy due to several reasons. Firstly, it ensures the food security of the farm family. Secondly, risk and uncertainty factors in paddy production in relation to other crops are comparatively low. This is specially true when considering the marketing aspects of paddy and the ability to store the produce for longer periods.

The average cost of cultivation of paddy in the enumerated sample is Rs. 25,707.05 per ha. This figure does not include the above-mentioned imputed costs of family labour and other farmer-owned material inputs. The break down of the cost items is given in Table 5.1

If family labour is excluded, the major cost component of paddy production is input costs (fertilizer, agro-chemicals and seeds) which account for 39.5% of the total cost while hired labour and machinery costs account for 37.4% and 23.1%

Table 5.1: Cost of Production of Paddy (per ha)**

Operation/Activity	Labour Cost* /ha (Rs.)	Cost for Power Source (Rs)	Cost of Inputs (Rs)	Total
Seed Paddy	-	-	2353.05	2353.05
Canal and bund clearing	652.75	-	-	652.75
Ploughing, harrowing[1] and levelling	960.28	3327.43	-	4287.71
Bund construction	1087.75	-	-	1087.75
Broadcasting	917.25	-	-	917.25
Fertilizer application	383.75	-	4344.40	4728.15
Weed Control[2]	237.50	89.85	2525.75	2653.10
Pest Control[2]	205.50	84.50	935.15	1225.15
Harvesting	1296.10	-	-	1296.10
Collecting	1050.28	-	-	1050.28
Threshing[3]	1453.50	1701.55	-	3155.05
Winnowing[4]	1047.43	399.88	-	1447.31
Processing and drying	326.90	-	-	326.90
Transport[4]	-	326.50	-	326.50
Total	9618.99	5929.71	10158.35	25707.05

* Excluding the imputed cost of family labour ** For 92/93 Maha Season
Source: Survey data, 1993

respectively. Apart from the input costs and hired labour cost, the cost for machinery hire indicates that a high demand exists for the agricultural machinery.

1 Four-wheel tractors
2 Knapsack sprayers
3 Threshing machines
4 Two-wheel tractors

The very low usage of draught power may have contributed to the high cost (Table 5.2).

Table 5.2: Total Cost of Cultivation of Paddy by Factor Costs

Cost Component	Amount (Rs)	% of Total Cost
1. Hired labour	9618.99	37.4
2. Inputs		
a. Seeds	2350.05	9.2
b. Fertilizer	4344.40	16.9
c. Agro-chemicals	3460.90	13.4
3. Machinery hire	5929.71	23.1
Total Cost	25707.05	100.0

Source: Survey data, 1993

Labour use in paddy production is given in Annex 7. About two thirds of the labour used in paddy cultivation is hired labour while the rest is provided by family labour, but the other kinds of labour such as *'attam'* are rarely used in the study area. Total amount of labour used in paddy production was 154 mandays per ha. This figure is low compared to areas where transplanting is practised. The average wage rate per manday was Rs. 100/- and for woman day Rs. 75/-. There is a high demand for labour during the cultivation seasons. The activities for which most of the labour is used are land preparation and (crop establishment) and harvesting.

5.2.1 Cost of Cultivation of OFCs

The main factor contributing to the cost of cash crop cultivation is hired labour except for tomato in which material inputs account for the largest share. This is because most of the cash crops require labour intensive management. Moreover, OFCs require high quantities of agro-chemicals to control pests and diseases. Red onion requires the highest labour input while tomato requires the least (Annex Table 8).

5.2.2 Profitability of Paddy and OFCs

It has been observed that paddy cultivation is no longer an economically profitable venture for the Kirindi Oya farmers. The average price received for kg. of paddy during the 1992/93 Maha season was Rs.6.77 and the average yield in the project area was 4083 kg/ha, which amounts to a gross return of Rs.27,645 per ha. Therefore, the profitability without imputed costs amounts to Rs.1938 per ha. If the imputed cost of family labour is included, the net loss per ha. is Rs.3884.

According to the study on the production and marketing of OFCs, which analyses the 1991 Yala season, red onion is a profitable crop. The gross return varied from Rs. 44,650 per ha for red onion to Rs.3300 per ha for green gram. Of the cost incurred, more than 60% cash cost is spent on hired labour except for tomato. The highest net return to cash input/unit recorded 5.1 for red onion while for cowpea it is -0.22 which is the lowest (Table 5.3).

5.3 Ownership of Agricultural Equipment

Most farmers do not own farm machinery such as two-wheel or four-wheel tractors. They opt to hire the machinery for land preparation which accounts for a considerable share of the cost of production. In fact, only 3.8% of the farmers in the New System and 12.4% of the Old System have their own two-wheel tractors. While only 0.9% of farmers of the New System and 2.5% farmers of the Old System of the enumerated sample reported to be having a four-wheel tractor (Annex Table 9). This also proves the income disparity between the old and New Systems.

The reported percentages of farmers having ploughs and harrows of their own are 28% and 9.9% for the New System and Old System respectively. The use of buffaloes for land preparation is very minimal. Only 1.3% of the Old System use buffaloes for land preparation, as they are economically more established than the New System farmers and therefore they could afford to use farm machinery such as four-wheel tractors. About 6.6% farmers of the New System own a water pump compared to 5.0% of the Old System. This shows that the water storage in the New System is greater and farmers tend to use lift irrigation methods.

5.4 Off-farm Activities

The inadequacy of irrigation water for year round cultivation results in farmers seeking off-farm income avenues to meet their day to day expenses.

However the lack of capital and technical know-how seemed to constrain the off-farm income avenues for Kirindi Oya farmers.

The majority of the settlers (80.2%) in the New System were engaged in farming before coming to the project area. (See Table 5.4). However, the unavailability of adequate irrigation facilities in the new area has put them in a position where their experience becomes invalid.

Since they are traditional farmers, they are reluctant to engage in other income earning activities other than farming. However, some farmers of the sample were engaged in off-farm activities such as carpentry, cadjan weaving, brick making etc. Some managed to run small retail boutiques in their own houses. The types of off-farm activities of the enumerated sample are given in Annex Table 10.

Table 5.4: Pre-Project Employment Status of the Settlers

Type	No. of Respondents	%
Farming	85	80.2
Casual labourer	04	3.8
Govt. sector	05	4.7
Trading	06	5.7
Animal husbandry	01	0.9
Fishing	03	2.8
Technical	01	0.9
Self-employment	01	0.9

Source: Survey data, 1993

Another important feature identified in this study is that 5.6% of farmers in the enumerated sample work as hired labourers in the project area. These farmers are found in the New System and they work as hired labourers in paddy and OFCs cultivating activities in the Yala season in the Ellagala System.

There can be several reasons for this phenomena. The most obvious reason is the irrigation water shortage that restricts the area cultivated in the New System. During Maha season, if sufficient rains are not experienced, even the rainfed OFCs cultivation is not possible. In such a situation farmers in the New System are left with virtually no alternative but to become hired labourers elsewhere.

