Kirindi Oya

Irrigation and Settlement Project

Project Impact Evaluation Study

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Sri Lanka

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CHAPTER 10 COST-BENEFIT ANALYSIS

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Maps

Abbreviations

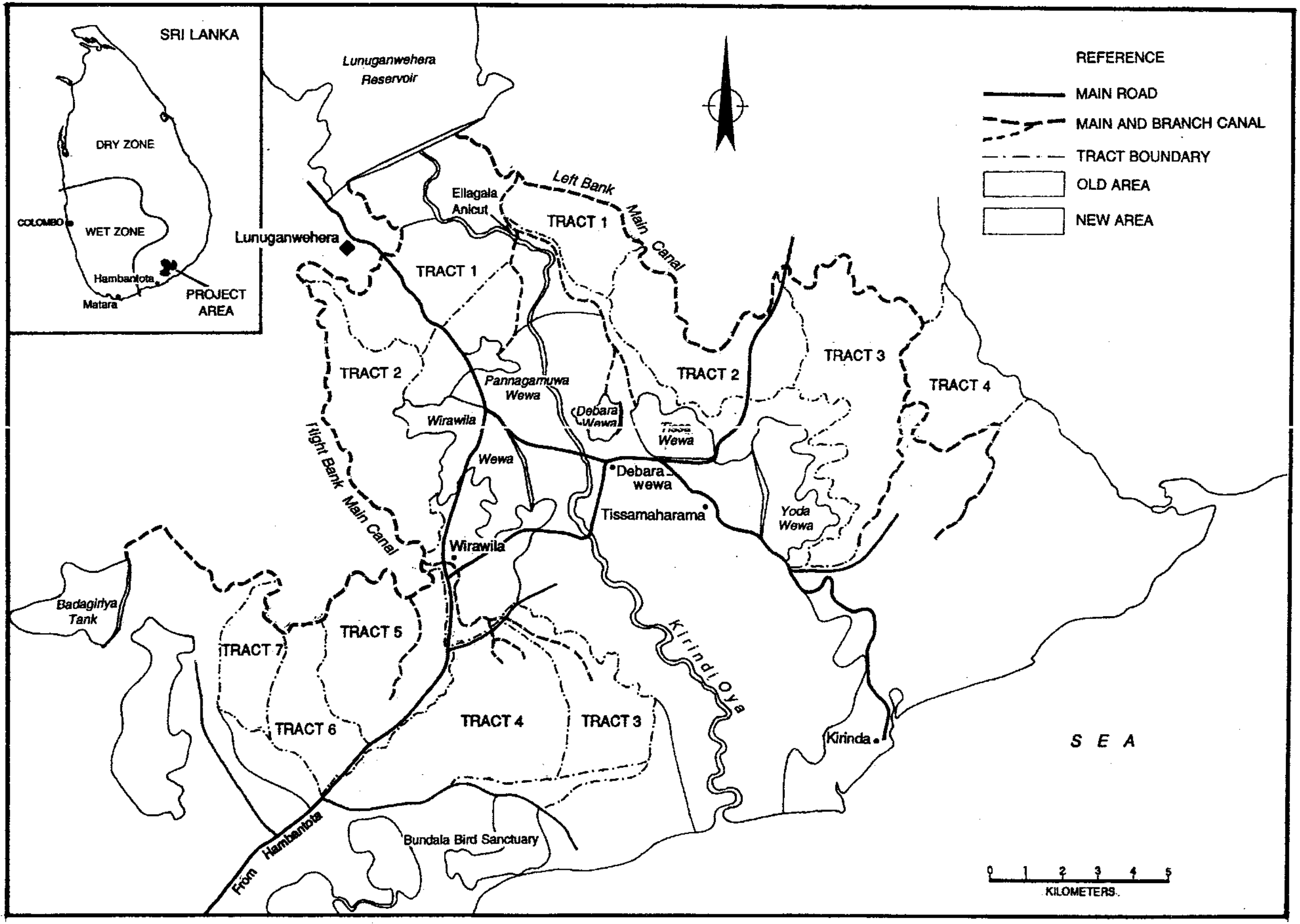
ABP	Air-Based Topo Map
ac	acre
acft	acre-feet
ADB	Asian Development Bank
AGA	Assistant Government Agent
AMO	Assistant Medical Officer
ARTI	Agrarian Research and Training Institute
ASC	Agrarian Service Center
AT	Ambalantota (rice variety)
BC	Branch Canal
BG	Bathalagoda (rice variety)
bu	bushel
CBA	cost-benefit analysis
CDA	Coconut Development Authority
CECB	Central Engineering Consultancy Bureau
CF	Contact Farmer
CI	cropping intensity
CO	Cultivation Officer, Colonization Officer
COFO	Cattle Owner Farmers Organization
COP	cost of production
cm	centimeter
CRE	Chief Resident Engineer
cusec	cubic feet per second
DC	Distributary Canal
DCO	Distributary Channel Organization
DMA	District Medical Assistant
DMO	District Medical Officer
DOA	Department of Agriculture
DS	Divisional Secretariat
DTC	District Training Center
EC	electrical conductivity
EIRR	economic internal rate of return
ERR	economic rate of return
FAO	Food and Agriculture Organization of the United Nations
FC	Field Canal
FCG	Field Channel Groups
FD	Forest Department
FI	Field Inspector, Field Instructor
FF	Follower Farmer
FM	Food and Mouth Disease
FO	Irrigation Based Farmer Organization
FR	Farmer Representative
FRR	financial rate of return
GA	Government Agent
GCE(OL)	General Certificate of Education (ordinary level)
GDP	gross domestic product

gm	gram
GOSL	Government of Sri Lanka
GS	Grama Seveka
ha	hectare
HS	Hemorrhagic Septiceam
HYV	high yielding varieties
ID	Irrigation Department
IFAD	International Fund for Agricultural Development (*Italy*)
IIMI	International Irrigation Management Institute
IMCD	Irrigation Management and Crop Diversification
IMD	Irrigation Management Division
INMAS	Integrated Management of Major Irrigation Systems
IPM	Integrated Pest Management
IRD	Integrated Rural Development
JTF	Janasaviya Trust Fund
K	Potassium
kg	kilogram
KOISP	Kirindi Oya Irrigation and Settlement Project
km	kilometer
K.V.S.	Krushi Vyaptha Sevaka (Village level extension worker)
LB	Left Bank
LBW	low birth weight
LCD	Land Commissioner's Department
LDD	Land Development Department
LDO	Land Development Ordinance
LHG	low humic gley soils
lt	liter
l/s	liter per second
LSS	large scale sample survey
m	meter
mcm	million cubic meters
MDADDP	Mahaweli Draft Animal and Dairy Development Program
MEA	Mahaweli Economic Agency
mm	millimeter
MOU	memorandum of understanding
MP	Member of Parliament
msl	mean sea level
mt	metric ton
MUV	Unit value index in US$ terms of manufactures exported from the G-5 countries (France, Germany, Japan, UK, USA), weighted proportionately to the countries' exports to the developing countries (source: Worldbank)
N	Nitrogen
NGO	Nongovernmental organization
NIA	Newly Irrigated Area
NIS	New Irrigation System
NWSDB	National Water Supply and Drainage Board
OEIS	Old Ellegala Irrigation System
OFC	Other Field Crops

OIA	Old Irrigated Area
O&M	operation and maintenance
OPD	Out Patients Department
P	Phosphorus
PC	Provincial Council
PCC	Project Coordinating Committee
PEM	protein energy malnutrition
PF	Plasmodium Falciparum
PHI	Public Health Inspector
PMC	Project Management Committee
ppt	parts per thousand
PTB	Peoplised Transport Board
PV	Plasmodium Vivax
RB	Right Bank
RBE	Reddish Brown Earth
RID	Rectification of Irrigation Difficulties
RMO	Registered Medical Officer
RRC	Regional Research Center
Rs.	Sri Lankan Rupees
RVDB	River Valleys Development Board
RWS	Relative Water Supply
SEDZ	South-East Dry Zone
SL	Sri Lanka
SMO	Subject Matter Officer
SNF	Solid Non Fat
SLFO	Sri Lanka Field Office
SLRs.	Sri Lankan Rupees
S&P	Seepage and Percolation
SPC	Sub-project Committee
sqft	square feet
SS	solodized solonetz
VC1	Variable Costs including family labor
VC2	Variable Costs excluding family labor
VEW	Village Extension Worker
WFP	World Food Program

Glossary

ande	landlord-tenant system
anicut	dam or weir to divert river water into a channel
ara	stream
asweddumised	land leveled and bunded for flood irrigation of rice
Ayurvedic medicine	ancient Hindu art of medicine and of prolonging life
basnawa	outfall
bowser	cilindrical tank on vehicles in which (usually) water is stored.
brinjal	eggplant, aubergine
cabook	kind of hard rock used as building bricks
cadjan	dried coconut palm leaves used for roofs
cadju	cashew
chena	slash and burn cultivation
gambaras	absentee landlords
ganja	marihuana
Grama Niladhari	village officer
Grama Sevaka	village administrator
jak	kind of fruit
Janasaviya	charitable government scheme
kachcheri	administrative office at district level
kalapuwa	inland lagoon, not connected to the sea
kanjee	softened rice mixed with water given as a drink to patients
kanne	cultivation
kattinayake	plot leader
Krushikarma Vijapta Seveka	Village Extension Worker
lakh	one hundred thousand
lewaya	inland lagoon, connected to the sea
madya maha vidyalaya	central school
maha	northeast monsoon cultivation season
maha vidyalaya	government school
mammoty	hoe
modera	mouth of a river
paddy	rice
palmyrah	type of palmtree
pola	market
Pradeshiya Sabha	provincial council
Raja Rata	north-central province of Sri Lanka
shramadana	voluntary communal labor
tank	reservoir
taungya	clearance of land for chena cultivation
thriposha	milkpowder comprising a mixture of various nutrients
vel vidane	Irrigation Headman
Tumpath Rela	group of 3 elephants: father, mother and baby
wadiya	temporary settlement, camp
yala	southwest monsoon cultivation season


SRI LANKA
DRY ZONE
WET ZONE
COLOMBO
Hambantota
Matara
PROJECT AREA
Lunuganwehera Reservoir
Lunuganwehera
REFERENCE
MAIN ROAD
MAIN AND BRANCH CANAL
TRACT BOUNDARY
OLD AREA
NEW AREA
Left Bank Main Canal
Ellagala Anicut
TRACT 1
TRACT 1
TRACT 2
TRACT 2
TRACT 3
TRACT 4
Pannagamuwa Wewa
Debara Wewa
Tissa Wewa
Wirawila
Wewa
Debara wewa
Tissamaharama
Yoda Wewa
Right Bank Main Canal
Wirawila
Badagiriya Tank
TRACT 5
TRACT 7
TRACT 6
TRACT 4
TRACT 3
Kirindi Oya
Kirinda
S E A
Bundala Bird Sanctuary
From Hambantota
0 1 2 3 4 5
KILOMETERS

CHAPTER 1

IRRIGATION SYSTEM DEVELOPMENT, OPERATION AND MAINTENANCE

1.1 Background

The Kirindi Oya Project is an irrigation and settlement project, located in the dry zone of the southern quadrant of the island, about 260 km. from the city of Colombo. The project planned to augment irrigation water supplies for the existing irrigation systems Ellegala and Badagiriya which cover about 4,500 ha. Besides the project intended to provide irrigation facilities through the Right Bank and the Left Bank Main Canals from the newly constructed Lunugamvehera reservoir for an additional area of approximately 8,400 ha. and settlement of about 8,320 families on the newly irrigated lands. Increasing food production and providing employment through settlement of landless people are the important national objectives for the project.

Under Phase I of the project, the reservoir at Lunugamvehera was commissioned in early 1986. New and improved irrigation facilities were provided for 8,775 ha. of which 4,584 ha. were already under cultivation. Phase II construction commenced in 1987 and was meant to develop an additional 4,100 ha. of new land. The phasing of the project was necessitated by large cost over-runs and time delays. The project has been in operation from 1987 yala.

The climate of the project area is tropical and is characterized by nearly constant year-round temperatures (26^0c to 28^0c). Evaporation is uniform throughout the year, with an annual average approximating 2100 mm. Mean annual rainfall is 1000 mm. in the project area with maha season rainfall (October to February) approximately three times the yala season (March to August). Soils in the project area consist of well-drained reddish brown soils (RBE) in the upland and intermediate zones, and poorly-drained low humic gley soils (LHG) in the lowland areas.

1.2 Methodology

Data for this chapter were derived from a variety of sources including direct field measurements by the personnel hired under this project as well as those collected by the Hydrology Division of the Irrigation Department. Published work, research reports (especially IIMI's Irrigation Management and Crop Diversification (IMCD) phase I and phase II seasonal and final reports), project design and various reports from the funding agencies were studied. Interviews were held with operating and decision making officials. Minutes of the Central Coordinating Committee and progress reports of the Irrigation Department were consulted as well as the large-scale sample survey of farmers conducted under this consultancy.

Unfortunately, most of the details regarding design, implementation and as-built drawings were destroyed during the 1989 insurgency and thereby restricting the ability to compare between proposals and achievements. Therefore, the operational and procedural aspects of water delivery and performance were collected through field observations, measurements and published reports. For field measurements and analysis a set of sampled distribution systems

(representing head, middle and tail as well as representing Right Bank Canals, Left Bank Canals, the Old Ellegala System and the dam proper) was selected, data collected, analyzed and inferences drawn.

The analysis looked into the following aspects: planning, design, implementation, operation and monitoring of irrigation systems. In addition, analysis also took into consideration the performance of the system as a whole, main system operation and tertiary system operation and maintenance.

1.3 Irrigable Area[1]

Table 1.1 provides the actual irrigable area developed and contemplated (proposed in the Appraisal Report) in the project. The table does not include the area of Badagiriya as it is not considered part of the developed area under the project. However, it receives supplementary water from the Lunugamvehera reservoir and the benefits from the Badagiriya area have been included in the cost-benefit analysis. A comparison of these two areas indicates that only 71 percent of the contemplated area has been developed under the project. The shortfall in the developed area is due to insufficient water flow to the Lunugamvehera reservoir. Therefore, some of the area contemplated under Phase II of the project could not be developed for want of sufficient water. The total area developed was estimated at 9,430 ha. by the study. The Irrigation Department has indicated that this figure has risen to 9,940 ha. at present.

Table 1.1 Extent of irrigable area (1994)

System	tract no.	Actual Irrigable Area			Proposed Irrigable Area		Actual/ Proposed
		Under tract in acres	Total		Total		
			acres	ha.	acres	ha.	
Right Bank	1 2 5 6 & 7	2,220 2,100 2,500 1,850	8,650	3,500			
Left Bank	1 2 3	1,850 1,950 750	4,550	1,840			71%
Ellegala	Five Tanks + Gemunupura Scheme	10,100	10,100	4,090			
Total Area in KOISP			23,300	9,430	32,850	13,300*	

* *Includes 7,424 ha. (57 percent) rice area and 5,506 ha. (43 percent) OFC area*

[1] Irrigable area refers to the actual area developed at the project and not the gross area irrigated.

1.4 Water Resources of Kirindi Oya Basin

The water resources potential of the Kirindi Oya basin has been a subject of discussion since the project was initiated. Over the years, there have been a number of estimates of water potential of the basin and the area that can be irrigated. Table 1.2 presents a list of estimated average annual inflow into Lunugamvehera reservoir.

Table 1.2 Average annual inflow into Lunugamvehera Reservoir in mcm.

Agency	Sri Lanka Atlas Published by the Survey Dept.	ADB Appraisal	ADB Appraisal	Water Management Consultants	Hydrology Division of ID	CECB	ID and IIMI Action Research Study
Year of estimation		1976	1986	1989	1989	1991	1992
Quantity	476[1]	343[2]	319[3]	333[4]	347[5]	307[6]	287[7]

(1) Annual flow to the sea.
(2) Based on historical data at Lunugamvehera reservoir.
(3) Based on 20 years inflow data.
(4) Based on 22 years data (1946-1967).
(5) Based on recent measurement at Tanamalwila.
(6) Synthetic generation and use of rainfall run off relationship based on recent flow measurement.
(7) Based on 1944-1978 data replaced by outlier by recent measurement.

As one can see, the estimated average inflow over the years has decreased considerably. The decrease is about 25 percent of ADB's 1976 estimated inflow. In its 1986 Appraisal Report (ADB 1986), the Asian Development Bank has indicated that tank construction in the catchment area has definitely affected the Basin's water yield. Figure 1.1 presents a 5 year moving average of weighted basin average rainfall for two basins - the Kirindi Oya and the Menik Ganga. From 1973 onwards, there is a drop in average rainfall of the Basin. The drop is of the order of 200 mm. In addition, Table 1.3 compares the recent Kirindi Oya weighted average rainfall with that of Kirindi Oya project rainfall measured at Weerawila Research Station. There is a perceptible drop in the weighted average rainfall of the Kirindi Oya basin from 1,646 mm to 1,152 mm. It is not clear whether this drop is due to cyclic pattern of rainfall received or a permanent change that is likely to continue. Clearly this drop in average rainfall is one of the major causes for decreased inflow into the Lunugamvehera reservoir.