Table 5.3 : Gross and Net Income from Paddy and OFCs

Description	Chilli	Groundnut	B'onions	R'Onion	Green gram	Cowpea	Paddy*
Yield (kg/ac)	549.84	495.20	344.87	1776.63	127.94	306.18	1633.38
Avg. farm price							
(Rs/kg)	15.14	17.08	22.38	25.13	25.79	34.38	6.77
Cost (Rs/ac)							
Inc. farm labour	23969.53	7203.66	30682.27	30297.59	5915.01	13059.44	12611.58
Excl. farm labour	8884.31	2548.46	6915.38	7322.33	2564.10	5657.96	10282.82
Cost (Rs/kg)							
Incl. farm labour	43.59	14.55	88.97	17.05	46.23	42.65	7.72
Excl. farm labour	16.16	5.15	20.05	4.12	20.04	18.48	6.30
Gross return (Rs/ac)	8324.58	8458.02	7718.19	44646.71	3299.57	4402.87	11057.98
Net return							
Incl. farm labour	-15644.95	1254.36	-229 64.08	14349.12	-2615.44	-8656.57	-1553.60
Excl. farm labour	-559.73	5909.56	802.81	37324.38	735.47	-1255.09	775.16
Net return to cash							
input/unit	-0.06	2.32	0.12	5.10	0.29	-0.22	0.08

*Survey data Maha 1992/93

Source: Production and Marketing (1991 Yala) of OFCs ARTI 1993.

Another reason for this situation may be "*Bethma*" cultivation practice where people jointly cultivate the land which are provided with irrigation water. Some farmers are indebted to banks either due to crop failure or poor production which is barely sufficient for their survival and are unable to obtain cultivation loans when irrigation water is available for cultivation. These farmers also tend to work as hired labourers. Some farmers who have other off-farm income avenues are reluctant to cultivate with no firm assurance of irrigation water availability and seek work as labourers in others' cultivations. Most farmers work for their neighbours. As the cultivation season starts the demand for labour also goes up and the wage rate is about Rs. 100/- with a meal and tea provided.

5.4.1 Settler Migration

One significant feature of the water deficit problem of the project area is the temporary migration of the settlers to surrounding urban centres. Migration is quite widespread in the New System compared with the Old System. Because of the lack of irrigation water, 14.2% of farmers of the New System migrated to other surrounding areas. However, 6.2% farmers of the Old System also reported migration (Table 5.5).

Table 5.5: Migration During Off-Season

Old System	No.	%
Old System	5	6.2
New System	15	14.2
Total	20	10.7

Source: Survey data, 1993

Migration is two-fold. One is the migration within the project boundaries and the other outside project boundaries. Within the project limits, Tissamaharama attracts the majority of the migrants. Baragama, Magama, Kataragama, Debarawewa are some other areas where settlers prefer to migrate. Outside project boundaries people migrate to the towns such as Matara, Ambalantota, and Thanamalwila to earn a living for their families.

This migration is due to economic reasons which proves that the settlers are unable to survive solely on the project activities at least for a part of the year. The areas of migration of the enumerated sample are shown in Annex Table 11.

The majority (58.8%) of migrants of the New Systems during the water deficit seasons, mainly in Yala, engaged in paddy farming in the migrated areas. Apart from paddy cultivation, they are involved in chena cultivation, skilled work such as carpentry and brick making and as hired labourers (Annex Table 12).

5.5 Farm Income

Farm and family income of the enumerated sample were calculated for three distinct groups of farming namely, crop farmers, livestock farmers and crop-livestock integrated farmers. Farmers who cultivated crops only earn the lowest annual income. As much as 84% of the total sample belong to the paddy-based farming category, 13.4% to the integrated crop livestock category, and 2.7% to the livestock farming category in which all farmers are from the Old System. It must be noted at this point that the majority of the farmers (84%) are solely dependent on crop income for living.

The average annual family income of the crop farmers of the New System is Rs. 28,214/- in the case of crop farmers in the Old System is Rs. 40,440/- which is significantly different from the New System. This clearly shows the vast difference of the economic status of the average farmer in the New System (average family size 5.2) and Old System.

A farmer whose sole income is from livestock (found only in the Old System of the enumerated sample) earns Rs.76,621/- as annual income. A farmer who cultivates crops and rears animals earns an average income of Rs. 58,939/- and 110,421/- for the new and Old Systems respectively (Table 5.6).

Table 5.6: Annual Family Income (Rs.)

Category	New System		Old System	
	Avg. Farm Income	Avg. Family Income	Farmer Income	Family Income
1. Crop farmers	24,890	28,215	32,717	40,441
2. Livestock farmers	-	-	76,621	76,621
3. Crop-livestock farmers	56,445	58,939	110,421	110,421

Source: Survey data, 1993

5.6 Institutions and Support Agencies in KOISP

Kirindi Oya Irrigation and Settlement Project is equipped with a number of line agencies which support the proper functioning of the project. All these line agencies work with the Ministry of Forestry, Irrigation and Mahaweli Development. These line agencies include the Irrigation Department, the Land Commissioner's Department, the Agriculture Department, Central Bank, the Forest Department and the Wildlife Department. The Central Co-ordinating Committee (CCC) is comprised of representatives from all these line agencies. The committee functions at ministerial level where the policy decisions are taken. In addition to this, there is the Project Management Committee (PMC) in which all the representatives of line agencies together with the Project Manager are the members. The PMC functions at project level with the participation of farmer organizations.

The project beneficiaries are provided with an extension service which advises farmers on agronomic problems as well as all problems and activities of farmer organizations. The enumerated sample showed that the officers concerned paid at least three visits to their households per season in the New System. In the case of the Old System, the number of visits per season were two (Table 5.7).

5.6.1 Farmer Organizations

A well established network of farmer organizations exist in the Kirindi Oya project area. The prominent two categories of farmer organizations operating in the study area are cattle owners' farmer organizations ("*Ruhunu Gava Himi Govi Sanvidanaya*", of Chapter Four) and crop growers' farmer organization which are formed at the field canal level, distributory channel (DCs) level, field canal level and project sub-committee level (Table 5.8).

Table 5.7 : Extension and Support Services

Officer	Average No. of Visits/Season	
	New System	Old System
Agricultural Instructor (AI)	3	2
Field Assistant (FA)	3	2
Institutional Organizer	2	2
K.V.S.	3	2
Institutional Development Officer	2	2
Agricultural Officer	2	2

Source: Survey data, 1993

Table 5.8: Farmer Organizations at Different Levels

Level	New System	Old System
Sub-Project committee	02	02
"D" channel	26	37
Field channel	371	391

Source: "Study of Beneficiary Participation in KOISP, 1993"

The majority of the farmers interviewed held membership in farmer organizations (see Annex Table 13). In the New System, 89.6% of the sample held membership of at least one farmer organization and 11.1% of farmers in the Old System did not hold membership of any farmer organization. The majority of the farmers do not have membership of any farmer organization since they do not have the legal rights to their lands. Hence they are not entitled to become members of these organizations. Apart from this, other reasons given are lack of time, corruptive activities of the office bearers, lack of faith in the organization, conflicts among farmers, etc. (Annex Table 14).

Farmer participation in decision-making is an important factor in reducing conflicts between officers and farmers as well as among different farmer groups. Farmer organizations provide the forum to express farmers' views on the water issues, cultivation schedule and other project related matters.

The structure of the farmer organization and their integration to project management enhance the vital participatory approach. The crucial and sensitive decisions like water allocation, type of crops to be grown (paddy or OFCs) are usually taken at the Project Management Committee (PMC) meeting which is held before the cultivation season.

5.6.2 Usefulness of Farmer Organizations

The complex nature of the various issues in Kirindi Oya project area makes it difficult to arrive at decisions on a non-participatory basis. In this context, farmer organizations along with the line agencies of the project play a useful role in irrigation water issues and planning and implementation of cultivation schedules. Of the interviewed sample, 22% of the New System stated that farmer organizations were extremely useful while 48% stated they were useful. However, 30% of farmers in the New System view that the farmer organizations are not upto their expected level and hence not so useful in finding solutions to farmer problems.