Table 1.3 *Recent rainfall figures*

Year	Kirindi Oya Basin Rainfall (mm.)	Tissamaharama Rainfall (mm.)
1986/87	1,236.6	959.0
1987/88	1,651.6	-
1988/89	1,131.4	1,079.0
1989/90	1,009.0	794.0
1990/91	1,307.0	1,231.0
1991/92	887.0	904.0
1992/93	843.0	-
Average	1,152.0	993.0
Long-term average	1,646.0	-

1.5 Lunugamvehera Reservoir Release

Table 1.4 gives the annual release from Lunugamvehera reservoir starting from 1987-1988 to 1992-1993. The average annual release works out to 177.6 mcm.

Table 1.4 *Total annual release from Lunugamvehera Reservoir*

Cultivation Year	Water Release (MCM)
1987-88	222.7
1988-89	231.9
1989-90	166.4
1990-91	157.3
1991/92	125.5
1992/93	162.7
Average annual release	177.6

Table 1.5 compares the proposed and actual reservoir release. Compared to the ADB Appraisal Report of 1982 and 1986 estimation, the actual reservoir release works out to only 60 percent. The Water Management Consultants through their simulation studies have worked out that if the average reservoir release is 295 mcm, then 100 percent of the irrigable area can be irrigated with 100 percent irrigation intensity. On the other hand, if the average reservoir release is only 185 mcm, then only 77 percent of the irrigable area can be irrigated with an irrigation intensity of 62 percent while with 126 mcm, it would be possible only to irrigate 35 percent of irrigable area with 62 percent cropping intensity. During the last six-year operation, it was possible to irrigate 71 percent of the irrigable area with an irrigation intensity of 66 percent.

Table 1.5 Reservoir release (proposed and actual)

Serial No.	Source of Estimates	Estimated Reservoir Release (mcm)	Proposed/Actual Cropping Pattern and Cropping Intensities	Irrigable Area
1	ADB (1977)	382.74	100% irrigation cropping intensity both maha & yala	7,428 ha. paddy 5,508 ha. OFC
2	ADB (1982)	294.00	71% Lowland rice 29% Upland rice for maha 63% Lowland rice 37% OFC for yala	Same as above
3	ADB (1986)	297.00	Cropping pattern same as above 100% irrigation intensity for maha 70% irrigation intensity for yala	Same as above
4	Water management consultant (1987)	295.00 185.00 126.00	Paddy, fruit crop & OFC 100% irrigation intensity 62% irrigation intensity 62% irrigation intensity	Same as above Irrigation area 77% of the above Irrigable area 35% of the above
5	Actual average of 6 years	177.6	Mostly paddy 66% irrigation intensity	Actual area irrigable 71% of the above

Note: Irrigation intensity refers to a season. It can be a maximum up to 100 percent for a season. On the other hand, the cropping intensity is for a year. For a two season crop, the cropping intensity can be maximum up to 100 percent.

Table 1.6 presents area cultivated seasonwise, water duty for the old and new area and intensity of irrigation based on proposed and actual irrigable area.

Table 1.6 Area cultivated in the Kirindi Oya Project

Season	Duty		Ellegala acres	Section 1 R1, L1, L2 (acres)	Section 2 R2, R3 (acres)	Section 3 R6 & R5 (acres)	Badagiriya (acres)	Total Irrigated area excluding Badagiriya (acres)	Intensity of Irrigation	
	New (ft.)	Old (ft.)							Based on proposed %	Based on developed %
1987 yala			10,100				1,650	10,100	31	43
1987/88 maha	7.8	3.8	10,100	6,000	4,600		1,650	20.700	63	89
1988 yala	7.4	1.5	10,100	6,000	0		1,650	16,100	49	69
1988/89 maha	9.5	1.4	10,100	6,000	4,600		0	20,700	63	89
1989 yala	10.0	2.7	10,100	0	4,600		0	14,700	45	63
1989/90 maha	9.7	2.5	10,100	6,000	0		1,650	16,100	49	69
1990 yala	OFC	5.1	10,100	650	0		1,650	10,750	33	46
1990/91 maha	8.6	2.1	10,100	6,000	4,600	1,475	1,650	22,175	68	95
1991 yala	OFC	1.5	10,100	0	500	375	1,650	10,975	33	47
1991/92 maha	7.2	1.2	10,100	6,000	4,600	1,850	0	22,550	69	97
1992 yala			10,100*	0	0	0	1,650	10,100	31	43
1992/93 maha	8.0	1.8	10,100	6,000	4,600	0	0	20,700	63	89
1993 yala			6,000**	0	0	0		6,000	18	26
	8.5	2.4				Average		15,512	47.2	66.6

The average cropping intensity = 133.2 percent.

Data Source: R.E. (RB), Irrigation Department.

*Note: * Crop failure 8,000 acres.*
*** OFC 2,000 acres and paddy 4,000 acres.*
??? OFC cultivation

The average duty for the new area works out to 8.5 acft/acre while for the old area, it is only 2.4 acft/acre. This decreased duty is mainly due to additional water received from drainage of new areas and surface runoff from its own catchments. The intensity of irrigation based on the proposed irrigable area is 47.2 percent while it is 66.6 percent based on the actually developed irrigable area.

Table 1.7 presents a comparison of efficiency of overall irrigation based on simulated results of water management consultants and actual irrigation. The overall efficiency is defined as percentage of irrigable area developed for irrigation multiplied by the percentage of irrigation intensity. As can be seen from Table 1.7, the actual observed overall efficiency is 47.3 percent against a simulated value of 44.5 percent for an inflow of 177.6 mcm. In spite of the fact that

in actual irrigation, most of the area was planted with rice, the overall efficiency figure indicates that the system performed well.

Table 1.7 Efficiency of overall irrigation

Source	Reservoir Release	Area Irrigated %	Intensity of Irrigation %	Efficiency %
Water management consultant	177.6 mcm	71.75	62.0	44.5
Actual observed over a 6 year period	177.6 mcm	71.00	66.6	47.3

Two reasons are attributed to the improved performance. One is the large amount of return flow emanating from the new irrigated area which adds to the total quantum of water utilized in the project area. Secondly, the operational plan adopted by the Irrigation Department (ID) especially to effectively utilize the rainfall by closing the distributary canal has improved the water use efficiency. During maha 1991/1992, the distributary canal D5 was closed for a total of 21 days out of the targeted 105 days of water supply. This closure of the DC canal has a very great impact on improving the water use efficiency.

1.6 Development of Agro-Wells in the Command Area

Agro-wells are dug wells with diameter ranging from 1.5 m. to 3.5 m. Their depth typically varies from 3 m. to 6 m. and they tap the seepage and percolation water entering underground from irrigation. The wells constructed along flood plains of the river are somewhat deeper and larger in diameter. These wells are used by the farmers to raise limited extent of other field crops in their land. Table 1.8 gives the development and use of agro-wells for 3 yala seasons, 1991 to 1993, indicating the number of wells developed, area irrigated and the number of farmers using these wells. The trend indicates that there is a rapid development of agro-wells in the command area of the Kirindi Oya project.

Table 1.8 Extent cultivated and farmer participation on shallow well irrigation program

Description	Season		
	1991 yala	1992 yala	1993 yala
Number of wells	2.0	241.0	325.0
Extent (ha.)	1.5	65.5	74.5
Number of farmers	2.0	230.0	266.0

Data Source: A.D. (Agriculture [K.O.I.S.P.])

1.7 Reuse of Drainage Water

Drainage measurements were carried out from 10 May 1993 to 12 July 1993 (Table 1.9). The drainage discharge varies from 83 cusecs in May to 32 cusecs in July. It is estimated that drainage discharge during maha will be much higher.

Table 1.9 Drainage flow measurements

Date	Quantity of Discharge (cusec)		
	Attikkawa	Magama	Kirinda
10 May 1993	8	50	25
24 May 1993	3	30	23
8 June 1993	5	10	10
23 June 1993	1	17	12
12 July 1993	15	10	7
	Volume Discharge (acft)		
10 May 1993	222	1,386	693
24 May 1993	89	891	689
8 June 1993	149	297	297
23 June 1993	53	628	436
12 July 1993			
Total discharge	512	3,202	2,115

While drainage water moving out from tracts 1 and 2 of LB and 1 and 2 of RB reaches Ellegala tank systems, drainage from the new area tracts 5, 6 and 7 cuts across the road leading to Tissamaharama and outfalls into the sea. No measurements of drainage water was made in these tracts; however, during maha season, 1991/1992 the drainage discharge was estimated to be about 50 cusecs. This drainage water is not effectively reused.

Use of dug-wells and effective use of drainage return flow for supplementing Lunugamvehera reservoir water were not given due consideration while planning for the water resources of the Kirindi Oya Irrigation and Settlement Project.

1.8 Design Assumptions and their Realization

Table 1.10 gives a comparison of the proposed and actual irrigation water requirements during land preparation and the time taken for land soaking, land preparation and sowing. Both these parameters as used in the field are very much different from what have been assumed in the design and operation guidelines. A number of reasons have been attributed to these divergence; the most important among them are: the irrigation system has not yet stabilized, the farmers are not organized well, the support services are poor, and the design assumptions need to be updated.

Table 1.10 Comparison of Proposed and Actual Irrigation Water Requirement during Land Preparation

Description	Design Guideline	Operation Guideline	Actual Observed in New Area	
			D2 1989 (yala)	Sub D1/5 1991/92 (maha)
Land soaking, land preparation and sowing period	15 day	21 day	**38 days**	42 days
Water requirement	175 mm	100 mm	800 mm	577 mm

Table 1.11 gives a comparison assumed and actual seepage rates. The measured seepage and percolation values are high especially for upland soils. While measured values need to be used for designing field channels, it is surmised that the design values may be appropriate for the design of main and branch canals. The design guidelines were for individual plots, while observed values were for distributaries.

Table 1.11 Comparison of assumed and actual seepage and percolation rates

Description	Assumed Old Area	Assumed New Area	Measured Values in RB tract 5, BC 2
Seepage and Percolation	3 mm/day	6 mm/day (upland)	10.9 mm/day
Loss		3 mm/day (lowland)	3.9 mm/day

Table 1.12 presents a comparison of assumed and actual distributary efficiency in the new area. The measured efficiency is not very much different from the design guideline values.

Table 1.12 Comparison of assumed and actual distributary efficiency in the new area

Description	Design Guideline	O&M	Measured
Distributary canal DC2 in the New Area (yala 1988 season)	0.65	0.95	0.7

Table 1.13 gives the return flow computation to the Ellegala tank system based on data obtained during maha 1992/1993. The results indicate that the actual drainage water including rainfall run off entering into the Ellegala system tanks (53.5 percent of water supplied to RB and LB) is much higher than what is normally assumed (20 percent) for scheduling purposes. This higher inflow of drainage water into the Ellegala system allows to release a lower quantity of water from the Lunugamvehera reservoir, thereby bringing down the duty of water released from Lunugamvehera to the Ellegala system.

Table 1.13 Return flow to Ellegala Tank during maha 1992/1993

Water supplied to RB from Lunugamvehera	43,073 ac.ft
Water supplied to LB from Lunugamvehera to LB tracts	33,086 ac.ft
Total water supplied to RB and LB tracts	76,159 ac.ft
Water received by OEIS tanks from feeder channels	37,120 ac.ft
Water received by OEIS tanks from direct drainage	21,208 ac.ft
Total water received by OEIS tanks	58,218 ac.ft
Water received directly from Lunugamvehera reservoir	17,477 ac.ft
Water received by way of drainage and rainfall runoff	40,752 ac.ft
Water received as a percentage of release from Lunugamvehera to RB and LB tracts	$\frac{40,752}{76,159}$ = 53.5%
Actual drainage water including rainfall run-off	53.5%
Design assumption of drainage water to OEIS	20%

1.9 Design Management Interactions

The design of field canals and turnouts in the Kirindi Oya Irrigation Project embodies a set of technical, operational and institutional assumptions. The field canals are designed for a typical design discharge of 28 l/s (one cusec) and the turnout areas are sized to serve the peak irrigation water requirements for rice, depending on the total percentage of well-drained and poorly-drained allotment areas served by the field canal. Most of the field canals are able to meet their requirements; however, some turnouts serving 20-24 ha. with predominantly well-drained soils have operational difficulties as the design discharge in the field canal cannot meet the irrigation needs of all the farmers within the typical irrigation interval of seven days, if rotation is implemented.

Some of the distributaries in the Kirindi Oya system have design discharges which are less than the aggregate sum of the design discharges of all field canals served by them. This imposes a potential capacity constraint particularly during the land preparation period when all the field canals are operated simultaneously with continuous flow. If such a distributary has excessive conveyance losses above the assumed values (eg. DC5 canal of RB tract 1) and large turnout areas served by one or more field canal (eg. field canal 49 in DC5 in the Right Bank tract 1 which consists of 24 ha.), the distributary canal capacity becomes a constraint in ensuring an adequate and equitable supply to the farmers.

The design of the farm turnouts in Kirindi Oya assumes that 14-15 l/s is the best manageable stream size for an individual farmer and two farmers below the field canal turnout will share the entire 28 l/s flow in the field canal simultaneously.

In Kirindi Oya, the "variable discharge - fixed period" mode of water distribution was adopted. The variable discharges were converted into equivalent heights of water above the crest level of measuring weirs constructed immediately downstream of the field canal turnout structures and the irrigators were provided with the water depths to be maintained in each week of the growing period. However, it was observed that the farmers rarely followed the intended internal rotations and instead resorted to various informal ways of water sharing throughout the season. This compelled the turnout attendants to deviate from strict adherence to the schedules prepared by the Department for rotation among the field canals and to respond to the needs of each individual field canal in an ad hoc manner.

During maha 1991/1992, the ID did not implement rotation within distributary canals (DCs) during the crop growth period. Instead of rotating the field canals (FCs), the ID operated the FCs continuously but closed them during rainy days. This closure contributed tremendously to the reduction of water duty during crop growth period. The Relative Water Supply values during the crop growth period is low as shown in Figure 1.2 (varying between 1.1 to 1.3). Moreover, equity in water distribution among field canals was also maintained as seen in Figure 1.2.

1.10 Design Construction Conformity

Design construction conformity could not be verified in the field because much of the as-built drawings and connected files were destroyed at Tissamaharama office in 1989 during the insurgency. However, for a few constructions, as-built drawings are available.

Figure 1.3 shows design-construction conformity for a typical distributary canal in LB tract 3. The conformity between design and construction appears to be good.

1.11 Post-Construction Data Collection Program in KOISP

The data shown in Table 1.14 are being collected routinely at the Lunugamvehera Dam and maintained in a register. However, there is little evidence that most of the data are analyzed and any corrective measures, if necessary, are taken.

Table 1.14 Data collection on Lunugamvehera Dam

Measuring Interval	Description
Every Operation	Sluice gate operation Sluice discharges variation
Hourly	Tank water level
Daily	Rainfall Evaporation Wind speed Sunshine record Temperature Piezometer reading Load well reading
Weekly	V - notch reading (Sam seepage)
Monthly	Spill tunnel pressure gauge

1.12 Maintenance Management

Maintenance allocations in Kirindi Oya are quite low. These allocations are part of a total allocation for operation and maintenance provided through the Irrigation Management Division (IMD). The distribution of allocation (IMD) for operation and maintenance for 1992 is given in Table 1.15.

Table 1.15 Distribution of allocation (IMD) for operation and maintenance - 1992

Scheme	Com. Area (Ac)	Maintenance (Rs)	Operation (Rs)	Total (Rs)	Main/Acre (Rs)	Operation/ Acre (Rs)	O&M/ Acre (Rs)	1991 Allocation (Rs)
Hambantota	14,906	665,000	540,000	1,205,000	44.61	36.23	80.84	940,800
Tissa	10,433	575,000	335,000	91,0000	55.11	32.11	87.22	704,872
Badagiriya	2,100	98,000	52,500	150,500	46.67	25.00	71.67	120,344
Right Bank	10,408	34,000	221,000	561,000	32.67	21.23	53.90	479,175
Left Bank	4,856	160,000	104,000	264,000	32.95	21.42	54.37	236,012
Southern Range	42,703	1,838,000	1,252,500	3,090,500	43.04	29.33	72.37	2,481,203
Uda Walawe	29,640	4,675,000		4,675,000	157.73			

Within the Hambantota range, maintenance allocations range from Rs.53/= to Rs.87/= per acre. Old systems like Tissa gets higher allocations to cover its overhead costs.

The operation and maintenance allocation does not cover salaries of maintenance staff but it covers salaries of casual staff (typists, peons, watchers and drivers), travel and subsistence, and vehicle repairs. As against this, the maintenance cost allocated to Uda Walawe by the Mahaweli Economic Agency (MEA) is Rs. 156/= per acre which is 2.82 times that of the ID (Draft Final Report, IMCD Phase II, 1994). An analysis of breakdown of O&M cost between administration and operation and maintenance shows that in 1991, the ratio of administrative expenditure to O&M expenditure was 3.96 in 1991, compared to 0.21 and 0.71 during previous years. (Please refer Table 1.16).

Table 1.16 Allocation and expenditure data of Tissa Division

Year	Administration		Maintenance		Total		ID Operation		Total O&M		Expend. Acre (Rs)
	Alloca. (Rs)	Expend. (Rs)	Alloc. (Rs)	Expend. (Rs)	Alloca. (Rs)	Expend. (Rs)	Alloc. (Rs)	Expend. (Rs)	Alloca. (Rs)	Expend. (Rs)	
1987	406,466	296,216	704,096	776,062	1110,562	1,072,278	339,000	357,844	1,449,562	1,430,122	120
1988	358,650	249,926	486,850	673,627	845,500	923,553	550,400	506,288	1,395,900	1,429,841	117
1989	290,000	247,501	585,000	591,102	875,000	838,603	318,000	402,644	1,193,000	1,241,246	104
1990	276,026	578,559	673,556	407,285	949,582	985,844	332,894	408,836	1,282,476	1,394,680	117
1991	250,920	1,056,621	408,460	147,400	659,380	1,204,021	388,500	119,539	1,047,880	1,323,560	128

There seems to exist a trend to spend a greater part of available funds on administration with a corresponding detrimental effect on maintenance. IIMI's IMCD Phase II research concluded that administrative overhead of maintenance work for the ID is high compared with the physical work; the administrative cost are covered by using the funds provided for physical work. When construction activities are diminishing in a project, administrative (overhead) costs should be readjusted to suit the work load. Under administrative cost, there are certain fixed costs like salaries, vehicle maintenance, electricity, telephone, etc. which are difficult to minimize. To overcome this situation and to minimize fixed expenditure, the ID should reorganize its operation and maintenance division by bringing in more command area under each division in order to maximize the man power utilization; such rearrangement would lead to reduced per acre maintenance overhead cost.

1.13 Irrigation Performance

Figure 1.4 indicates the area cultivated in KOISP starting from maha 1987/1988 to yala 1993. Figures 1.5 and 1.6 gives duties for Ellegala system and KOISP new areas. The average cropping intensity for the irrigable area developed both in the new and the old systems works out to 133.2 percent.

1.14 Farmers' Perception about Construction of Irrigation Systems

In a large scale sample survey (LSS) farmers were requested to respond to the construction quality of the main canal, branch canal, field canal, regulators, gates and farm turnouts. The response of the farmers is shown in Figure 1.7. Most of the farmers (more than 50 percent) felt that the construction of the various components of irrigation structures is normal

except for the branch canal (BC) and farm turnouts. In the case of BC, there was only one BC in the whole system and the farmers using the BC who were interviewed under this sample survey were very few and therefore, many farmers who were interviewed did not have any idea about the BC; with regard to farm turnout, only 38 percent said that the construction is normal while 35 percent said that the construction is poor. On the whole, the construction quality of Kirindi Oya as perceived by the farmers appears to be normal.

1.15 Farmers' Perception about Irrigation Problems

The large-scale sample survey extracted the following information:

(a) 75 percent of the farmers think that water received in the reservoir is used efficiently.

(b) About 67 percent of the farmers expressed that during the cultivation period, their field canals receive enough irrigation water.

(c) About 40 percent of the farmers reported to get adequate irrigation water from the field canal during maha while the same percentage farmers said that they are unable to get adequate irrigation water from the FC during yala.

(d) About 80 percent of Ellegala farmers said that they have water problems only during the early stages of crop growth in yala. In contrast, 90 percent of the new area farmers indicated to have problems in getting adequate water during all stages of crop growth in yala.

(e) About 65 percent of the farmers stated to participate both in FC and DC canal maintenance works.

(f) Approximately 70 percent of the farmers feel that they can do routine maintenance better than what ID is presently doing.

(g) The money allocated for maintenance is not adequate according to 50 percent of the farmers.

(h) The money allocated for DC maintenance is used efficiently by the farmers organization on a contract basis according to 45 percent of the farmers.

(i) About 50 percent of the farmers feel that FO would be able to handle successfully the O&M responsibilities turned over from ID.

(j) The rehabilitation completed just after the Lunugamvehera reservoir construction failed due to the poor construction quality.

The structures collapsed in a short period. This is reported by 65 percent of the farmers in the Ellegala system.

(k) According to 45 percent of the farmers the ID rectified the difficulties pointed out by the farmers after walk-through surveys.

(l) About 40 percent of the farmers feel that the OEIS tanks are to be operated by ID officials (technical assistants, work supervisors) while another 40 percent feel that it should be operated by farmers and ID officials both in collaboration.

1.16 Farmers' Proposal for Water Deficiency Problem in the Lunugamvehera Reservoir

Figure 1.8 indicates farmers' perception to overcome water deficiency in the Lunugamvehera reservoir. As one would expect, diversion of water from other basins and efficient use of available water are the two major solutions identified by farmers.

1.17 Organization for Operation and Maintenance

Evolution of Irrigation O&M Organization in Kirindi Oya

The main organizations involved in project operation, maintenance and management are the Land Commissioner's Department, Department of Irrigation, the Irrigation Management Division, the Department of Agriculture and the Department of Agrarian Services.

The Land Commissioner's Department, Department of Irrigation and the Irrigation Management Division are headed at the project level by Project Managers. The Department of Agriculture functions in the project under an Agricultural Officer who has responsibilities towards both the new and old systems as well as to areas beyond project boundaries.

The Project Manager (Irrigation/Chief Resident Engineer) was initially responsible for the implementation of the irrigation construction work under the project. However, when the irrigation system in the Phase I area began to function, he became responsible for operation and maintenance (O&M) activities as well as for construction work. His construction cadre included four resident engineers in charge of the Right Bank, Left Bank, Headworks and a number of Design Engineers attached to his office, as well as irrigation engineers, technical assistants, work supervisors, and skilled and unskilled laborers.

Initially, the O&M activities in Phase I area of the project were handled by the Left and Right Bank resident engineers from the yala 1986 season to the end of maha 1986/1987. The resident engineers simultaneously managed some construction work in the Phase I area and other construction-related activities in Phase II. With the assistance of an Irrigation Engineer in charge of construction, the Resident Engineers prepared water issue schedules and were in charge of operation. The field level operational activities were handled by technical assistants who also supervised construction work. They were assisted by work supervisors and irrigation laborers. The resident engineers had the authority to instruct the resident engineer (Headworks)

for the operation of main sluices and were responsible for distribution and monitoring of water down to the field channel turnouts.

Since the operational performance was not satisfactory during the two seasons referred to above, it was decided starting with maha 1987/1988 to put a senior irrigation engineer in the office of the Chief Resident Engineer in charge of preparing water issue schedules. He was also given authority to control the issues from the main sluices. The resident engineers now had to contact the Senior Irrigation Engineer whenever they wanted to increase the discharge in the main canals, as their previous authority to instruct the resident engineers (Headworks) for such purposes was withdrawn. However, the resident engineers remained responsible for the operation and maintenance of the system below the main sluices, and monitoring discharges. They appointed Irrigation Engineers (O&M) with some subordinate staff to attend to these duties while also attending to construction work in the area. The technical assistants and work supervisors were appointed on the basis of one for each tract, with seven to eight irrigation laborers to assist them.

During the third stage of development, i.e. after the special status of the project was withdrawn from February 1994, the system started operating with one chief resident engineer, one resident engineer for the Right Bank canal and headworks, one resident engineer for the Left Bank canal and old Ellegala System. They are supported by one irrigation engineer at the CRE office, 13 technical assistants, 16 work supervisors and about 50 irrigation laborers. This arrangement continues even today.

IIMI's Phase I Research Findings on O&M Organization

IIMI's Phase I research on the Kirindi Oya Project (IIMI 1989) identified the following weaknesses in the institutional set up for O&M functions:

(1) As long as O&M functions were clubbed with construction activities of the project, resident engineers who were in charge of both construction and operation and maintenance gave priority to construction over O&M. This is mainly due to the fact that Irrigation Department evaluations are based primarily on the achievement of construction targets, as well as a natural tendency of civil engineers to prefer construction work.

(2) The division of O&M authority vested among so many officers (Chief Resident Engineer, Senior Irrigation Engineer, three resident engineers, two O&M engineers) seriously affected the performance of the staff. The authorities and duties among various officers did not match properly thus hindering the ability of some managers such as the Senior Irrigation Engineer to exercise direct authority over O&M.

(3) Clear definitions of roles through specific job descriptions for technical assistants, work supervisors, and irrigation laborers were not provided. There was no incentive for the officials of the O&M organization to motivate them to attend to their duties as required by the operational assumptions. These constraints particularly affected the performance of the middle- and lower-level field staff who are the kingpins of water management from the agency side.

(4) IIMI's study recommended that the Irrigation Department should implement measures to encourage officials to achieve a higher professional standard in the operation and maintenance of irrigation systems. The O&M staff should be given full responsibility with appropriate authority for improved system management. The Department should provide both in-service and on-the-job training in the skills required in operation and maintenance of irrigation systems including "people management skills". The system of incentives might include such non-monetary rewards as selection of good system managers for valuable overseas training opportunities, and letters of recommendation to system managers who achieve consistent improvements in the performance of their system.

Interview with O&M Staff at Kirindi Oya Project

A fair section of the O&M staff of the Kirindi Oya Project [Chief Resident Engineer (1), technical assistants (4), work supervisors (2), and gate operators (2)] was interviewed to identify their roles and functions in operating and maintaining the system and their perception on the strength and weaknesses of the system affecting its performance. The following is a summary of their responses:

- In the Old Ellegala System, the open cut-out turnout and main canal gate regulators introduced during the first (initial) rehabilitation construction were not constructed properly, not functional and farmers did not like it. Pipe turnouts constructed in the new area performed better.

- No measuring gauges are provided in the tail portion of the tanks main canals for proper water measurement.

- Because of farmer's encroachment of irrigation reserves, command areas of DCs and FCs have increased, consequently, the main canal capacity during peak flow is not sufficient to provide an adequate supply. Main canal bund raising and selective lining of main canals were suggested to overcome these difficulties.

- The Weerawila tank bund needs strengthening and turfing at selected locations. There is encroachment on the foreshore of the Weerawila tank by powerful farmers, these farmers, in the opinion of technical assistants in charge of the tank would not allow the Weerawila tank bund to be raised; also these farmers interfere with the operation of surplus arrangement when the tank is full and when there is likelihood of their lands getting submerged.

- The irrigation laborers allotted to the Ellegala division are used for canal operation and maintenance work. During canal operation, they record tank water measurements and gate settings; during off-season they carry out weeding, desalting of selected reaches and repairs and greasing of structures; they are fully used.

- The drainage channel improvement during the recent Rectification of Irrigation Difficulties (RID) has considerably reduced the salinity problem in the Old Ellegala

System. The structures under the RID works were designed in consultation with farmers but they could not be completed as designed due to FOs delay in completing the work. Moreover the illegal tapping of water directly from the main canal by farmers adjoining the main canal through pipe outlets has to be effectively prevented for proper functioning of the main canal.

- The following are the routine measurements recorded by the operating personnel: tank water level, tank discharges, gate setting of off-takes, rainfall and evaporation (wherever equipments are installed). This information is routinely used for making operational decisions.

- Invariably most of the measuring structures, especially broad crested weirs did not function properly due to submergence and they were not made use of. The farmers think that these are obstructions to flow in their channel and a few of them got damaged by farmers.

- Escape structures in Tissa Wewa did not function properly and needs proper maintenance and improvement.

- In the Old Ellegala System, there is a large scale encroachment of irrigation reservations, but evictions of the farmers are not possible due to political reasons.

- Some box culverts in the DCs of the new area are not functioning properly due to obstruction and blocking by floating materials, thus creating operational problems and water problems to farmers downstream of the blocked culvert.

- The present design of offtake gates are such that farmers can easily meddle with it and alter the gate setting; a number of off-take gates are being tampered by farmers and farmer organizations at times of water scarcity; improved design and proper locking arrangements need to be provided to prevent tampering of offtake sluices.

- Within some field channels, the field pipe outlets vary in size anywhere between 9" to 4". Because of these differences, supply of water based on variable discharge and constant time delivery could not be implemented; farmers with 4" outlets complain that 9" and 6" pipe outlets get an undue proportion of their share of water.

- Field channel groups do not clean their channels properly and in time. This results in not supplying their demand in time. Moreover, the field channel needs to be cleaned at least two to three times in a season which farmers do not carry out. This makes equitable and adequate water delivery difficult.

- In the main canals of RB and LB, below some of the cross-regulators there is a large scale scour in the bed and sides; proper rubble packing and lining are to be carried out to protect these structures.

- Canal cattle crossings are not used by the cattle owners, instead they use the natural place of their choice for crossing the cattle. This damages canal cross-sections; cattle

grazing should be strictly controlled and if possible, should not be allowed in the irrigated area.

- Bathing steps are provided for each hamlet. However, these are not used by the hamlet people because of algae formation which makes them slippery. People use the natural places and sometimes cause damage to the canal slopes.

- Most of the operating officials interviewed stressed the importance of providing additional foot bridges in order to protect the canals.

- A number of under tunnels provided across main canals bring in a large amount of sediment and dumps in the command area. Since drainage channels are not maintained properly, the flood water at times overflows the drainage channels inundating the farmers field and depositing the catchment sediment in the fields. In view of this, the affected farmers plug the under tunnel with debris and mud, thereby stagnating the flood water on the upstream side of these under tunnels. This flooding affects the main canal bunds and causes damage.

- There are five rainfall stations within the command including Lunugamvehera Dam. All meteorological measurements are carried out at Lunugamvehera Dam site. However for want of stationary such as recording papers, ink, etc. the automatic rain gauges are not used; proper and timely supply of adequate consumables is necessary.

- Although canal lining was not originally included in the project design, vulnerable reaches where high seepage was experienced were taken up for lining. The main canal capacity is not a problem when irrigation is started after commencement of rainfall. However, canal capacity becomes a constraint when irrigation is started with no rain and after a long drought period.

- The operating personnel is not provided with adequate facilities and there is no incentive for better operation and maintenance of the system. For example the gate operator in the Headworks (Lunugamvehera Dam) works for 12 hours a day with no extra renumeration. Even the basic amenities like drinking water and toilet facilities are not provided to him.

1.18 Concluding Remarks

(a) The estimated inflow into the Lunugamvehera reservoir is not taking place mostly due to reduction in rainfall within the basin during the last 20 years. The average rainfall within the basin has reduced by about one-third of its normal rainfall. Moreover, a number of small tanks constructed within the catchment has obstructed regular flow to the reservoir. Because of this shortage of water, only 71 percent of the proposed irrigable area was developed during the Phase I and II construction of the project.

(b) The average annual release from the reservoir during the last eight years of operation works out to 177.6 mcm which is only about 60

percent of the estimated release. However, the irrigable area developed is 71 percent of the design area.

(c) The cropping pattern suggested in the project Appraisal Report did not take place for a number of reasons. Farmers went for mono-paddy crop initially and only now they have started diversifying to other field crops.

(d) The proposed cropping intensity for the project is 170 percent in three out of 4 years and on an average every fourth year, the suggested cropping intensity will be less than 170 percent. The above cropping intensity is for raising paddy and OFC both during maha and yala. Against this, the cropping intensity achieved is 133.2 percent with mostly paddy crop.

(e) The Lunugamvehera reservoir water is used more efficiently. The water duty obtained during the various seasons in both Ellegala and new systems indicate that water is used more efficiently, equitably and to the satisfaction of farmers.

(f) The maintenance allocation for Kirindi Oya Project is low when compared to the neighboring Uda Walawe system operated by the Mahaweli Economic Agency. However, even from this low maintenance allocation, a considerable amount is expended in administration and overhead cost leaving less for works. In view of the fact that a large amount is expended on administration, it is suggested that the irrigated area under each operation and maintenance division of the ID needs to be reappraised and suitably modified to reduce the overhead and administrative cost.

(g) Construction standard appears to be normal. The assumed design parameters appear to be more or less in line with what has been measured in the field except the parameters time taken and water requirement for land preparation for paddy. The actual time taken and water used for land preparation are very much higher than what the design allows for.

(h) Most of the farmers perceive that they get sufficient water during the maha season while they do not get adequate water during the yala season.

(i) From the side of the agency, maintenance of some of the infrastructures needs to be improved, measuring structures do not perform as intended; the cattle problem needs to be solved; additional provision and repair of structures is suggested; better coordination between farmer and agency and incentives for operating personnel are suggested.