In contrast, 24% of the interviewed farmers in the Old System felt that farmer organizations are extremely useful while 59% farmers stated they were useful. Only 17% of the enumerated sample in the Old System stated that the farmer organizations are not useful compared to 30% in the New System (Table 5.9).

Table 5.9 : Usefulness of the Farmer Organizations

	New System		Old System	
Response	No.	%	No.	%
Extremely useful	20	22	15	24
Useful	42	48	37	59
Not useful	26	30	11	17

Source: Survey data, 1993

5.6.3 Limitations of Farmer Organizations

There are several factors which may hinder farmer organizations achieving their full potential. Farmers were asked to comment on the weaknesses of their own farmer organizations. Most farmers viewed leadership weaknesses (29% of the New System and 17% of the Old System) as a main drawback affecting the smooth functioning of the organization. This is mainly due to political interference in the farmer organization's activities which is not necessary as the organizational structure of the project provides a forum to represent farmers' views and settle their matters in a democratic way. The other limitations mentioned are co-ordination problems, lack of technical knowledge to carry out specific tasks, corruptive activities, pitfalls of the law regarding the farmer organizations and poor participation of the membership in the decision making process (Table 5.10).

5.7 Farmers' Attitudes

Farmer attitudes regarding the water issues in general are not very encouraging. This is obvious because of the disparity that prevails between the old Ellagala system and the New System. Farmers in the New System expressed their dissatisfaction over the irrigation water allocation to Old System farmers as they have the same right to water.

Table 5.10: Limitations of Farmer Organizations

Weakness	New System No. of Respondents	New System %	Old System No. of Respondents	Old System %
1. Inactive	16	22	09	17
2. Lack of technical know-how	-	-	02	04
3. Lack of funds	03	04	08	15
4. Corruptive activities	12	16	04	08
5. Leadership weaknesses	21	29	09	17
6. Co-ordination problems	12	16	12	23
7. Inadequacy of laws	05	07	04	08
8. No membership participation in taking decisions	04	06	04	08

Source: Survey data, 1993

The majority (84.9%) of the farmers in the New System are not satisfied with the present water distribution system. Even though first priority is given to the Old System when issuing irrigation water, 66.7% of the Old System farmers are not happy with the system. One possible reason for this attitude might be the monopoly they had been enjoying for irrigation water before the project's inception. The farmers' responses on the allocation of water are shown in Table 5.11.

Table 5.11: Farmers' Response on Water Issues

Response	New System No.	New System %	Old System No.	Old System %
Satisfactory	09	8.5	23	28.4
Not satisfactory	90	84.9	54	66.7
No response	07	6.6	04	4.9

Source: Survey data, 1993

Table 5.12 indicates that the dissatisfaction on the issue of irrigation water is the inadequacy of water for cultivation. This is purely due to the water deficit in the reservoir which is beyond the control of project officials. In addition, inefficient water management, inequality of water issues for new and Old Systems, and the position of the field along the field channel are the other reasons enumerated in the survey.

5.7.1 Position of the Field Canal (FC)

About 4.3% of the enumerated sample said that their fields are located at the tail end while 27% and 30% of the farmers reported having their lowland fields at the top and middle respectively. The higher percentage of fields located at the tail end might be a reason for the majority of the sample farmers to be dissatisfied with the water distribution. Usually the water availability to the lower end of the canal is comparatively poor either due to mismanagement of the upper end farmers or the situation of the field canal at the lower end (Annex Table 15).

Table 5.12: Reasons for Dissatisfaction Regarding Water Issues

Reason	New System No. of Respondents	%	Old System No. of Respondents	%
1. Inequality regarding water rights	38	36	05	06
2. Inadequacy of water	46	43	39	48
3. Inefficiency of water management	01	01	05	06
4. Unfavourable position of the field along the FC	-	-	10	12
5. No reason given	18	17	21	26

Source: Survey data, 1993

5.7.2 Farmers' Responses Regarding Irrigation Calendar

Since irrigation water is the most sensitive issue to all the farmers, the severe water shortages and unexpected water inflow to the reservoir seemed to hamper the irrigation schedules to a greater extent. When farmers were asked to comment on the irrigation calendar, those of the New System responded saying that they could not agree with the present system (Table 5.13). As mentioned earlier, the main reason for this strong agreement is the disparity that prevails in water issues between new and Old Systems.

Table 5.13: Farmers' Responses on Irrigation Calendar

Response	New System No. of Respondents	%	Old System No. of Respondents	%
Agree	11	10	35	43
Do not agree	90	85	37	46
No response	5	5	9	11

Source: Survey data, 1993

On the other hand, farmers of the Old System have a mixed attitude regarding the irrigation calendar but the percentage of farmers who agree with the plan (43%) is much higher than that of the New System.

CHAPTER SIX

Conclusions and Recommendations

6.1 Introduction

Farming systems of the Kirindi Oya area are basically centred around two distinct activities i.e. lowland paddy cultivation and extensive cattle and buffalo rearing on common property resources. There is no integration between these two activities and most of the farmers solely depend on one activity for their living. Paddy is the main crop grown in both Maha and Yala seasons in the old irrigated area (Old System) while in the New System paddy cultivation is predominantly done in the Maha season. For the New System, irrigation water seems to be the primary determinant deciding the farming system for a particular season. According to water availability of the reservoir, the extents that paddy and OFCs should be grown are decided by the Project Management Committee [PMC] with the involvement of farmer organizations at each cultivation season. According to the systems adopted so far, there have been a rotatory system of paddy cultivation for each tract to facilitate more equity in utilizing irrigation water among the settlers of the New System.

The general conditions of the Krindi Oya area are favourable to crop production as the soils are rich and the micro-climate of the area are indecisive. The educational status and the literacy rates of the farmer community are high and most of the settlers are competent in farming activities. However, the main limitation is the water shortage. The major soil types found in the project area are reddish brown earths, low humic gleys and alluvial. The sub-soil of LHG soil consists of Calcium Carbonate concretions, the upward movement of which is due to high evaporation demand and the inadequacy of irrigation water for flushing out salts accumulated on soil surface causes soil salinity.

6.2 The System Perspective

The agricultural system of Kirindi Oya area consists of several sub-systems. At the lowest level one can identify the crop system, i.e. the plant sub-system and their interaction. Paddy can be identified as the prominent plant sub-system, throughout the region with seasonal variations on cultivation in the newly developed area and the Ellagala system. The affinity of farmers to grow rice can be clearly seen in the analysis of the extents grown in the project area under different crops. The main factors that contribute to this feature are food security, relatively low price fluctuations, low risk and easy marketing. Apart from these reasons, farmers are traditionally bound to paddy cultivation. The technical know-how of other field crop cultivation is lacking in some instances. High technology was used for paddy cultivation in KOISP area. Interestingly most of the farmers do not use buffaloes for land preparation work. Even though the buffaloes are extensively available in the area, they use 4-wheel tractors instead. In the case of paddy almost all farmers interviewed use high yielding varieties [HYVs] including salinity-resistant AT varieties. Cultural practices in general were not very satisfactory. Even the fertilizer and agro chemical application levels were not at acceptable levels. Lack of cash and technical know-how can be attributed to this factor.

OFCs form the other plant sub-system. In this context there were instances where multiple cropping was practised though not extensively. In most instances, three or more cash crops were grown together. One of the cash crop combinations identified are ground nut, green gram and finger millet. In the case of the next higher system, the cropping system involves complex, spatial and time arrangements of various crop species. It is clear that the main division of the study area viz. the New System and the Old System have different cropping systems. The obvious reason is the disparity in irrigation water issues between the two areas. In the Old System both Maha and Yala seasons are provided with irrigation water for paddy cultivation mostly, whereas in the New System, water issues are made only in Maha season. The prominent cropping pattern of the New Area is Maha rice followed by Yala fallow. Apart from this, Maha rice followed by OFCs on residual moisture or under shallow wells are also practised to a lesser extent. The Old System's cropping pattern is very clearly demarcated by Maha rice followed by Yala rice This is the most widespread cropping pattern in the Old System. In very few instances the cropping system of Maha rice followed by Yala OFCs can also be seen. Perennial crops found in the homegarden are also a part of the cropping system and most widely found ones are jak, breadfruit, coconut and mango. However, in some instances, it has been observed that the soils of home garden are not suitable for even perennial crops.

The objective of crop diversification in the project area has not yet been attained despite the promotional work by the support agencies. According to the survey results, the total OFCs cultivated extent did not exceed 6 per cent of this total land area during 1992/93 Maha season. The seasons before 1992/93 Maha also show a similar trend. The preference for OFCs cultivation is very low due to several factors. The main reason for this rice-biased attitude may be the food security as it is vital for the farm family. The high risk factor involved in cultivating OFCs with respect to the water deficit, pest and disease problem and marketing also play a major role in farmer's decision for OFCs cultivation. In addition, high labour input and inadequacy of sound technical know-how to grow OFCs also constraints the extent of OFCs grown. Further, the farmers who grew OFCs were experiencing an unfortunate situation where their crops were damaged by cattle herds grazing in common property resources. Even though the farmer organizations are now more concerned to avoid these mishaps, in practice the instances of cattle damage are still high in the area and it precludes more farmers growing OFCs.

The increasing incidence of salinity also poses a threat to the project objectives, shrinking the available land for cultivation. This problem is not only confined to the newly developed area but also to the Old System. The electrical conductivity changes of the five tanks (Old System) and Lunugamwehera indicate that the Old System has become more prone to salinity build up than the newly developed area.

The input availability is a critical factor for successful adoption of any farming system. Unavailability of seed material for paddy and other field crops is also observed in the project area. The available labour force seems to be insufficient when both new and Old Systems are in the cultivation process, specially in the Maha season.

Use of credit facilities for cultivation shows a difference between the newly developed area and the old Ellagala System. More farmers from the New System have obtained formal loans whereas in the Old System the number is low which may be due to the fairly stable economic status because of two seasons paddy cultivation.

It is evident that strongly established farmer organizations exist in the Kirindi Oya project area. However, several factors that hinder achieving the full potential of farmer organizations such as corruptive activities, leadership weaknesses, lack of participation of members in the decision making process and inadequacy of laws for the effective functioning must be stressed. Institutional support for the farmer organizations to organize marketing for the agricultural produce is very important. Other institutional support apart from resolving conflicts and attending to water issues and production process is also necessary.

6.3 The Livestock Systems

The livestock farming systems in the Kirindi Oya basin are characterised by their unique features and most of the time function as a separate entity from crop farming. There are four specific livestock systems identified. The traditional system is widespread, where large herds are allowed to graze in forest reserves and in the off-season, they are allowed to graze fallow lands after the harvest in the village including shrublands. This extensive traditional cattle management has often resulted in conflicts with the OFCs growers and is a deterrent for both crop and livestock producers.

The results show that the indigenous Zebu animals at KOISP with their high fertility and ability to perform with the available feed resources (rough stubble) in the respective biomass, appears to provide the principal base for cattle farmers with relatively high incomes and agricultural operations of cattle farmers with relatively low inputs. The income, expenditure, reproduction and disease situations show a seasonal pattern.

The key determinants of livestock farming are the grazing pattern, labour availability, herd size and animal type. The major problems are the reduction of critical forests, pasture shrublands for grazing and water for the extensive management of indigenous cattle herds under the traditional system. The absence of livestock productivity improvement vis a vis agricultural crop production is a major concern and livestock farmers manage their herds at a very low level of technical efficiency.

The prominent feature of livestock production is the low input and output husbandry management. The feeding patterns of the identified systems show very low usage of concentrates and straw. Even though straw is a useful cattle feed available in abundance, it is interesting to note that this resource is not utilized effectively and the animals are allowed to rely mainly on the low quality roughage available in the area.

Milking is done only once a day and it is a need as the average milk yield of an animal is very low and lies between 1-2 litres per day. Further, the lactation periods of both cattle and buffalos are about 170 days which is fairly low. The cattle farmers earn a good income by selling animals but they neither utilize the animals, for draught work nor use cow dung as a fertilizer and as an income source.

Some selection work is done to upgrade animals which is not very satisfactory. The very high mortality rate (15.7%) indicates poor management and the weaning periods are prolonged. The large herd sizes and the lack of supervision and technical know-how may have contributed to this situation. However, the rate of vaccination (76.7%) was found to be satisfactory to control contagious diseases.

The major constraints for sustainability appears to be the limitation of grazing lands and common property resources for the type of husbandry preferred and practised by a majority of cattle farmers.

Credit use for livestock farming had not been enumerated by this study. The availability of critical resources for cattle grazing and water during the dry season and endemic diseases continue as major threats in addition to the poor prices and exploitative mechanisms of major processing organizations during the bulk purchasing of the fresh milk. Similarly, the chain of events precipitated by middlemen during the sale and transportation of live animals to urban slaughter houses continues to depress the legitimate incomes of livestock producers.

6.4 Recommendations

In general, to improve the present conditions of the farming system including the farmers' socio-economic status, the following specific recommendations are suggested:

a. A mechanism to reduce the present conflicts between crop and livestock farmers is an urgent necessity. As an immediate short term measure, the reservation of suitable grazing lands with the construction of watering facilities for livestock should receive priority consideration. This is of vital importance to stimulate OFCs production and is the only alternative to minimize crop damage by free grazing animals.

b. The cropping system in KOISP area is extremely difficult in the present context. This is particularly true because of the KOISP ecology faced with lack of reservoir water to supplement the moisture deficit, rendered by excessive evaporation, demand new irrigation. Therefore, to earmark on a cropping system one should use these resources very sparingly and efficiently. Thus moisture conservation is also equally important as its proper use. Up to date none of the cropping systems suggested by various agencies has been implemented due to reasons explained earlier. Based on the resources available at the moment, the following cropping systems should be viable.

(1) One season paddy with "*Kekulan*" sowing (dry land preparation with Maha rains in order to save water for latter stages of the crop) followed by Yala OFCs in the new area and two paddy crops in the old area.

(2) One season paddy with "*Kakulan*" sowing followed by Yala OFCs on residual moisture followed by fallowing Yala proper in the New Area and two paddy crops in the Old Area.