1.19 Lessons Learned

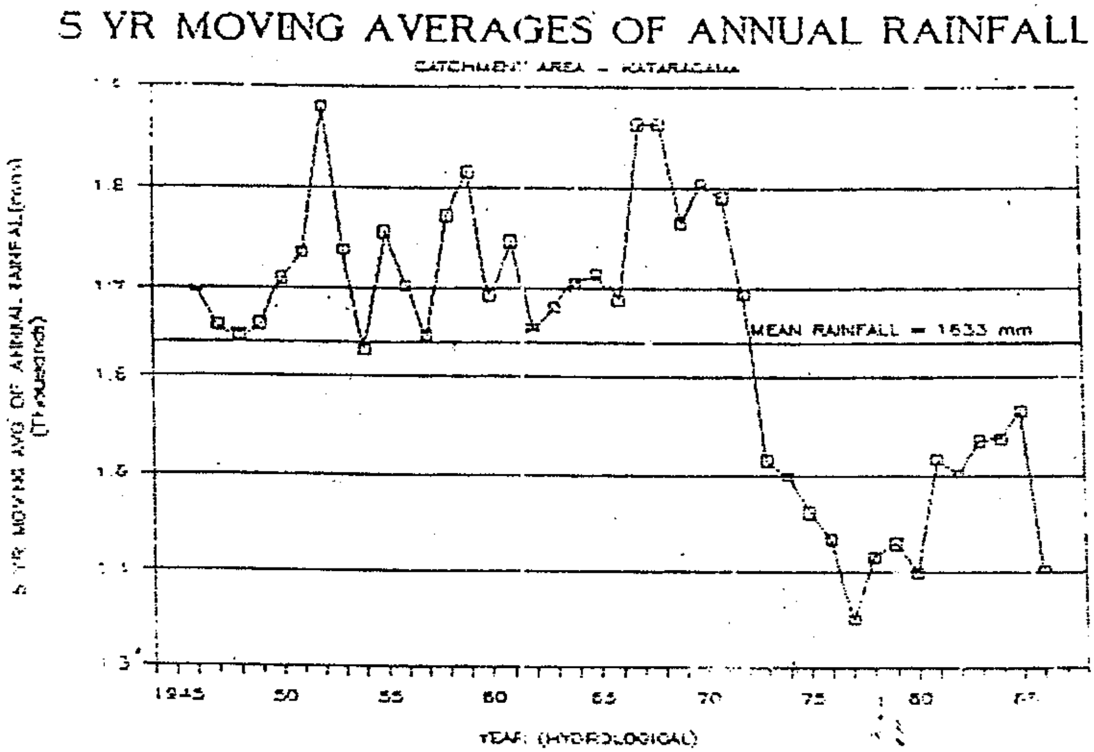
(a) Detailed hydrological analysis together with an integrated approach of using surface water together with drainage return flow and groundwater are very essential to plan an efficient project especially in water-short areas such as the Kirindi Oya basin.

(b) Water rights especially for old and new settlers are to be decided very clearly before the start of the project for efficient operation of the system.

(c) The present procedure of aligning field channels traversing well-drained, imperfectly-drained and poorly-drained soils is not conducive for efficient operation when OFCs are to be raised during the dry yala season. Separate provision of parallel field channels for well-drained and poorly-drained soils would facilitate a better system operation when OFCs are raised, it will effectively intercept the drainage flow and it will increase the on-farm water use efficiency. However, this needs to be field tested.

(d) Better maintenance, improved monitoring and evaluation of the system performance and incentives for the operating personnel are necessary for further improving system performance. The suggested incentives are: rent free quarters with an adjacent unit office for work supervisors at the tracts with essential facilities; recognition based on performance of field staff.

Figure 1.1. 5 year moving averages of annual catchment rainfall at Kataragama and Lunugamvehera



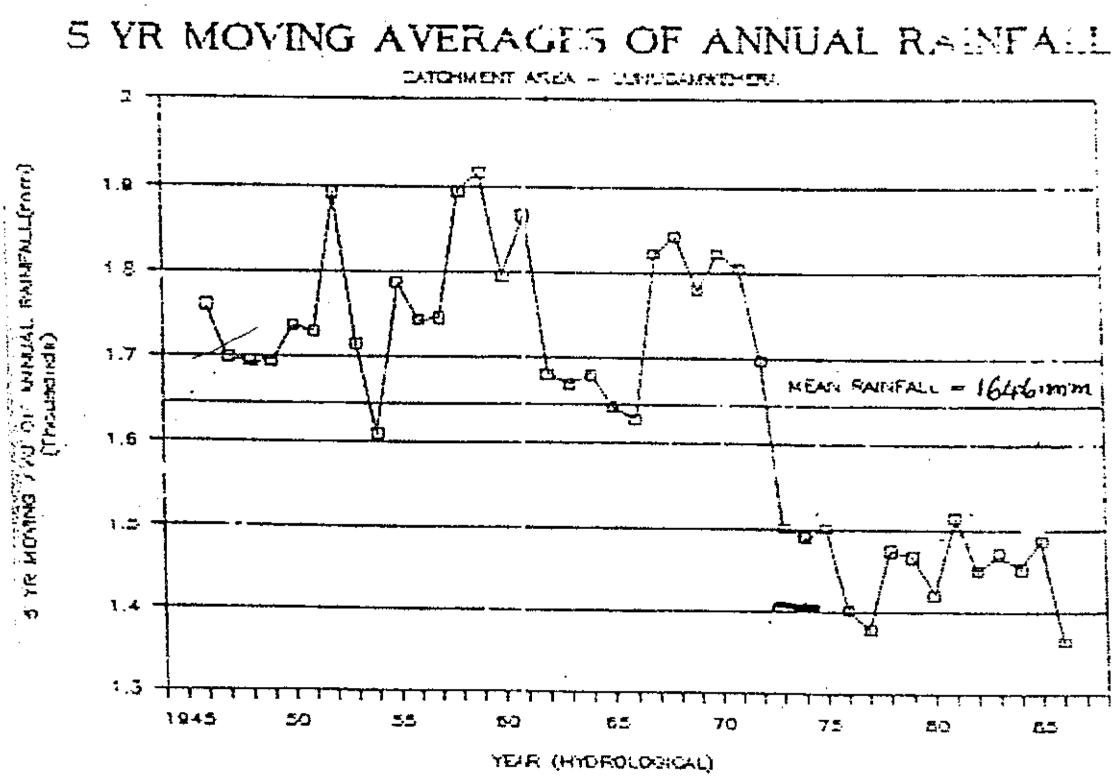


Figure 1.2. Mean relative water supply - Right Bank, tract 1: maha 1991/92

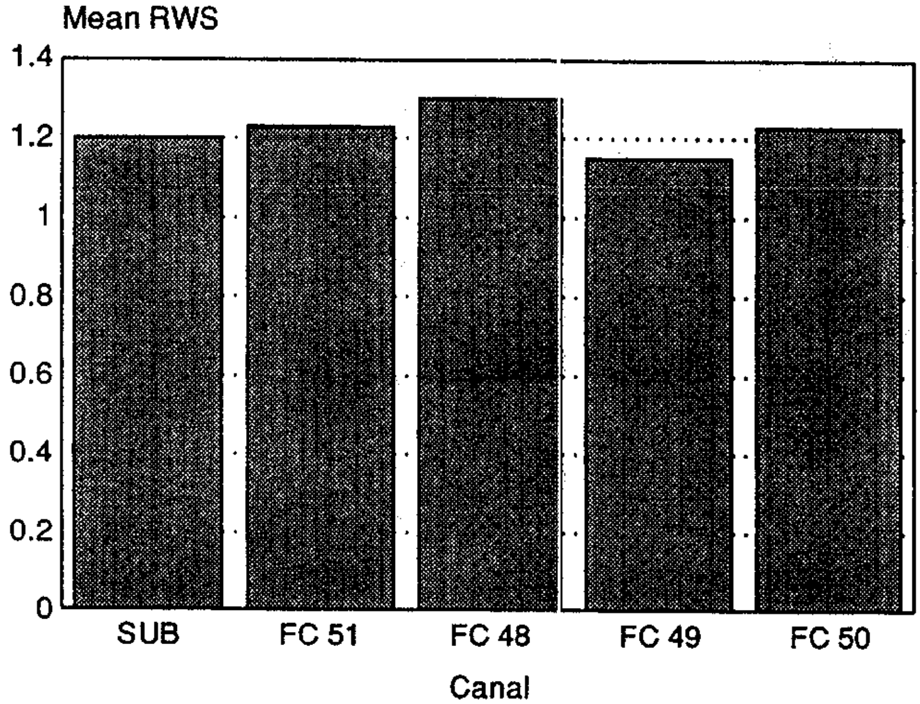


Figure 1.3. Design versus constructed canal levels: Left Bank, tract 3 DC 3 - KOISP

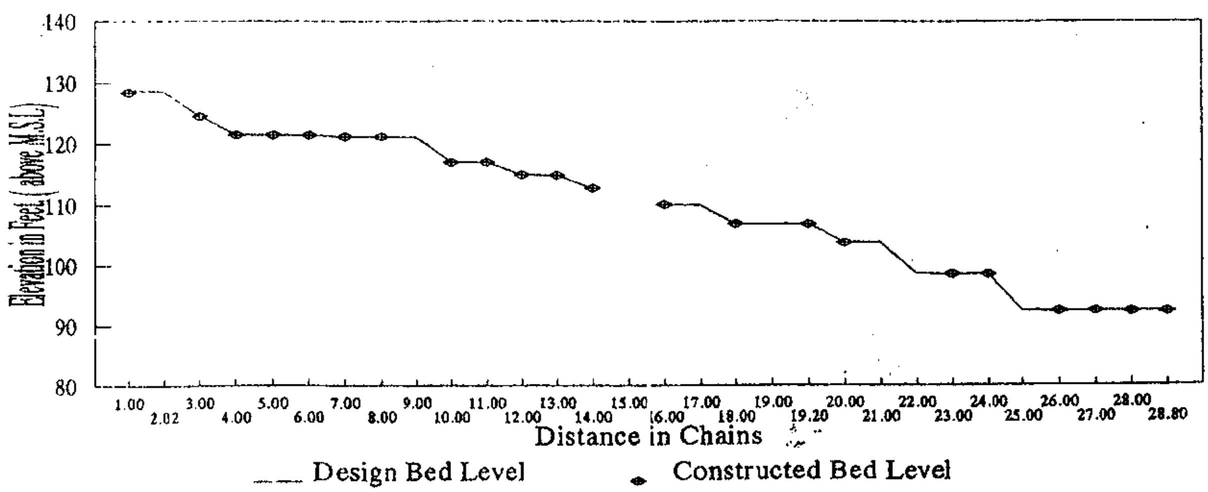


Figure 1.4. Area cultivated in KOISP: maha 1987/88 to yala 1993

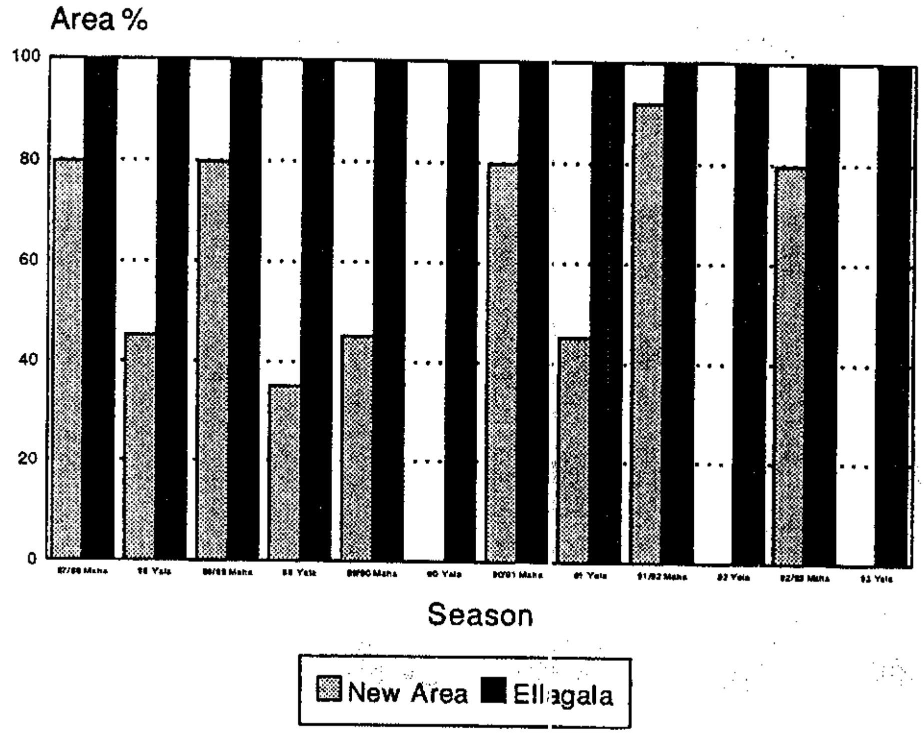


Figure 1.5. Water duty for paddy in Ellegala System - Irrigation and rainfall contribution: maha 1987/88 to maha 1992/93

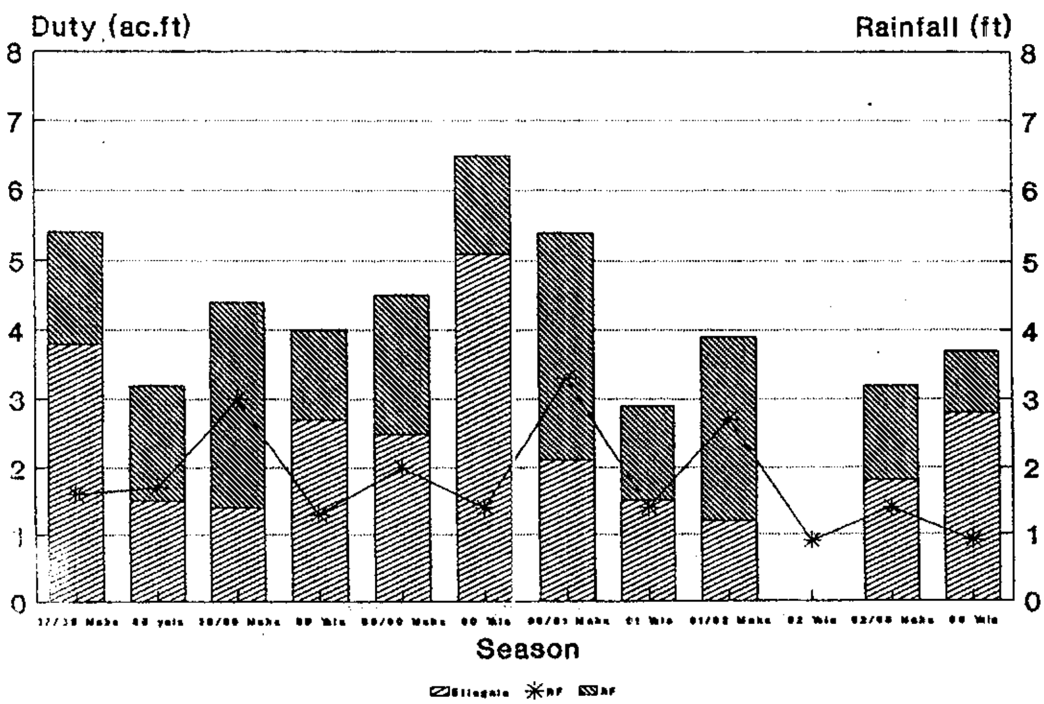


Figure 1.6. *Water duty for paddy in KOISP new area - Irrigation and rainfall contribution: maha 1987/88 to maha 1992/93*

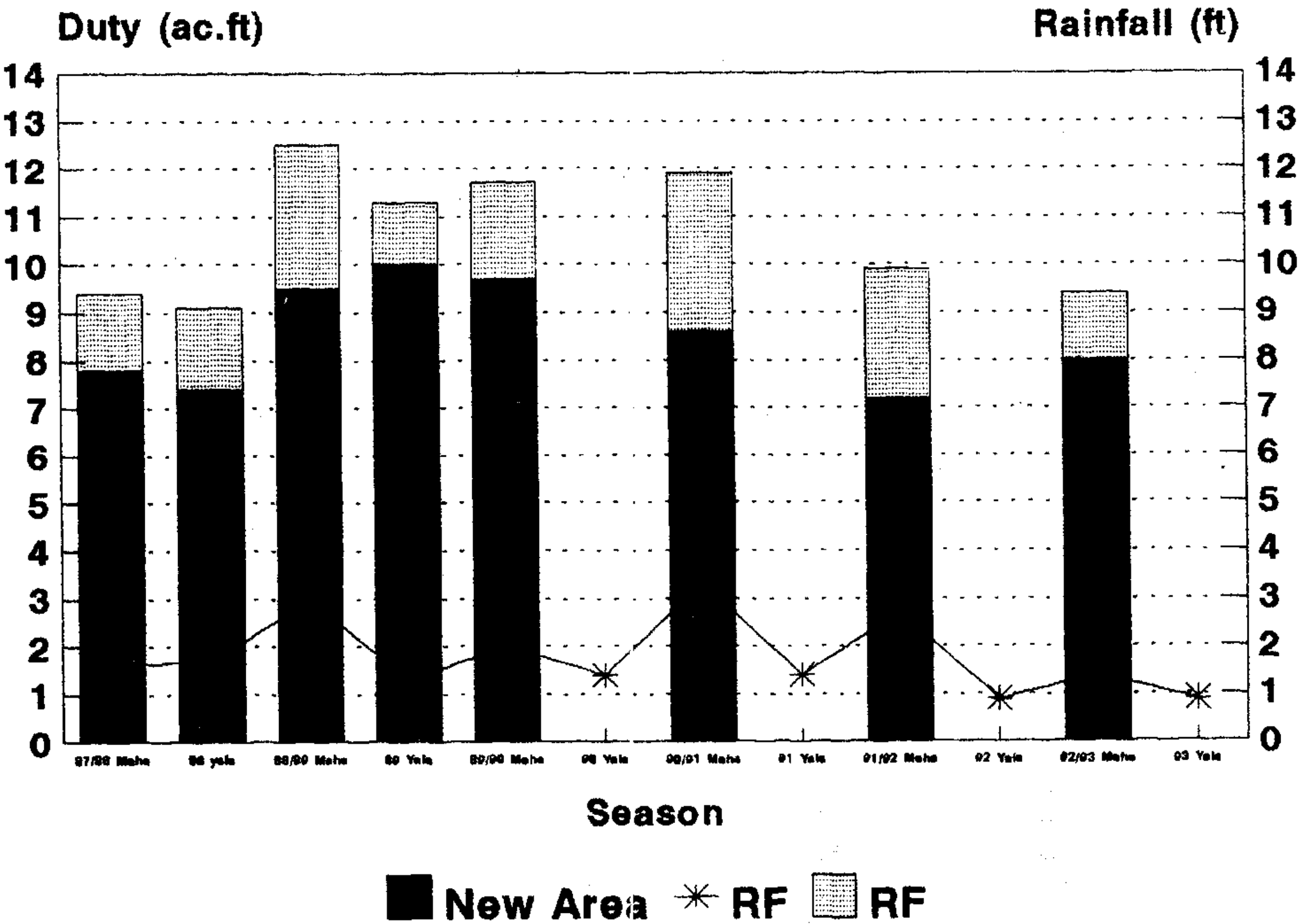
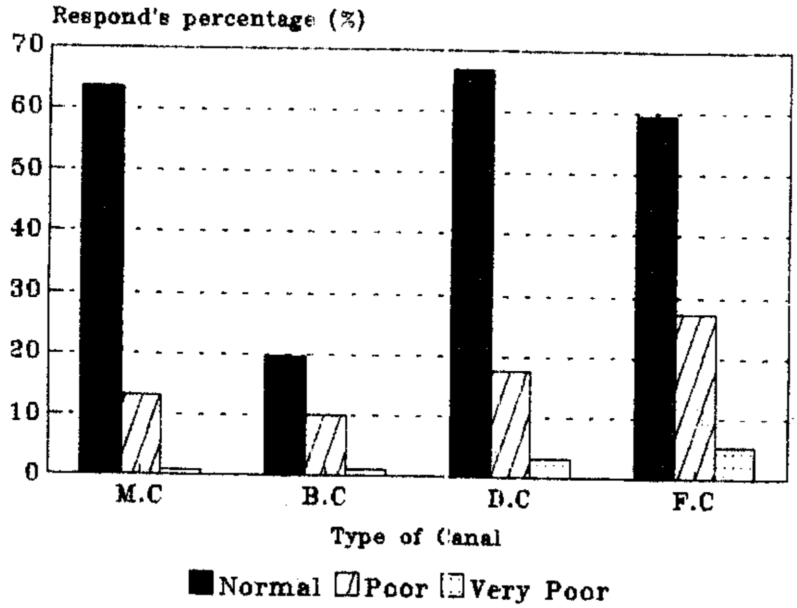


Figure 1.7. Farmers general idea about construction of irrigation systems



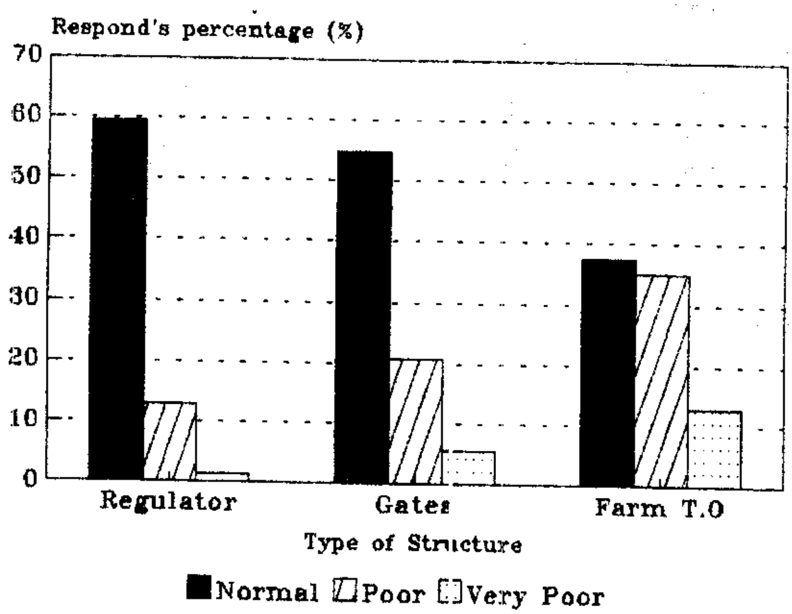
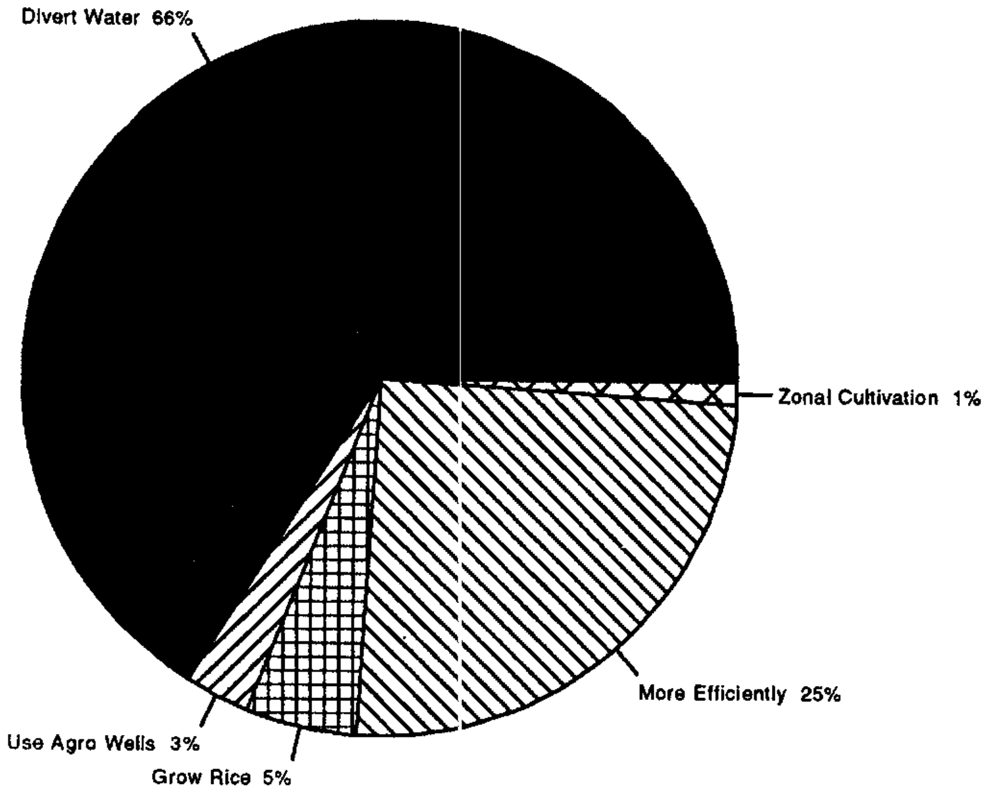


Figure 1.8. Farmers proposals for water deficiency problem in Lunugamvehera Reservoir



CHAPTER 2

LAND DEVELOPMENT AND SETTLEMENT

2.1 Introduction

This chapter aims to assess the immediate benefits of land development and settlement under the KOISP, on the population in the newly irrigated area (NIA) and in the old irrigated area (OIA) in particular, and on the people in Sri Lanka in general.

2.2 Methodology

As explained in the progress report of the project impact evaluation study, the principal data collection technique used, was the large-scale sample survey which involved about 500 farm families in both NIA and OIA. In addition, the survey included qualitative information gathering techniques such as discussions with field level officers, farmers and selected individuals.

Available literature on KOISP was also reviewed extensively such as the project progress reports, research and evaluation studies to obtain the required secondary data and information.

However, it has to be mentioned here that there were several limitations faced by the research team in completing this assignment. Chief among them are: lack of primary data related to land demarcation, land allocation to families, inconsistency and contradictions of available data gathered by different agencies, and lack of beneficiary perception on project benefits and services. The absence of a central office to collect field level data, with the termination of the project in December 1993 was another deterrent encountered during the process of data collection.

2.3 Pre-Project Status

The Kirindi Oya Irrigation and Settlement Project (KOISP) lies in the South-East Dry Zone (SEDZ) region, which extends from Nilwala Ganga East-wards and North-Eastward, up to the Southern reaches of the Gal Oya basin, bounded on the North and West by the central highlands and on the South and the East by the Indian Ocean.

The monthly average climatic data for 1931-1960 period at Hambantota show 1075.5 mm annual rainfall, a mean daily maximum temperature of 30.2°C, a mean daily minimum temperature of 24.0°C, and the mean daily wind speed is 20.0 km/p/h. Due to the low rainfall, the high temperature and high evaporation, this area needs extra water for cultivation. Similar to the North Central Dry Zone (*Raja Rata*) scientists believed that there were settlements and well-designed irrigation networks established under the tank cascade systems that allowed a higher land use and cultivation potential according to the intensity of the re-charging rate, during the monsoonal periods.

2.3.1 Irrigation Systems

Available reports suggest that prior to the commencement of the KOISP, people had settled under an extensive animal-agroforestry farming system. Paddy was widely cultivated under five major tanks, with smaller areas under minor tanks, and under rainfed conditions.

The old irrigation infrastructure consisted of two independent irrigation systems. The Ellegala system which was constructed in 1872-1877, served an area of 3,734 ha. and the Badagiriya system, an area of 850 ha. The Ellegala system consisted of a diversion structure across Kirindi Oya, which originates at Balgal Ella Kanda (6,375) at Ellegala, with two interconnected tanks on the Right Bank and three interconnected tanks on the Left Bank. These tanks are Debarawewa, Tissa Wewa, Yoda Wewa, Pannegamuwa and Weerawila. The feeder canals connected Kirindi Oya to the Right and Left Bank tanks and the main canals and distribution networks for each tank (see map).

The Badagiriya system consisted of a tank fed by the Malala Oya main canals and their distribution networks. The Badagiriya tank is located at the tail end of the Right Bank of the Lunugamvehera reservoir. Both these systems needed rehabilitation and upgrading.

Kirindi Oya originates at Balgal Ella Kanda and flows at a gentle gradient to the edge of the plateau and then drops sharply from an elevation of 3,500 ft. to 800 ft. at Raneriwela village. Below Ella rock commences the gorge from where Kirindi Oya begins from its mountain sources to the plains of the lower Uva Province. The total catchment area of the Kirindi Oya is about 291,200 acres and has been estimated at 347,490 acre feet annually. The mean daily flow at the dam site varies from 0.9 cum/second (cusec) in the dry season, to 573 cusec. in the wet season.

Thus, it is now acknowledged that in ancient times, the whole South East Dry Zone including the Kirindi Oya basin formed a unique agricultural and settlement entity. The striking feature of this system is that the traditional cascade type of small and medium scale tanks could store the whole of the surface run-off from the watersheds of the streams and rivulets.

2.3.2 Pre-Project Land Use Pattern

The following types of land use pattern were common:

(a) Forest, forest reserves and uncultivated (waste) shrub lands.
(b) Water spread areas (irrigation and paddy lands.
(c) Home gardens and highlands.
(d) Chena plots on jungle patches.
(e) Land for residential, commercial and recreational purposes.

In addition land was used extensively for the free grazing of cattle. The absence of a policy to alienate lands for livestock grazing considered in relation to the carrying capacity and the herd population has been one of the major deterrents of the land development and settlement process of the Kirindi Oya basin.

The percentage of land extents, under these categories of land use are illustrated in Table 2.1.

Table 2.1 *Agricultural land use*

Form of Land Use	Irrigated Area(ha.)	Region %	Unirrigated Area(ha.)	Region %
Low land	205.6	49.1	113.9	36.7
Chena	68.5	16.3	51.6	16.6
Homesteads	67.1	16.0	35.5	11.5
Highlands (Other than chena)	77.2	18.4	109.3	35.2

A majority of paddy lands in this area was irrigated under major irrigation schemes, which accounted for approximately eighty percent of the total paddy lands under cultivation. Most of the paddy farmers in the unirrigated region cultivated substantial portions of encroached lands. Shifting cultivation was based on slash and burn techniques of clearing the land and was seen on an extensive scale on the uplands adjoining the rural settlements. The encroachment of common properties is a major deterrent for the extensive grazing management system of cattle and buffaloes. These are kept for draught, meat and for milk particularly in areas where there is a demand for curd production and fresh milk.

About 75 percent of the total irrigated paddy lands in this area were located in the settlements under the Ellegala Anicut. Nearly 17 percent was located in the unirrigated region.

Associated land use in the traditional villages of the area showed that the wet lands were cultivated with rice and the higher dry lands occupied by homesteads were cultivated with tree crops, pulses or vegetables. The forest shrub lands and fallow lands were used for livestock grazing or animal agroforestry. The paddy tracts stretched along the river banks, mainly along the lower part of the Kirindi Oya and the catchment of the major reservoir. The arable land and the associated irrigation system are shown in Table 2.2.

Table 2.2 *Arable land and irrigation systems in the KOISP*

Source of Water		Arable Land Area (ha.)
Kirindi Oya	Left Bank Canal	2,634.59
	Right Bank Canal	972.50
Malala		426.96
Total		4,034.05

Source: ADB (1977) Appraisal of Kirindi Oya Project, p. 1.

2.3.3 Population Distribution

The census of 1981 enumerated the population on the basis of the *Grama Sevaka* division of the old area. This population distribution showed a threefold pattern (a) an aggregation of population along the irrigation channels connected to the tanks (b) a linear spread along the major roads and (c) concentrations at Tissamaharama and several junction centers.

The population was predominantly rural with an average density below 100 per square kilometer. The percentage increase in rural population in the period 1971-1981 was 52 percent.

The population density of the AGA division of Tissamaharama was 40 person per square kilometer in 1971 which increased to 60 in 1981. The urban density of Tissamaharama increased considerably in the 1971-1981 period. In 1981 the population at Tissamaharama was 6,237.

The Census of Ceylon in 1971 recorded the population of this area, Magama Pattu to be around 3,651. From 1921, large scale migration to Magama Pattu was evident mainly from the Matara district. Between 1936-1946 the population of this area, more than doubled due to migration consequent on the availability of irrigable lands. Two colonization schemes Badagiriya and Bogahapalessa, also brought in an increase of population.

According to the Census and statistics of 1991, the population in *Grama Sevaka* divisions of the KOISP old areas were: Debarawewa - 4,745, Kirinda 2,120, Magama 1,152, Ranakeliya(M) 4,314, Ranakeliya (S) 6,853, Tissa (M) 4,332 Tissa 1,944, Uduwela 4,043, Weerawila 7,363.

2.3.4 Pattern of Employment and Unemployment

According to records of employment structures prior to the project, 30 percent was employed while 5.4 percent was unemployed. Housewives 17.8 percent, students 25.2 percent, discouraged workers 1.3 percent and others 20.2 percent. Employed is understood as paid and unpaid family workers. The unemployed include those without gainful employment for at least 15 days within three months prior to the survey. Discouraged workers are those not looking for employment; and others include retired, disabled, too young or too old to work.

Two-thirds of the employed in the sample were engaged in agricultural activities. There was no significant difference found between the irrigated and unirrigated areas. Out of those employed in the agricultural sector 37 percent (or 25 percent of the total employed) are owner cultivators and 25 percent are laborers. 78 percent of the female employees fell into the categories of farm helpers, agricultural and non-agricultural laborers and domestic servants. Only 46 percent of the employed men fell into these categories. About 23 percent of the employed were engaged in subsidiary occupations in addition to their main occupation. The more common subsidiary occupation are the cultivation of own land (26 percent) and labor (55 percent). The distribution of the households according to the source of employment is given in Table 2.3. It can be seen that 45 and 55 percent of the households of irrigated and unirrigated areas respectively were salaried employees and only 6 percent self employed, in both areas.

Table 2.3 *Distribution of households according to occupation*

	Occupation	Irrigated Area		Unirrigated Area		Both Areas	
		No.	%	No.	%	No.	%
1.	Paddy cultivation	123	32	57	22	180	28
2.	Non paddy cultivation	32	8	28	10	60	9
3.	Salaried employment	94	24	57	22	151	23
4.	Salaried employment + paddy cultivation	17	4	13	5	30	5
5.	Salaried employment + non paddy cultivation	66	17	73	28	139	21
6.	Self employment	12	3	09	3	21	3
	Self employment + paddy cultivation	03	1	05	2	08	1
	Self employment + non paddy cultivation	07	2	05	2	124	2
7.	Others	34	9	15	6	9	8

This table indicates the pre-project status where 37 percent of the households were entirely agriculture based income holders. Salaried employees and agricultural income holders, were only 49 percent.

2.3.5 Townships at the KOISP Area in the Pre-Project Period

Tissamaharama and Debarawewa were comparatively big towns in the KOISP area before the project. These towns had marketing, educational, postal, transport, and health care services etc. Other townships had a limited number of service outlets, such as bus stops and other facilities. Consumers who lived in Weerawila, Yodakandiya Pannagamuwa, Pallemalala and Kirinda and in the surroundings of these town areas had to travel to the big towns to purchase certain goods and to avail themselves of certain services and facilities.

The Tissamaharama township occupied a central position in the old settled areas, in relation to the other centers, Wellawaya, Kirinda. Kataragama and Yala. Tissamaharama was raised to urban status according to the local government classification in 1963. Its urban population was 4,126 in 1963. In 1971 the population was 4,343 and in 1981 6,402.