OFCs in the old area under irrigation are risky and not quite possible because of the high water table. Therefore irrigation for two paddy crops in the old area is the only answer. If at all, OFCs in old area may be possible only under rainfed conditions.

c. A programme for having wind breaks all over the project area to curtail high wind velocities as a moisture conservation measure is recommended. Wind-breaks restrict the high velocity carrying moisture away and further evaporation of moisture from the agriculture land is minimized. Thus ground water depletion during drier months of the year is reduced. Continuous moisture evaporation depletes the ground water during Yala which could also increase the Maha irrigation requirement.

d. Ground water reserves are a vital component in KOISP agro ecology when there is moisture deficiency year after year. Thus conservation of moisture during non-cultivating periods is also important. Soil moisture evaporation to the outside atmosphere needs to be broken, which could be achieved by having a dried soil mulch on the surface. Tilling the land after the Maha crop harvest or after the residual moisture crop harvest forms a dry soil mulch preventing moisture movement to the atmosphere. This practice probably cannot be popularized among farmers so easily and they see it as a wasteful operation. If it cannot be implemented by the farmers, institutions can take action to implement it. However, this cultural practice has other advantages such as less weed growth during the fallow period and could either do away with the first ploughing altogether or light land preparation is needed in the next cropping season.

e. Increasing water use efficiency is another way of moisture conservation. In the case of paddy cultivation, lot of water is needed for land preparation and also as a weed control measure. Therefore crop diversification to grow OFCs can increase the water use efficiency. Two important aspects in water management should be focused on in this situation. That is to see how long does an allotee take to irrigate his plot and can all the allottees irrigate their plots in a single field ditch once in 4-5 days (OFCs needs frequent irrigation). While flooding cannot be practised in OFCs cultivation and a ridge and furrow system is more suitable. The regional Agricultural Research Centre at Angunakolapalessa has identified and studied a ridge and furrow irrigation system namely, zig-zag furrow irrigation which is a labour and time intensive method. In this system, if an allottee can allocate 3 cubic feet of the water stream, 1 ha. of land can be irrigated in 35-45 minutes. However, this system needs capital expenditure which is still worth in the long term. Thus in this system, water use efficiency can be increased tremendously. Similarly, if the stream size is 0.5 cubic foot, a farmer can irrigate 1 ha. of land in 2 1/2 hours. The labour required for this method of irrigation is to direct water in the channels which can be even handled by using family labour, even a small child. The practice of zig-zag furrow irrigation can convince farmers to resort to OFCs cultivation.

f. Under crop diversification, use of short duration crops needs to be emphasised for the cropping systems of KOISP. In the case of paddy too 3 - 3 1/2 month duration rice may be recommended in the new area, but 4 - 4 1/2 month varieties which have a high potential may be grown in the old area during the Maha season. The suggested OFCs are cowpea, green gram, ground nut, (draught resistant varieties) and low moisture required crops like red onions, sesame, soya bean and finger millet.

g. A well integrated farming system comprising of both crops and livestock as a long term measure is recommended. The objective of such a programme will be to reduce the present indigenous cattle herds to a manageable size and improve their nutritional status and productivity by cross breeding up to a 50% level in order to elicit hybrid vigour. It is clearly evident that the very large herd sizes of cattle and buffaloes are not feasible in today's context, where land and critical resources are becoming more and more scarce. Therefore, a transformation from the present traditional methods to semi-intensive methods recommended. Semi-intensive husbandry systems can reduce the pressure on grazing lands and minimize the utilization of farm residues such as straw effectively in combination with leguminous tree fodders or urea - molass supplements for dry season feeding. A simple technology package for the use of these feeding regimes are already available from the University of Ruhuna and within easy reach of the farmers. A more extensive technology transfer and farmer education programme to use all available crop residues and other feed resources to counteract the dry season and wet season feed deficit and loss of body condition of livestock is essential to optimize livestock nutrition and cattle productivity.

h. Efforts to obtain realistic prices for fresh milk and for sale of live animals through the existing livestock owner-farmer organizations are essential to eliminate middle operators and monopolistic mechanisms of milk processing organizations. This can be implemented as an immediate short term measure to enhance the cash incomes of livestock producers. Introduction of mini dairy/ meat processing technologies will be advantageous rather than selling fresh milk and live animals to a central processing and marketing network.

i. Upgrading Indigenous Stock

The mistakes and the lessons learnt from the various cross breeding programmes attempted and ongoing in Sri Lanka require to be carefully studied before attempting the upgrading of indigenous stock at Kirindi Oya. The indigenous animals should not be condemned as poor producers or dwarf animals. Application of selective breeding techniques and the use of cross bred studs will be of value in upgrading the existing stock and to produce a medium producing animal under moderate management levels, with good roughage ability, disease resistance and fertility rather than high producers requiring major inputs.

j. Technology transfer to introduce short cycle livestock species, goat for milk /meat, poultry/duck/fish/rabbit integrated farming methods is of tremendous value to enhance the income of the farmers.

k. OFCs cultivation under a system of alley cropping where crops are grown between hedge-rows that are planted with leguminous shrubs such as

Glyricidia can be a better system of utilizing land sustainably. The advantages of this kind of alley cropping system are the ability to recycle nutrients, suppression of weeds and wind and water erosion control. In addition, this can act as a wind barrier to crops such as banana. These trees can be pruned periodically to avoid excessive shade to the crops.

l. As indicated in earlier chapters crop diversification in KOISP is also hampered by the marketing system operating in the area as marketing of produce is completely controlled by the local traders. They prevent outside traders meeting the producers through a network of middlemen. Invariably the local tradesmen in the chain prevent the producers getting a higher price for their produce. Therefore institutional involvement to strengthen the marketing system is of paramount importance in order to stabilize the price structure favourable to the producer.

m. The seed production programme is handled by the Department of Agriculture for both rice and OFCs. However, the Department of Agriculture cannot cater to the all-island requirements of both rice and OFCs. Thus a quality seed production programme to cater to the KOISP farmers needs to be undertaken by the KOISP management with the guidance and supervision of qualified officials of the Department of Agriculture. This will enable the good innovative farmers to produce quality seeds and to obtain higher incomes while looking after the seed requirements of the KOISP. In such a situation institutions should also have proper seed stores to store the seeds for future use.

n. The concept of shallow wells for Yala irrigated OFCs cultivation has limited scope. The main reason for this concept is that all the allottees cannot use shallow wells because it will lead to too much of ground water depletion, which will invariably increase the moisture requirement during Maha season. Shallow wells deplete only the saturated water tables and not the deep sealed aquifers. After a thorough study of the saturated water table one can recommend this method to a few allottees in each hamlet but not to all.

o. The past experience of the project area reveals that external interferences have adversely affected the beneficiaries. KOISP has to be independent of outside elements dictating terms and conditions, for it to become a viable unit.

Annex Table 1: Age and Sex Distribution

Age category (years)	New System				Old System			
	Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%
0 - 4	19	3.37	30	5.32	16	3.92	11	2.68
5 - 9	29	5.15	43	7.63	9	2.20	10	2.44
10 - 14	48	8.52	60	10.65	14	3.43	19	4.64
15 - 19	30	5.28	32	5.80	22	5.37	17	4.15
20 - 24	25	4.44	26	4.61	18	4.40	17	4.15
25 - 29	12	2.13	18	3.19	23	5.62	19	4.64
30 - 34	15	2.66	19	3.37	23	5.62	21	5.13
35 - 39	25	4.44	27	4.79	30	7.32	18	4.40
40 - 44	21	3.73	17	3.01	20	4.88	14	3.42
45 - 49	13	2.30	13	2.30	9	2.20	8	1.92
50 - 54	10	1.77	5	0.88	6	1.46	7	1.71
55 - 59	8	1.42	4	0.71	6	1.46	8	1.92
60 - 64	5	0.88	2	0.35	8	1.55	5	1.22
Above 65	7	0.71	3	0.53	20	4.88	11	2.68

Source: Survey data 1993

Annex Table 2: Family Size Distribution

No. of Members	New System		Old System	
	No.	%	No.	%
Below 3	18	16.9	14	17.2
4 - 7	77	72.6	60	74.0
7 and above	11	10.3	07	8.6