2.4 Project Plan

The project plan, focused on three development criteria: economic growth, resource equality and sustainability. Based on the above criteria the broad aims of the project were to:

(a) Increase the income of project beneficiaries through irrigation, improved crop management practices and livestock development.
(b) Encourage the establishment of settled agriculture and equitable land distribution through land settlement.
(c) Prevent further environmental degradation, associated with chena cultivation through improved land use and farming systems.

Thus, the project components included the development of irrigation infrastructure land settlement programs, agriculture support services and environmental aspects. According to the project plan, the project anticipated the settlement of 8,400 farm families in 32 hamlets to be created under the project. Twenty hamlets in the Right Bank (RB) and twelve in the Left Bank (LB) respectively. In addition, to the settlement of farm families, the project also expected the in-migration of considerable non-farming populations, through the development of basic infrastructure, roads, village and urban centers, marketing and other agricultural support services.

2.5 Land Settlement

The settlement program of the KOISP aimed at providing user rights to the landless people in order to increase the productivity of land resources in the project area. One of the major objectives of the project was to provide more agricultural land for landless peasants. The land settlement program had the following objectives in mind at the beginning of the project:

(a) To improve the socio-economic conditions of the peasants already living in the area by ensuring irrigation facilities to their lands.

(b) To establish necessary irrigation infrastructure and cultivable lands to the landless migrant people from the densely populated areas surrounding the project.

(c) To evolve a self-reliant peasant community in the project through the equitable distribution of land and water.

Although the project had originally planned to settle people in 1978, it was delayed until the beginning of the 1980s due to several unforeseen constraints. The project process was also split into two phases. The first phase commenced in 1982 and the second phase started in 1987. Unlike other settlement projects, implementation of the project development activities began simultaneously with the settlement of people. This is popularly known as "Advanced Alienation Scheme" which also meant to curb the encroachment problem and to obtain the settler participation in the project development activities.

2.5.1 Selection Scheme and Criteria

Based on the surveys conducted in 1979 and 1980, the project planners have followed two approaches selecting suitable persons to allocate lands.

(a) Provision of alternative lands to the households that lost their original lands due to the project development. Those who have obtained lands under these schemes are known as **alternative settlers**. These are people whose land was taken to the project or those who had government permits for chena cultivation, prior to the project.

(b) Provision of land to the landless families in the surrounding districts. Mainly Hambantota, Matara, some parts of Moneragala, Galle and Ratnapura Districts. These settlers are known as **open settlers.**

The main reason for the selection of allottees under an open selection scheme was to reduce the social unrest among young families due to unemployment, low income and landlessness in the South-East region. The selection criteria for alternative settlers put more emphasis on youth and persons who had experience in agriculture. The Land Commissioners Department was responsible for the land *kachcheries* to select allottees from the project area. For land *kachcheries*, all the families surveyed in 1979-1980 were called. Their qualifications were assessed using the following criteria:

(a) Persons who are totally dependent on agricultural operations in the project area for their livelihood.

(b) Persons who do not possess adequate land area for cultivation, even outside the project area.

(c) Persons who have nuclear families (wife and children) or single persons having their parents and other family members as dependents.

Although the Land Commissioners Department (LCD) strictly followed the above criteria in the selection of alternative settlers, there were some incidents where lands have been allotted to encroachers who have settled just prior to the commencement of the project.

With respect to selection of outside persons (open settlers), the general land *kachcheri* method was adopted by the Government Agent (GA). For this purpose the GAs have been provided with necessary financial and advisory support by the project. They have followed a common marking system for the selection of suitable persons. But the GAs have been requested to submit the final selection list to the local politicians for their approval. The present criticism on political interference in the selection procedure, steams from this reason.

In addition to the above two main schemes of selection, land was also given to few families as special allottees. They were given land because they lost their original lands elsewhere, due to natural disasters or social reasons.

Although it was planned to settle 8,400 families in two phases, only 5,000 families have been settled so far. This is mainly due to continuous water shortages for cultivation and delays in the infrastructure development activities, specially in phase two.

The following table shows the number of families settled under phases 1 and 2 per hamlet. It further indicates that open settlers were the largest segment of allottees in phase I while more lands have been allotted for alternative settlers, under phase II.

Table 2.4 *Number of families settled under phase 1 and 2*

Location	Selection Criteria			
	Open	Alternative	Special	Total
Phase I				
Right Bank				
Hamlet 1	207	23	1	231
Hamlet 2		255		255
Hamlet 3	1	194		195
Hamlet 4	3	157	2	162
Hamlet 5	27	194		221
Hamlet 6	155	187	1	343
Hamlet 7	270	10	2	282
Hamlet 8	199	3		202
Hamlet 9	152	1		153
Hamlet 10	248	13		261
Hamlet 11	279	28	1	308
Left Bank				
Hamlet 1/2	351	95	1	447
Hamlet 3	8	228		236
Hamlet 4	8	269		277
Hamlet 5	139	85		224
Hamlet 6	149	8		157
Total	2,196	1,750	8	3,954
Phase II				
Right Bank				
Hamlet 18	105	130		235
Hamlet 19		311		311
Hamlet 20		126		126
Left Bank				
Hamlet 7		163		163
Hamlet 8		201		201
Hamlet 9		110		110
Total	105	1,041		1,146

Source : Land Commissioner's Department

Findings of the ARTI sample survey on the selection method supports the position that the majority of the persons living in the project area are alternative settlers. 57 percent of the respondents identified themselves as alternative selectees. Table 2.5

Table 2.5 System of allottee selection

	New Area	
	No.	%
Open selection	125	41.7
Alternative selection	172	57.3
Special selection	2	0.7
Others	1	0.3
Total	300	100.0

Source: ARTI Large-Scale Sample Survey, 1994

Another interesting finding of the survey is that 50 percent of open settlers have been allocated land not only because they were landless but also because of their political affiliations. Although most of the open selectees received land under the project due to landlessness in their places of origin they admitted that the political affiliations with the members of parliament in their original electorate, also helped them to get lands under the project. But almost all the alternative settler respondents in the sample said that they were provided land mainly because of the loss of their lands to the project (see Table 2.6).

Table 2.6 Criteria for land allocation

Qualification/Criteria of land allocation	Open		Alternative		Special		Others	
	No. 125	%	No. 172	%	No. 2	%	No. 1	%
Loss of lands for Kirindi Oya Project	0	0.0	166	96.5	0	0.0	0	0.0
Landless	110	88.0	0	0.0	1	50.0	0	0.0
Original settler	0	0.0	8	4.7	0	0.0	0	0.0
Ethnic basis	0	0.0	0	0.0	0	0.0	0	0.0
Agricultural experience	26	20.8	4	2.3	1	50.0	0	0.0
Political affiliation	64	51.2	2	1.2	1	50.0	0	0.0
Loss of land for other than Kirindi Oya Project	7	5.6	2	1.2	0	0.0	0	0.0
Terrorism victims	0	0.0	0	0.0	1	50.0	0	0.0
Land owner handed over the land to develop	0	0.0	0	0.0	0	0.0	1	100.0

As far as the allocation of land for settlers was concerned, some differences can be noted. In the Right Bank tracts 3,4,6, and 7, one hectare of irrigated land and 0.2 ha.

of upland have been allocated per family. But only 0.8 ha. of irrigated and 0.6 ha. of upland had been given per family to the settlers in Left Bank tracts 3 and 4.

According to the project reports, allocations were revised twice. Firstly to accommodate more people from the Tissamaharama electorate because the project was located in this electorate. The second revision was aimed at accommodating all ethnic groups, according to the ethnic ratio of the national population.

2.5.2 Consequences

As stated above only about 5,000 farm families have been settled under the KOISP despite the original plan to settle 8,400 families. Main reason for this limited number, is not the lack of lands but the difficulty to provide improved irrigation infrastructures to ensure water for cultivation.

Two criticisms raised by different agencies and individuals must be mentioned here. First is the claim that the selection of farmer families from outside the project area led to the disappointment and displacement of bona-fide farmer families who had been in the project area prior to the project, but were not selected as settlers. This point is the result of two aspects: (a) some of the open selectees were not bonafide farmers, therefore families from the project area felt that they had been discriminated and (b) a large number of poor farmer families migrated into the project after the commencement of the project. Although they needed land for cultivation they did not have the qualification to receive alternative lands (ARTI, 1992).

In addition the irrigation difficulties experienced during the initial period of the project also exacerbated the frustration among settlers in sharing project benefits.

It is very difficult to conclude that there were political or other influences that hindered the progress of the project. But certainly the lack of assurance of irrigation water for cultivation, problems in the co-ordination of project activities among agencies involved and unforeseen delays in decision making have created many ill feelings and frustration among families who have enjoyed fairly good life styles prior to their settlement in this project.

2.6 Assistance to Settlers

A prescribed range of assistance was provided to new settlers to establish themselves early in their allotments and communities. These included food aid, drinking water, assistance in constructing shelter, fencing and the provision of free planting materials along with some agricultural implements. Settlers of the NIA were most vulnerable in every regard. Hence the assistance is appreciated most by these settlers. The package of assistance includes also help to setting up an organization with the objective to serve the settlers in order to steer their life to prosperity.

All settlers selected for the project were peasants in the sense that they had no other means of sustenance and who were willing to develop the land given to them. They were capable of doing so using their family labor. However, they needed assistance to settle down and develop their land towards productivity. Further, a subsidy scheme was implemented with the following package of items.

(a) During the beginning of the project, free transport facilities for the settler, his family members and household items to the project area. Accommodation for a period of 2 to 4 weeks in a camp prior to their settlements in their temporary homes.

(b) Printing materials and barbed wire for the forestry program in extended homesteads in Left Bank hamlets 8 and 9 and wood plantation materials.

(c) Barbed wire for perimeter fencing for those who took up cultivation of subsidiary food crops in an organized manner.

(d) Provision of tap water facilities to the settlers of the NIA and other community development centers along with cooperative societies to distribute provisions.

The assistance to settlers can be categorized as follows: agricultural assistance, housing and sanitation facilities, food and drinking water and organization and community assistance. In this section the impact of agricultural assistance, housing and food assistance will be assessed. The other categories are dealt with in detail in Chapter 3 and 4.

2.6.1 Agricultural Assistance

During the pre-project period there were 16 agricultural extension workers supervised by two agricultural instructors serving the area. They provided farmers with advice and they carried out demonstrations of new technologies. In addition they collaborated with the Agrarian Services Centers in providing planting materials, agro-chemicals etc. A veterinary service center at Weerawila carried out artificial insemination and made provisions for animal health care.

One of the main objectives of the project was to increase the agricultural production in the KOISP area. In addition, the project had adopted two inter-related strategies to increase the employment levels in crop cultivation by enticing farmers from elsewhere whilst providing the same incentives in this area.

While giving assistance to the agriculture sector, the cropping intensity of lands devoted to rice cultivation could be increased. Settlers do expect assistance and assured irrigation water for new lands for two rice crops a year. The settlers were provided with:

(a) Free seed materials for the harvested and irrigable allotment.
(b) Cash subsidy of Rs. 300/= and ridging of the irrigable allotment.
(c) Free agricultural implements along with interest free loans to start the cultivation practices.
(d) Instructions from agricultural and agrarian services with regard to their cultivation.

Further KOISP settlers could utilize the agricultural research station which was established in Weerawila new town in order to enhance agricultural research and area specific issues. In addition to this, the center has 10 acres of irrigated and 5 acres of highland to conduct experiments with various crops, soil conditions and water management practices etc. The settlers benefitted by this research station since they were involved in conducting research to identify suitable crops for the area in order to raise their productivity and income. At present this center provides advises and solutions to the salinity problems of farmers and settlers of old and new areas both.

An agricultural extension unit has been established to implement extension services which comprise experimental plots and training. Some of the recent experiments and demonstrations by this unit were found to be very useful to farmers as they have been educated to make their land fertile by cultivating maize and ground nut with chemical fertilizer and paddy straw.

The Farmer Training Center constructed by the KOISP has the capacity to train 150 farmers at a time. The various subjects covered, such as suitable crops, methods of cultivation, application of fertilizer and agro-chemicals and improving productivity, benefitted farmers, *Janasaviya* beneficiaries and school children and improved their general agriculture knowledge.

It is noteworthy to mention that the failure to introduce irrigation technology suitable for other field crops has, in the project area contributed to non-adoption of OFCs among settlers and a seasonal transformation from rice crops to non-rice crops in both the old and the new area. Further the improper management and administration of subsidy schemes led to farmers and settlers of the NIA abandoning their cultivation practices. Immediate relief was originally expected to overcome the difficulties experienced by the prevailing drought and consequent effects.

2.6.2 Housing Assistance

On the whole OIA housing conditions are better than that of NIA. The housing conditions and floor areas are increasing along with the income of the household. Most of the high income group households have constructed permanent houses with larger floor sizes.

During the pre-project and mid-project period farmers found it difficult to construct a house according to the specifications given without materials being supplied by the project at concessionary prices. Hence the subsidy scheme was later revised to cash subsidy as interest free loan which helped them to be temporarily relieved from initial hardships. However, a material subsidy along with cash subsidy could have provided better relief to the farmers.

At the beginning of the project the settlers received Rs. 500/= to build a temporary shelter. Once this was completed, they received another Rs. 1,500/= to purchase construction materials for a semi-permanent house. The package of building materials to be bought comprised 21 teak pillars, 2½ kg of ropes and 400 *cadjans* etc. In addition they were given interest free loans of Rs. 11,500/= to start a venture. These loans have not been repaid by the settlers. The housing program has not been sufficient to assist the settlers building permanent houses as only the higher income groups have constructed a permanent house.

2.6.3 Food Assistance

At the beginning of the KOISP settlers who were brought into the then non-irrigated areas were provided with food subsidies until they settled down. Dry rations of major food items such as rice, sugar, dried fish and pulses were given to the settlers for a period of 18 months for all family members. The World Food Program (WFP) further assisted the project by providing adequate quantities of food items to all settlers. In fact the WFP supplied food rations to most of the families for a period exceeding 18 months in order to overcome the initial difficulties caused by delayed irrigation facilities.

Aid was provided to the settlers from the very first day they settled. They were given free food for one week. According to our observations if one member of the family started his ventures, that person would be given food per day as follows:

Sugar	-	140 g/day
Dried fish	-	140 g/day
Rice	-	300 g/day
Dhal	-	25 g/day
Butter oil	-	25 g/day
Pulses	-	125 g/day

After the whole family settled, children above one year were provided with free food under FAO assistance. The quantity of food received by a family was subject to the size of the family.

According to plan settlers under the first phase had to be given free food for nearly four to six years but the program continued only up to 18 months. This has caused problems for the settlers who did not overcome the initial difficulties. Under the FAO program, free food aids for a five member family was as follows:

Sugar	-	3 kg.
Dried fish	-	6 kg.
Rice	-	6 kg.
Dhal	-	1½ kg.
Butter oil	-	1½ kg.

The Right Bank settlers were given FAO supplied food for 2 years while the same package was given to the Left Bank settlers for 1½ years only.

During the ARTI (1994) survey period monthly expenditure on food as a percentage of household income is seen to decrease with increasing income in both OIA and NIA. However, among the lower income groups (those receiving below Rs. 2,000/=) in both areas, the monthly expenditure on food is equal to their income or even above it. The overall household expenditure rises to 150 to 200 percent of the household income when expenditure on non-food items is also taken into consideration. Even when the value of food stamps and other food assistance were deducted from the total household expenditure, the latter still remains above 100 percent in the low income category. Hence, the current program of food assistance to the settlers should be revived for betterment of settlers.

The assistance with regard to drinking water is dealt with in detail in Chapter 3 of Infrastructure Development.

2.6.4 Assessment of Impact

The agricultural assistance program and the development of agricultural related organizations had a considerable impact on the settlers. The assistance provided in the initial stages of the project has activated settlers to venture in agricultural related activities. The main objective of the project was to increase agricultural production in the KOISP area. Hence, the assistance schemes were designed to achieve these objectives. The establishment of more agricultural services centers and agricultural research stations benefitted the settlers. The program to produce a new rice variety which could bear the long drought seasons would certainly benefit the settlers since from 1986 to 1994 prolonged droughts periods were experienced which caused hardships to the settlers. The Farmer Training Centers started educating farmers in various aspects

of general agriculture and related fields. But the unorganized manner in subsidy schemes resulted in confusion among settlers and to some extreme forced settlers to give up agricultural practices. Further, OIA farmers have benefitted more rather than NIA settlers. As anticipated in theories of economic development, in this case essentially based upon agriculture, with the higher gains in productivity and income in the OIA, income disparities among the NIA settler's households have tended to increase. Hence, carefully designed further assistance is required until the disparities have been eliminated.

With regard to the housing scheme, only the higher income group farmers and a few settlers have constructed permanent houses. The settlers who have been provided with initial assistance and loans to build temporary shelters have constructed semi-permanent houses. Permanent houses seemed to be a day dream to them due to the prevailing hardships. The housing assistance has not been sufficient to construct permanent houses. The loan provided by the government to build semi-permanent houses have not been paid back by some settlers which led to hesitation from the side of the government to provide further loan schemes.