Source: Survey data 1993

Annex Table 3 : Seed Paddy Provision by the Department of Agriculture

Variety	Requested Registered	Requested Certified	Provided Registered	Provided Certified
BG 350	1042	2550	1700	-
BG 94-1	60	250	-	-
BW 351	350	950	1000	-
AT 303	50	150	-	-
BG 300	840	2500	1300	-

Source: Dept. of Agriculture

Annex Table 4: Extent of Paddy Cultivation in the KOISP (ha)

Season	New System	Ellagala	Bandagiriya
86 Y	617	3526	561
86/87 M	587	3743	0
87 Y	-	-	-
87/88 M	1627	3708	851
88 Y	1581	3724	38
88/89 M	3213	3760	280
89 Y	1616	3577	760
89/90 M	2108	3802	52
90 Y	26	3700	650
90/91 M	1793	3708	694
91 Y	34	3782	620
91/92 M	4562	3803	642
92 Y	0	1070	-
92/93 M	3964	3889	648

Source: Dept. of Agriculture

Annex Table 5: OFC Cultivation During Maha Season 92/93 in the Project Area (ha)

Crop	Highland	Irrigated	Rainfed	Total
1. Chillies	54.7	7.1	73.8	135.6
2. Red Onion	3.6	1.1	1.0	5.7
3. Green gram	511.7	0	254	765.7
4. Ground nut	110.3	0	807	917.3
5. Cowpea	166.0	0	13.5	179.5
6. Vegetables	9.6	6.8	103.2	119.6
7. Pigeon Pea	11.7	0	0	11.7
8. Black gram	0	0	2.7	2.7
9. Finger millet	0	0	2.6	2.6
10. Maize	0	0	5.8	5.8

Source: Dept. of Agriculture

Annex Table 6: Agricultural Credit and Repayment

	Credit Obtained		Repayment	
	No. of Farmers	%	No. of Farmers	%
N.S.	84	44.9	46	36.5
O.S.	42	22.4	25	19.8

Source: Survey data 1993

Annex Table 7 : Labour Use for Paddy Cultivation

Activity	Average Family Labour (Mandays/ha)	Average Hired Labour (Mandays/ha)	Total Labour (Mandays/ha)
Seed paddy transporting	1.25	-	1.25
Canal and Bund clearing	2.5	7.5	10.0
Ploughing, harrowing and levelling	2.5	12.5	15.0
Bund construction	2.5	11.25	13.75
Broadcasting	2.5	10.0	12.5
Weed control	2.5	2.5	5.0
Pest control	2.5	2.5	5.0
Fertilizer application	2.5	2.5	5.0
Other maintenance	22.5	8.75	31.25
Harvesting	2.5	13.75	16.25
Collection	1.25	10.0	11.25
Threshing	1.25	7.5	8.75
Winnowing	1.25	7.5	8.75
Processing and drying	2.5	5.0	7.5
Total Mandays/ha for all activities	50.0	101.25	151.25

Source: Survey data, 1993

Annex Table 8: Cost of Cultivation of OFCs, by Factor Costs (%)

Crop	Labour	Power	Material Inputs
Green gram	81	14	5
Chillie	79	4	17
Red onion	90	3	7
Tomato	48	-	52
Cowpea	68	8	24
Groundnut	82	13	5

Source: ARTI Survey, Production and Marketing of OFCs

Annex Table 9: Ownership of Agricultural Equipment

Equipment	New System No. of farmers	New System Reporting percentage	Old System No. of farmers	Old System Reporting percentage
Mammoties	327	58.4	292	52.6
Plough	04	0.7	11	2.0
Harrows	03	0.5	11	2.0
Threshing machine	04	0.7	09	1.6
Buffaloes	30	5.3	60	10.8
Two Wheel tractors	40	0.7	12	2.1
Four whell tractors	01	0.1	02	0.4
Water pumps	08	.40	-	0.2
Sickles	168	30.0	139	25

Source: Survey data 1993

Annex Table 10 : Types of Off-farm Activities

Activity	No. Reporting	%	No. Reporting	%
Cadjan weaving	-	-	4	44
Selling fuel wood	1	14	-	-
Retailing	1	14	-	-
Brick making	-	-	1	11
Carpentry	2	29	-	-
Other	3	42	4	44

Source: Survey data 1993

Annex Table 11: Areas of Migration

Areas	NS No. of respondents	OS No. of respondent	Total
Baragama	1	-	1
Magama	1	1	2
Tissa	7	1	8
Ambalantota	3	1	4
Thanamalwila	2	-	2
Matara	1	-	1
Kataragama	0	1	1
Hambantota	0	1	1

Source: Survey data 1993

Annex Table 12: Type of Work Involved During Off-season

Type of work	NS		OS		Total	
	No.	%	No.	%	No.	%
Paddy farming (in other areas)	10	58.8	1	12.5	11	45.8
Carpentry	-	-	1	12.5	1	4.2
Chena Cultivation	3	17.6	2	25.0	5	20.8
Labour	2	11.7	1	12.5	3	12.5
Other	2	11.7	3	37.5	5	20.8

Source :Survey data, 1993

Annex Table 13: Membership of Farmer Organizations

Far. Organization	New System No. of respondents	%	Old System No. of respondents	%
1. Crop growers	90	84.9	64	79
2. Cattle owners	07	6.6	7	8.6
3. Milk Producers' co-op	4	3.8	4	4.9
4. Fishermen's	-	-	02	2.5

Source: Survey data 1993

Annex Table 14 : Reasons for not obtaining membership of the Farmer Organization

Reason	New System No. of Respondents	%	Old System No. of Respondents	%
1. No legal rights to land	4	3.8	-	-
2. Lack of time	4	3.8	3	3.7
3. Corruptive activities of the office bearers	1	0.9	2	2.5
4. No faith	1	0.9	4	4.9
5. Conflicts among farmers	-	-	1	1.2
6. Other	-	-	1	1.2