The assessment of the impact of the food assistance scheme has raised a lot of queries amongst the authorities. Even though the food aid and food stamp program prolonged, it had caused little or no effect on their expenditure pattern. For the lower income classes the expenditure on food is almost double to the monthly income. This is situation further aggravated by the prolongation of drought. During the initial stages, the settlers were provided with food aid. During the later stages, this was reduced in order to promote domestic productivity. But the haphazard manner of this scheme negated their anticipations and consequently forced them to seek alternatives.

The rural poverty observed in certain hamlets of the KOISP has further led to malnutrition among children. This could have been prevented if the *Thriposha* supply had continued correctly without any interruptions. The intake or nutritional food is important to keep the body healthy.

2.7 Present Land Use Pattern

An analysis of the present land use practices in the project area may be useful to understand the impact of the land development program of the project. Therefore, in this section an attempt is made to set forth the existing land use pattern. In this regard, it focuses attention on the land use in agriculture, operational practices, size of farm holdings and tenurial situation.

Compared with the pre project situation, considerable changes have been observed in land use practices in the area, particularly with regard to land use for agriculture. The extent of low land has increased due to improved irrigation facilities,

for example. Table 2.7 demonstrates that the percentage of low land has increased from 44 percent to 76 percent at present. It further indicates that even in the OIA the lowland area increased by almost fifty percent.

Table 2.7 Land use in agriculture (percentage)

Forms of Land use	Pre-project Situation			End Project Situation		
	OIA	Unirriga-ted area	Total	OIA	NIA	Total
Low land	49.1	36.7	43.8	74.5	76.6	75.6
Chena	16.3	16.6	16.5	3.3	3.3	3.3
Homesteads	16.0	11.5	14.1	20.3	16.9	18.4
Highland (other than chena)	18.4	35.2	25.6	1.9	1.4	1.6

Source: ARTI (1982). Pre-project sample survey and ARTI (1994). Final Impact Assessment survey

It has been observed that lands have been used extensively for chena and other highland cultivation before the KOISP commenced. At the implementation of the project chena and the other highland cultivation had decreased significantly. ARTI's recent sample survey showed that the percentage of chena land has dropped to 3.3 at the end of project. Also the figures related to size and distribution clearly show a decrease of chena operations after the project. Therefore, it can be concluded that with the improved irrigation facilities and settlement of farm families under the project land for chena cultivation declined.

Examining the cultivation systems adopted before and after the project, some changes can be noted. Although more area was brought under irrigation, the unreliable water supply and erratic rainfall compelled farmers to adopt different farming systems which are suitable for the available land type and the season. The classification of farms according to systems of cultivation in the pre-project period (1979/1980) and post-project period (1993/1994) is summarized in the following table.

Table 2.8 Type and distribution of farms

Type of farm	Percentage of farms	
	maha 1979/80[1]	maha 1993/94[2]
Only Lowland	5.76	12.5
Only Highland	40.38	9.8
Only Chena	16.07	0.0
Lowland - Highland	27.06	66.2
Lowland - Chena	3.21	2.3
Highland - Chena	7.52	0.2
Lowland-Highland-Chena		6.1

Note: 1. Maha 1979/1980 survey covered the OIA and unirrigated lands of the probable project area. 2. Maha 1993/1994 survey included both the OIA and the NIA under the project.

An analysis of the cultivation systems indicates that there are considerable variations in the farming systems adopted during the two seasons. During the wet season with sufficient irrigation water, production in the OIA and the NIA concentrated mostly on low land paddy. But in some wet seasons, when there is insufficient water at the reservoir, farmers adopt farming systems other than paddy. For example during the pre-project period almost 38 percent of the farms adopted more than one cultivation system. This percentage almost doubled during the post-project period. The predominant combination was paddy farming and highland cultivation. However, the percentage of highland cultivation only has declined significantly (from 40 percent during 1979/1980 to 10 percent during maha 1993/1994). This change indicates that farmers prefer the combination of paddy and highland cultivation even during the season when water supply is unreliable. These changes may be due to the improved irrigation infrastructure and the unavailability of lands after the project commenced.

One of the objectives of the KOISP was to minimize income inequalities by providing land and water resources for poor families. Available records suggest that before the project commenced, lowlands were distributed unevenly in the area. Nearly forty percent of paddy lands had been operated by fifteen percent farmers. The pre-project survey also indicated that operators of medium sized holdings were the largest (55 percent) segment of the farming community.

The present survey reveals that the lowlands distribution among farmers in the project area (both OIA and NIA) has become more equal. Although the distribution of lowlands among farmers in the OIA has not much changed, lowlands in the NIA show an equitable distribution among settlers.

2.7.1 Tenure of Highlands

In this study "highlands" refer to the homesteads and unirrigable lands which have already been used for farming purposes other than chena cultivation.

The distribution and tenure of highlands including homesteads is summarized in Table 2.9.

Table 2.9 The distribution of highlands according to the tenurial categories pre- and post-project (1994) in percentages

Forms of tenure	Pre-project		Post-Project (1994	
	OIA	Unirrigated	OIA	NIA
Singly owned	44.0	32.0	67.0	97.08
Jointly owned	8.6	4.0	7.3	0.64
Rented/leased	2.8	1.4	2.8	-
LDO allotments	18.6	26.2	10.1	-
Encroachments	26.0	36.4	7.9	2.26
Tented			5.6	-

Source: ARTI (1982). Pre-project Survey and ARTI (1994). Large-scale survey.

It can be noted that in the OIA the singly owned category has increased from 44 to 67 percent. This was a result of issuing titles to lands for LDO permit holders.

2.7.2 Tenure of Lowlands

Lowland cultivation differs from cultivation of highlands and chenas. A high incidence of *ande* (tenancy) is found in paddy farming. Distribution of operated paddy lands according to tenurial categories is summarized in Table 2.10.

Table 2.10 Distribution of operated lowlands according to tenurial categories (percentages)

Tenurial Category	Pre-project Status			Post-project Status (1994)					
				Old Area			New Area		
	no. of operators	area (ha.)	% of area	no. of operators	area (ha.)	% of area	no. of operators	area (ha.)	% of area
Owners	48	76	23.8	50	165.00	26.3	280	663.82	86.4
Tenants	138	200	63.2	112	361.55	57.6	0	0.00	0.0
Owners Tenants	13	18	5.6	5	46.50	7.4	13	61.67	8.0
Tenants Owners	19	23	7.4	12	54.50	8.7	7	42.50	5.5

The above table indicates that even in the OIA, the percentage of owners has increased and tenancy has decreased. In the new area 86.4 percent of the lands are owner cultivated.

Although title deeds are not given to settle families in the NIA, they identified themselves as owner operators of the land. On the other hand illegal land transactions are not permitted under the project arrangements. But observation visits to the project area revealed that there are several hidden land transaction systems adopted by the allottees in the NIA.

Chena cultivation is a way to find additional income for the farmers but it also enhances land degradation. Table 2.11 shows the distribution of chena by size.

Table 2.11 Distribution of chenas by size. Post-project status

Size of group	Old Area			New Area		
	Number	Area (acres)	%	Number	Area (acres)	%
0.00 < 0.50	0	0.00	0.0	2	0.50	1.5
0.50 < 1.00	2	1.00	3.6	4	2.50	7.5
1.00 < 2.00	12	13.50	49.1	8	8.00	23.9
2.00 < 3.00	5	10.00	36.4	8	16.50	49.3
3.00 < 5.00	1	3.00	10.9	2	6.00	17.9

The data reveal that the majority of the chena lands fall within the 1 to 3 acres category, while there are no chena lands of more than 5 acres or less than 0.5 acre in the OIA. Hence, if the chena lands are comparatively small and affordable for each farm family, especially with regard to the labor availability, the farmers would be able to use proper soil conservation and renovation methods and to improve their chena lands.

2.8 Operational Problems of Settlements

The operational problems of settlements cannot be discussed separately, because most of the existing problems are the result of the land alienation and development process itself. Therefore it is necessary to discuss briefly the operational implementation findings of the project.

According to the pre-project socio-economic survey of 1983, a population of 2,897 families was living in the catchment, command and tank areas of the KOISP. With the commencement of the project, the number of encroachers had increased the population speculating on the future legal access to land.

2.8.1 Boundary Disputes

Advanced settling was started in 1984 to obtain settler participation in the project work and to reduce encroachment. Thus alienation was done amidst the construction of headworks and prior to the issue of water for cultivation. It was done in a vague manner using only temporary land marks. The fact that land was uncleared at the time of alienation, added further confusion to the boundary demarcation. The land clearing started almost after one year and at that time most of the land marks were not found in their original positions. The settlers had to mark their land boundaries as they remembered it one year ago. This has resulted in lowland plot sizes from one to four acres. When the actual land survey was conducted, instances were found where either distributary channels or field channels were running in the middle of the land, thus fragmenting the plot. However, the earlier boundaries did not change, creating numerous boundary disputes.

The major problems of the allocated lowlands were levelling and clearing difficulties and the rocky nature. The majority of the settlers of the sample (62 percent) reported that the land was not levelled properly. 59 percent of the respondents stated that the bunds were not built in their lowlands at the time of alienation. A percentage as high as 37 percent stated that their lands were not cleared. While 1 percent reported having rocky outcrops in their lowland plots.

Table 2.12 Major problems in allocated lowland

	New Areas (N= 181)	
	No.	%
Land is not levelled	112	61.9
Bunds are not built	107	59.1
Land is not cleared	67	37.0
Rock outcrops	2	1.1

"N" denotes number of settlers reported that they had shortcomings or problems in allocated Lowland. Percentages are based on N

Table 2.13 Shortcomings/problems in allocated highland

		New Area (N = 218)	
		No.	%
1.	Land was not cleared	187	85.8
2.	Land was not levelled	26	11.9
3.	Rock outcrops	19	8.7
4.	Soil is not fertile due to removal of top layer	6	2.8
5.	Inundation	2	0.9
6.	Salinity	1	

"N" denotes number of farmers reported that they had shortcomings or problems in allocated highland. Percentages are based on N.

Demarcation of boundaries

It seemed that problems relating to land demarcation are acute. Although 62 percent of the respondents in the new area reported their land boundaries to be clear, one cannot overlook the fact that some of them have oversized plots and do not want to admit it fearing to lose the excess land. 37 percent of the respondents stated that their boundaries are not clear, most of them having undersized plots.

Table 2.14 Demarcation of lowland boundaries

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Clear land boundaries	185	61.7	168	93.9	353	73.7
Unclear land boundaries	110	36.7	3	1.7	113	23.6
Not known	5	1.7	8	4.5	13	2.7
Total	330	100.0	179	100.0	479	100.0

Table 2.15 Demarcation of highland boundaries

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Clear land boundaries	287	95.7	169	94.4	456	95.2
Unclear land boundaries	11	3.7	2	1.1	13	2.7
Not known	2	0.7	8	4.5	10	2.1
Total	300	100.0	179	100.0	479	100.0

Attitudes on land boundaries

Though the majority expressed satisfaction over the clear land boundaries, a significant percentage (28 percent) of the new area was not happy about their boundaries. The problems regarding the highland boundaries are negligible when compared to lowland.

Table 2.16 Satisfaction over the clear land boundaries in lowland

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Satisfied	137	71.4	160	95.2	292	82.7
Not Satisfied	51	27.6	8	4.8	59	16.7
Unable to report	2	1.1	0	0.0	2	0.6
Total	185	100.0	168	100.0	353	100.0

The boundary problem appeared to exist mostly in the lowlands. Only 3 percent of the highland settlers expressed to be dissatisfied with the demarcation of their plots.

Table 2.17 Satisfaction over the clear land boundaries in highlands

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Satisfied	278	96.9	169	100.0	447	98.0
Not Satisfied	9	3.1	0	0.0	9	2.0
Unable to report	0	0.0	0	0.0	0	0.0
Total	287	100.0	169	100.0	456	100.0

The major reason given by the respondents in both the lowlands and the highlands for not being satisfied with their boundaries is that the extent allocated is not accurate or less than the usual extent. The second most important reason for dissatisfaction in both high and lowlands is improper demarcation of the boundaries. Other reasons stated over the dissatisfaction of the boundaries include changes due to tethering cattle, construction of FC's and roads, changes due to proposed new railway line and encroachment by neighbors.

Table 2.18 Reasons for dissatisfaction over the clear land boundaries in allocated lowland

		New Area N = 51		Old Area N = 8		Both Areas N = 59	
		No.	%	No.	%	No.	%
1.	Improper blocking out of land as well as boundaries are not indicated properly	11	21.6	0	0.0	11	18.6
2.	Changing boundaries by the neighbors	4	7.8	0	0.0	4	6.8
3.	Changing boundaries due to tethering of cattle	1	2.0	0	0.0	1	1.7
4.	Changing boundaries due to proposed new railway line	1	2.0	0	0.0	1	1.7
5.	According to perception, the land area given to them is not accurate	33	64.7	5	62.5	38	64.4
6.	Shrinking of land due to construction of FC road/drainage canal	3	5.9	0	0.0	3	5.1
7.	Encroach by neighbor caused the shrinking of land	3	5.9	3	37.5	6	10.2

note: Some respondents gave more than one reason

Another fact that has been reported is the change of land boundaries due to the above mentioned problems. Out of the interviewed settlers, 26 percent of the new area and 2 percent from the old area admitted that their boundaries have changed.

Table 2.19 Changes of boundaries and ownership in lowland

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Boundaries						
Number of having changed	78	26.0	4	2.2	82	17.1
Number having not changed	219	73.0	175	97.8	394	82.3
Unable to report	3	1.0			3	0.6
Ownership						
Number of having changed	5	1.7	1	0.6	6	1.3
Number having not changed	195	98.3	178	99.4	473	98.7
Unable to report						

Table 2.20 Changes of boundaries and ownership in highland

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Boundaries						
Number of having changed	12	40.0	3	1.7	15	3.1
Number having not changed	288	96.0	176	98.3	464	96.9
Ownership						
Number of having changed	7	2.3	5	2.8	12	2.5
Number having not changed	293	97.7	174	97.2	467	37.5

2.8.2 Settler Migration and Non-resident Allottees

Due to various reasons, a significant number of open settlers was reluctant to stay in the project area. The main reason was the uncertainty of receiving irrigation water. The water issue was done in a rotatory system to solve the water shortage. In this system, the project area was divided into three priority zones. The irrigation water is first issued to the zone which has the

first priority. Depending on the availability, water is then channelled to the other zones. At the end of a season, the priority shifts to another zone. Likewise, each zone will get the first priority in a rotatory manner. Most of the open settlers, who had land in their native villages and who had relatives elsewhere migrated to these places during the seasons when their respective zone did not have the priority.

Table 2.21 Non-resident problem in the project area

Location	Permanent Non-residency (%)	Migrant farmers (%)	No. of canceled plots due to non residency (%)	No. of plots to be canceled (%)
Right Bank	8.4	11.7	183 (5.6)	269 (8.2)
Left Bank	3.1	9.3	84 (5.3)	82 (5.2)
Project	6.6	10.9	(5.5)	(7.2)

Source : CO & FI Records

The non-residency problem is high in the Right Bank compared to the Left Bank. The migrant farmers account for 12 percent in the RB and 9 percent is LB. However, these figures were very much higher a few years ago when water was not available for 2 to 3 seasons at a stretch. About 5 percent of the allocated plots have been canceled so far due to non-residency. An even higher percentage (7 percent) are yet to be canceled due to the non-resident problem.

It cannot be overlooked that some settlers could not adapt to the barren conditions of the project area and abandoned their lands. These plots were later reallocated. But the majority of these settlers leased their land either to traders in the project area or to traders in nearby town centers.

Apart from these above reasons, the non-residency problem is also caused by the fact that those who have land and property in their native village tend to reside there in order to cater the educational needs of their children. Some settlers got government jobs after settling in the project area and had to move to different locations. Moreover, some settlers were compelled to stay in their native places as they had to provide better medical attention for their dependents.

2.8.3 Reallocation of Lands

Several originally allocated plots were abandoned due to various reasons and the settlers were given new land elsewhere. The main reason evidenced for this reallocation is the salinity problem. 128 plots (3 percent) of the RB and 10 plots (0.6 percent) of the LB have been reallocated already due to salinity. A further 101 (3 percent) allotments of the RB and 14 (0.9 percent) allotments of the LB have been identified as plots that have to be reallocated due to salinity. About 92 plots in the new area have been reallocated due to unsuitable soil conditions and rocky nature. See Table 2.22.

Table 2.22 Re-allocation of lands

Location	Already reallocated due to salinity (%)	Allotment to be reallocated (%)	Already reallocated due to rocky nature and bad soils	Allotment to be reallocated due to rocky nature and bad soil
Right Bank	128 (3.9)	101 (3.1)	66 (2.0)	3 (0.1)
Left Bank	10 (0.6)	14 (0.9)	26 (1.7)	21 (1.3)
New Area	138 (2.8)	115 (2.4)	92 (1.9)	24 (0.5)

Source: CO & FI Records

Some of the canceled plots were reallocated to settlers who were confronted with the salinity problem. It can be stated that hamlet no. 10, 11, 18, 19, 20 of the Right Bank are badly affected by salinity. Some settlers were compelled to prepare their uneven land at their own cost and labor.