Source: Survey data 1993

Annex Table 15: The Position of Field Along the Field Canal

Position	No. Reporting	%
Upper	50	27
Middle	57	30
Lower	80	43

Source : Survey data 1993

Figure A-1 : R.B.T. 1 Lay Out Plan

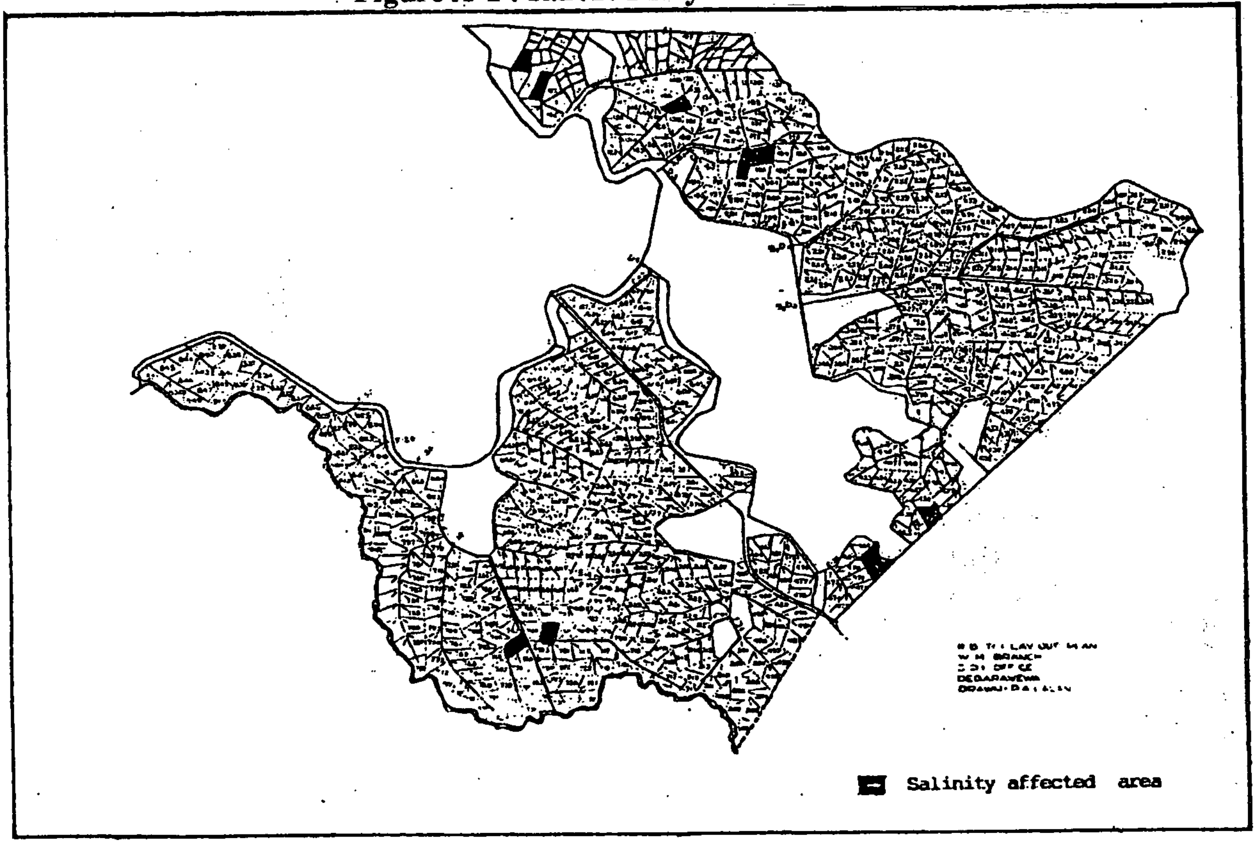


Figure A-3 : R.B.T. 5 Lay Out Plan

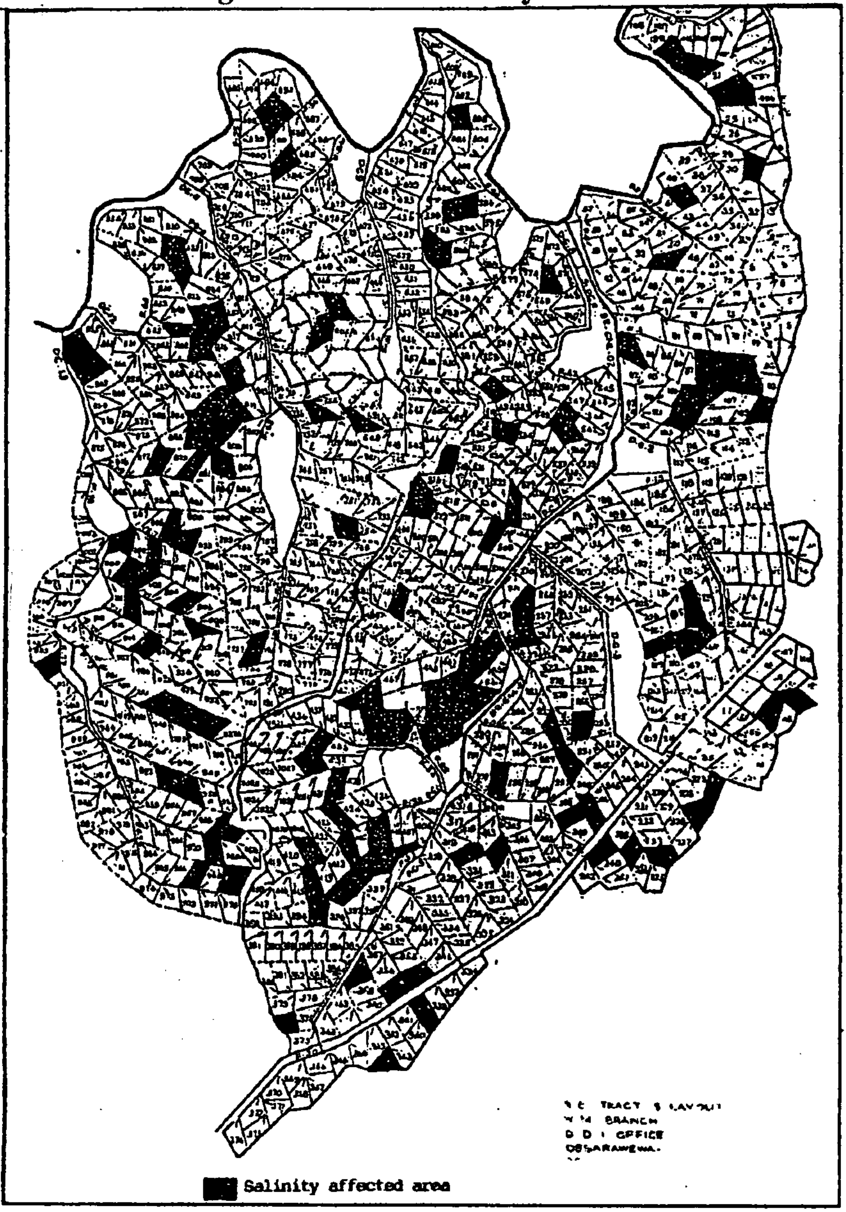
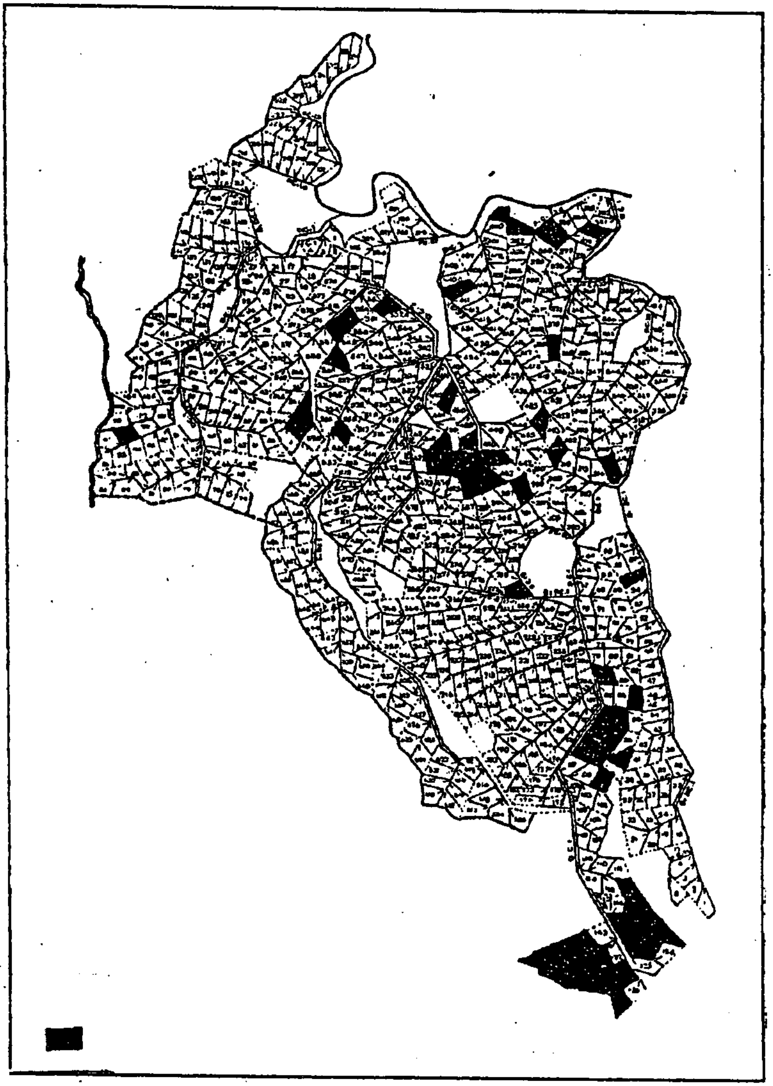


Figure A-4 : R.B.T. 6 & & Lay Out Plan



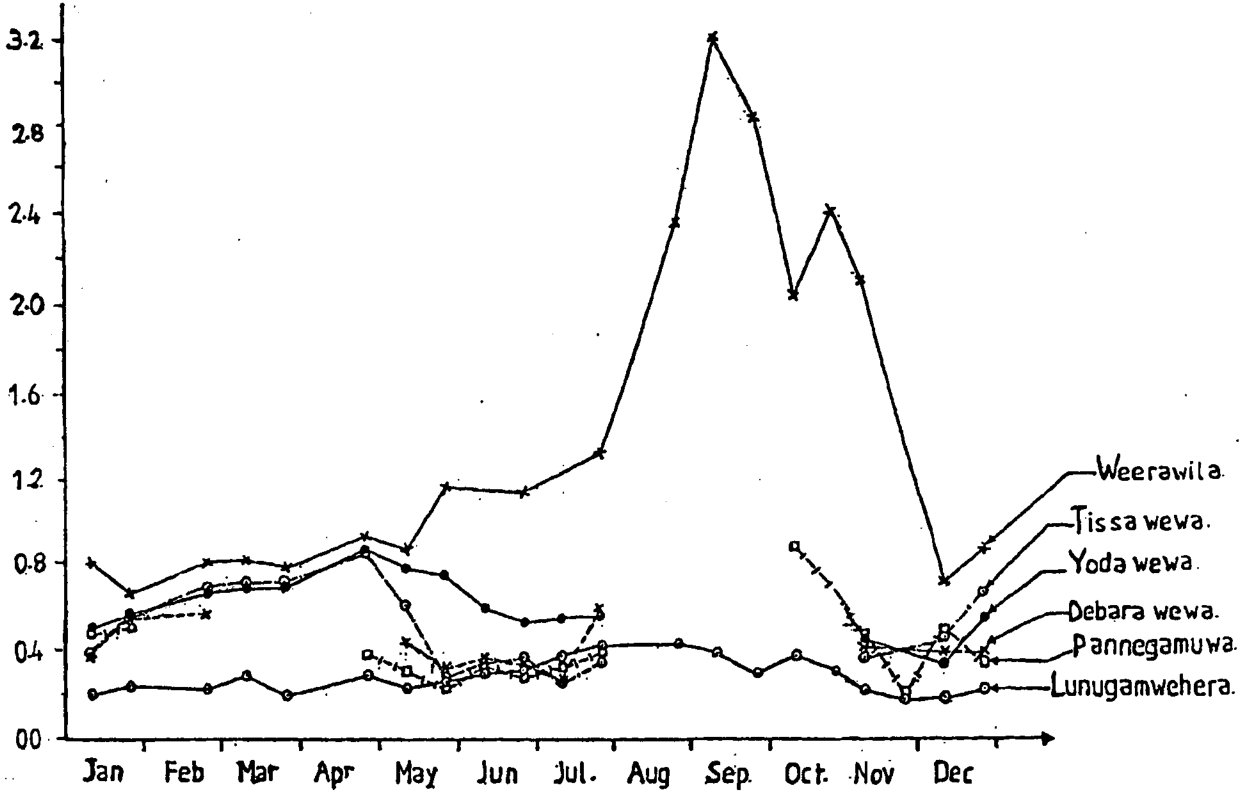


Figure A5 : Electricity Conductivity of the Tank Waters in KOISP Area - 1992

Figure A-7 : Schematic Diagram of Zia-zag Furrows (Not to scale)

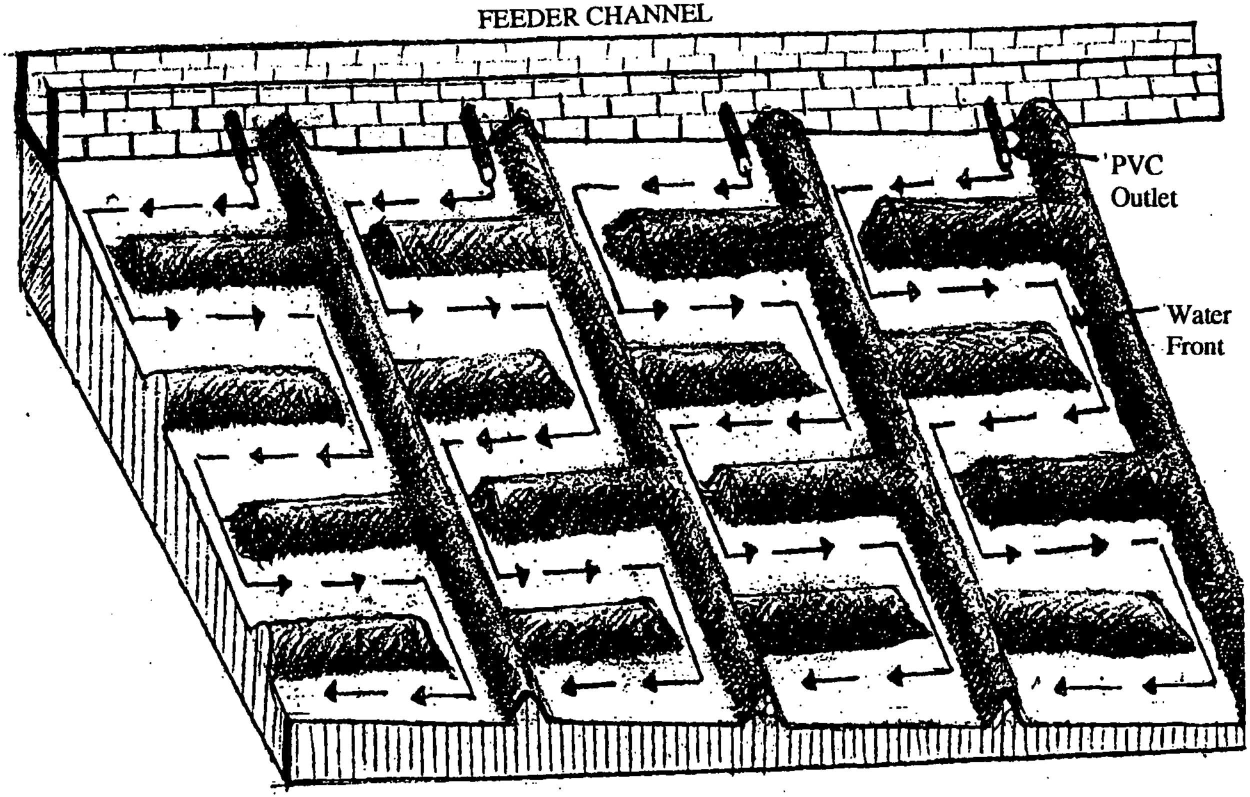


Figure A-8 : Schematic Diagram of Standard Furrows (Not to Scale)