Due to the reasons described above, a significant number of hidden land transactions are in operation. 24 percent and 30 percent of the RB and LB plots are under the short-term (less than one year) analysis is based on the 1994 Yala in the RB and 1994 pre-Yala in the LB. Several long term leasing (more than one year) is also found in the RB.

2.8.4 Other Problems and Constraints

Cattle conflict

It has been well realized now the assessment of the cattle population is done that the well being of the cattle herds has been ignored completely in the Kirindi Oya Project Plan. The project area was a prominent grazing area of the traditional itinerary cattle and buffalo herds living in the area. The conflict between cattle owners and paddy farmers has become one of the major operational problems of the project, threatening its sustainability.

Since there are no adequate grazing lands reserved for the cattle herds in the project area, the cattle damage to crops and to main channels is considerable. The problem is more intense in hamlets 4, 5 and 6 of the LB. In addition to these areas cultivation in Tissa wewa area, Tanamalwila and Berihala areas is also severely affected by the cattle problem. Although this problem has been reduced to some extent by the joint actions of the Cattle Owner's Farmer Organizations and the Project Farmer Organizations, it remains unresolved. Apart from the cattle damages, elephant damages are reported from hamlet no. 5, 10, 11, and 20 of the RB.

Land fragmentation

Land fragmentation is a major problem encountered in the old area. There was no land fragmentation reported in the new area. However, land for the second generation of the settlers is a problem that could come up in the near future in the new area. In the old area, low land

fragmentation is more acute than in the highland. The fragmentation has occurred in most cases where the number of family members involved is more than three.

Table 2.23 Land fragmentation among sample household during the period of 1986-1993

OLD AREA				
Total Number reported fragmentation	**Low Land**		**High Land**	
	Number	**Extent (AC)**	**Number**	**Extent (AC)**
Land fragmented to number of family members	11	36.25	8	6.87
1	4	6.75	3	1.25
2	5	23.00	5	5.62
3	2	6.50		

Heterogeneity among settlers

The two distinct categories of settlers are open and alternative settlers. Open settlers were selected from the districts outside the project area such as Hambantota, Matara, Galle, Ratnapura, Moneragala etc. They were generally identified as educated and wealthier than their counterparts, alternative settlers. The alternative settler status was given to the people whose land was taken to the project or those who had government permits for chena cultivation. The alternative settlers were well adopted to the harsh conditions of the project which were not alien to them in any way, and most of them had more experience in farming under local conditions than the open settlers. On the other hand, the open settlers had difficulties in acclimatizing to the local conditions with shortage of water and other facilities.

Resolution of conflicts

The KOISP being unfortunate in many respects, has not overcome its land disputes still. 92 percent of the respondents reported that their problems related to lowland boundaries are unresolved up to date. See Table 2.24.

In the case of ownership, the unresolved cases are very high (60 percent) and the Project Manager (Settlement) and Field Assistants have helped in some cases to come to a settlement. See Table 2.24.

Table 2.24 Persons who solved the problems in relation to lowland boundaries

		New Area N=78		Old Area N=4		Both Area N=82	
		No.	%	No.	%	No.	%
1.	*Grama Niladhari*	0	0.0	0	0	0	0.0
2.	Divisional Secretary	0	0.0	0	0	0	0.0
3.	Police	0	0.0	0	0	0	0.0
4.	Colonization Officer	1	1.3	0	0	1	1.2
5.	Field Assistant	1	1.3	0	0	1	1.2
6.	Farmer Organization	1	1.3	0	0	1	1.2
7.	Problems not solved	71	91.0	4	100.0	75	91.5
8.	Project Manager (Land Settlement)	1	1.3	0	0	1	1.2
9.	Not known	3	3.8	0	0	3	3.7
10.	Courts	0	0.0	0	0	0	0.0

"N" denotes number of farmers reporting change of land boundaries

It has been clearly indicated that almost all problems related to boundaries have not been resolved. In the new area, 91 percent lowland boundary problems and 100 percent highland problems have not been solved yet. The figures for the old area were 91.5 and 66.7 percent for lowland and highland respectively.

CHAPTER 3

INFRASTRUCTURE DEVELOPMENT

3.1 Introduction

The initial as well as the revised plans of the KOISP had provisions to establish a proper social and economic infrastructure, in addition to irrigation infrastructure, in the Newly Irrigated Area (NIA). This chapter describes the type of social and economic infrastructural facilities as were planned, the achievements and analyses the impacts of these.

3.2 Project Plan and Objectives

The KOISP intended to develop new lands and to resettle communities in the NIA. In order to assist the resettlers building up a community life and to start economic activities, they were provided with basic services in the fields of food, drinking water, transport, education and health. In addition the KOISP provided the same services to settlers with the same purpose. Other services pertaining to research, extension, training and marketing have been organized as well.

The infrastructure and public facilities of the KOISP have been designed to provide services at two levels: at hamlet level and at regional level. A hamlet which constitutes of 250 to 300 families, is the basic administrative unit of the settlement.

A village center is made up of five to six hamlets. It was planned to establish 28 hamlets (69 ha. each) and 5 village centers (16 ha. each). 3 centers would be newly constructed and 2 existing centers would be upgraded.

According to the original plan of the KOISP, each hamlet would be provided with:

(a) One health center (clinic)
(b) A cooperative
(c) A primary school

Each village center would be provided with:

(a) One health center which includes a maternity home and dispensary
(b) A cooperative bank branch, paddy stores, sales center
(c) A post office
(d) A junior and senior secondary school
(e) Quarters for the officers of these establishments

In addition to the above services, a total of 200 km. of roads, including homestead roads for hamlets and village centers, and 60 km. of roads linking hamlets were expected to be

constructed. Construction of 420 wells, that is one well for 20 farm families, was also an original objective of the project. The establishment of a district research, extension and training center for the area was also included in the original plan.

3.3 Accomplishment

Most of the originally designed construction as well as delivery targets regarding the infrastructure services of the KOISP have been achieved. Meanwhile there have been some changes in the originally designed service facilities by reducing plans as well as additions. These changes have occurred due to subsequent revisions of the plan based on the experiences and problems prevailing in the project area.

The area which was planned to be developed under the KOISP has been reduced due to shortage of water in the Lunugamvehera reservoir. This has resulted in reduction of number of families expected to be settled. This invariably caused the reduction of the number of hamlets and the required volume of service facilities.

Accordingly, there are 23 hamlets and 4 village centers established by the project instead of 28 hamlets and 5 village centers as was planned. Of these village centers, both Beralihela and Weligatta are new ones, Lunugamvehera and Weerawila are upgraded village centers. Table 3.1 indicates the type and number of service centers constructed.

Table 3.1 Service centers constructed by the project

Service Center	In Hamlets	In New Towns	Total
Primary schools	20		20
Junior and senior secondary schools		4	4
Co-operative shop buildings	21	4	25
Produce stores/world food program stores	19	4	23
Community centers	22		22
Hospitals/health centers		4	4
Post offices		4	4
Sales centers		4	4
Fairs		1	1
Agrarian service centers		3	3
Research station		1	1
Extension unit		1	1
Farmers' training center		1	1
Police stations		1	1

In general, buildings for a primary school and one cooperative shop have been constructed in each hamlet as planned. With regard to hamlets 1 and 2 and 3 and 4 these infrastructure facilities have been provided one each for two villages, since a couple of villages can easily share those facilities due to the nature of their locational set up.

Instead of a health center as planned, a building for a community center has been constructed in each hamlet providing opportunities to utilize it for multiple purposes including using it as health clinic.

A produce store has been constructed as a basic infrastructure service in one of each second hamlet. In all other hamlets where produce stores were not built a separate store was constructed at the commencement of the settling of people to stock free food from the World Food Program (WFP Stores).

The homestead roads (access roads or internal roads) in hamlets and the linking roads between hamlets have been constructed as planned. Of the 60 km. of linking roads constructed 43.9 km. have been tarred. The program of construction of wells as a source of water for settler families has not been successful. Instead of this program it was decided to provide a pump and purified water for every settler family. These facilities were supplied in two stages with the provision of two pump houses and treatment plants, three water towers and necessary distribution systems.

Of the infrastructure facilities provided to the four new towns, the health centers are important. In all four towns health centers are constructed, but they are operating at different levels with unequal facilities. The Lunugamvehera town has been provided with a special hospital with comparatively better facilities such as internal treatments. Only this hospital has a maternity home and a dispensary. Out of the other three health centers constructed by the project, only the Weligatta center has a dispensary. The Weerawila and Beralihela health centers are operating at present only as out door clinics.

Attempts have been made to provide other service facilities such as cooperative stores and their bank branches, paddy stores, and sales centers to all the new towns as planned earlier by the construction of necessary buildings. In addition there are three Agrarian Services Centers provided to Beralihela, Weerawila and Weligatta new towns and also physical structures have been completed in Lunugamvehera town for a weekly fair. Although buildings and necessary physical structures have been constructed for various service centers, not all of these are operational.

A junior and senior secondary school has been provided, as planned for Beralihela, Weerawila and Weligatta towns. The junior secondary school which was located in Lunugamvehera town has been upgraded into a junior and senior secondary school.

There are quarters of various grades constructed in all the new schools, towns and also in villages for service personnel and officers of the established service centers and institutions. The details about these quarters are shown in Table 3.2.

The Research, Extension and Farmer Training Centers have been set up by the project according to plan.

Table 3.2 The quarters provided by the project for service personnel/institutions

Service Personnel	Number Provided				
	Grade 1	Grade 2	Grade 3	Grade 4	Total
Schools		10	44	11	65
Colony Officers				7	7
Field Instructors			21		21
K.V.S.			9		9
Forest Department	(twin) 1	2			3
Total	1	12	74	18	105

In the following part of this section each infrastructure service facility will be discussed in detail.

3.4 Education

The KOISP has established 20 primary schools in hamlets and 4 junior and senior secondary schools in new towns. Of these schools one primary school and one junior and senior secondary school have been upgraded and others were newly constructed. For every school in the hamlets one or two school buildings of the size of 110′ x 20′ or 100′ x 20′ were constructed as required. In addition to that 3 or 4 teachers quarters in Grades 2 to 4 were constructed. One overhead tank (in some places with a well and a pump house) and 2 latrine sets were also built. In junior and senior secondary schools, more buildings and quarters were constructed with extra facilities such as a science block , a library and an office room.

After the construction of schools one *lakh* rupees was given to each school as an input to buy wooden items. The administration was handed over to the Education Department. This Department also has been providing some other inputs, including construction of new buildings for further expansion of the capacity. The World Food Program has donated library books and sports items. Except for one of the schools, the school of hamlet 9 in the Left Bank, where the people are not yet settled, all others are operating.

3.4.1 Change in Educational Infrastructure

The construction of 22 schools and the upgrading of 2 existing schools by the KOISP has made a drastic improvement in the type and volume of the educational infrastructure and service facilities in the project area.Before the project started there were only 28 schools in different categories (see Table 3.3 for details) in the project area. After the project this has gone up to 50, an increase of 79 percent. Apart from 2 schools constructed by the government in the old area, the increase is due to the KOISP activities.

Also the school facilities have positively changed. For example, the number of *Maha Vidyalayas* (schools in grade II), which have classes to conduct education up to advanced level in arts and commerce subjects, has increased by 50 percent in the area. Although the project has

not spent money for education in the old area, school facilities have developed there too. This development has been influenced by the project: the attraction of a large population which consists of a cross section from poor people to service personnel and project staff has required advanced educational facilities. The government and some other specific projects have responded well to this.

Table 3.3 *Schools in the project area*

Categories	Before Project		After Project	
	No.	%	No.	%
Primary	4	14	18	36
Secondary	17	61	19	38
Maha vidyalayas	6	21	12	24
Madya maha vidyalayas	1	4	1	2
Total	28	100	50	100

Source: Statistics of Education Offices (Hambantota, Tissamaharama and Lunugamvehera)

As the project schools are constructed in the centers of hamlets, the settlers have an easy and equitable access to those. Regarding *Maha Vidyalayas* there is an accessibility problem for people in hamlets far away due to the poor mode of transport. But, better access roads are available.

It was envisaged to construct one school for 274 settler families in the new area. Since the number of families actually settled is lower than scheduled, there is one school for every 246 settler families.

3.4.2 Educational Level

The educational standard in the KOISP area improved gradually during the project period. This is reflected by literacy and school participation rates of both males and females in the old area. These improvements are partly attributed to project activities undertaken to develop education in the project area while other factors have contributed as well.

Table 3.4 shows literacy rates of both sexes in different years and different areas. At national level the literacy rate has increased from 87.2 percent in 1981 to 89 percent in 1993. In the project area the same has increased from 85.3 percent in 1981 to 95.7 percent in 1994. Thus the literacy rate prevailing in the project area has increased tremendously. The educational standard of men is still higher than women's, but the big gap between male and female educational levels has been reduced .

Table 3.4 Literacy rates in the KOISP area by years, sex and sub locations

	1981*				1994***	
Male	90.8				97.3	
Female	79.2				94.1	
Both Sexes	85.3				95.7	
	1981*		1986**		1994***	
Sub Location	OIA	NIA	OIA	NIA	OIA	NIA
Male	92.1	88.7	98.0	94.0	96.7	97.7
Female	79.1	79.4	81.0	88.0	93.4	94.5

*Source: *Wanasinghe et al. (1983); **Gamage et al. (1986); ***ARTI Large Scale Sample Survey 1994*

An important observation is that literacy rates of both males and females in the new area has grown much faster than the literacy rates of the old area people. The differences of the increases are 5.2 percent with regard to men and 1 percent with regard to women. Apart from a better school attendance as a result of the project school facilities, the higher educational level of the settlers selected for the project has contributed to the improvements in literacy rates. A considerable number of settlers for KOISP have been selected from Galle and Matara Districts where people's educational levels were higher.

Table 3.5 indicates the age specific school participation rates of both sexes in the old and new areas in different years. School participation rates in all age and sex categories in both areas have gradually and satisfactorily gone up during the project period. One significant observation regarding this is that in the old area the 5 to 9 and 10 to 14 age groups in both sexes have shown a 100 percent school participation rate while in the new area the same age groups in both sexes have indicated a participation rate slightly over 98 percent. Improved physical access to schools especially created at new schools of the project as well as other school development activities and also improved social access to schools made by free inputs of the government such as school uniforms, books and midday meals have contributed to this upward trend.

Table 3.5 *Age specific school participation rates*

Age	Sex	1981*		1986**		1994***	
		OIA	NIA	OIA	NIA	OIA	NIA
5 - 9	M	82.8	71.1	74.5	78.2	100	98.6
	F	74.0	71.8	77.1	79.0	100	100
10 - 14	M	86.8	84.4	93.4	88.1	100	95.9
	F	81.2	91.5	91.3	93.5	100	98.6
15 - 19	M	50.8	49.9	42.6	47.0	55.4	57.4
	F	41.7	40.3	65.0	53.3	66.7	66.1

*Source: *Wanasinghe, et al. (1983);**Gamage, et al. (1986);*** ARTI Large Scale Sample Survey, 1984*

Another important observation on school participation is that the women have done better than men. In the pre-project period women's participation was lower than men in all age categories in both areas except in two age categories: 5 to 9 and 10 to 14, in the new area. After the project period female's school participation in all age categories in both areas has become equal or higher than men.

The Tables A-3.1 and A-3.2 indicate the age specific school participation of different income groups in both areas before and after the project respectively. They show that in general the school participation of all income groups in both areas has increased. In the old area the 5 to 9 and the 10 to 14 age groups in all income categories have achieved 100 percent school participation as opposed to the levels shown in the pre-project period. In the new area except for a few other income categories in the same two age groups have shown 100 percent progress. This indicates that without considering their income every family has tried their best to give their children a basic education.

With respect to the 15 to 19 age group which is qualified for having higher education there is no relationship observed between income level and school participation in the old area. In the new area this is also true when the income category of less than Rs. 1000/= per month is exempted. In that age and income category male's school participation is 22 percent which is much lower than female's in the same category. The field survey revealed that the main reason is involvement of children in income earning activities or family farm activities made necessary by economic problems.

According to the large-scale sample survey the avoidance of schools by children in the compulsory school going age is 1.4 percent in both the new and the old area (2.4 percent for male and 0.6 percent for female). The major reasons given for that in the pre-project period have changed. The KOISP baseline survey carried out by ARTI, in the pre-project period showed that 27 percent of school avoidents mentioned economic reasons as major cause. After the project the importance as a reason has decreased to 17 percent which is even applicable to the new area

where the problem of water shortage creates economic hardship. Lack of interest has become the major reason for school avoidance after the project period which explained 50 percent of school avoidents. This was mentioned by only 33.3 percent of the children in the pre-project period. The absence of a school which was a reason for 20 percent of school avoidents in the new area in the pre-project period has stopped being a reason.

3.4.3 Problems in Education

The delayed development of the settlement scheme has disrupted the pre-designed systematic school operational system in the new area. It was planned that students in primary schools in each hamlet would be absorbed by junior and senior secondary schools in new towns. This has become unpractical because of the long distances between hamlets and major schools and severe transport problems in the area. An easy solution has been to upgrade these schools to junior secondary level, rather haphazardly. There would have been a greater problem in developing senior secondary schools in new towns and to make use of their resources for the maximum benefit of the settlement. One example is the Weerawila *Maha Vidyalaya* in Weerawila New Town. According to the school principal there are not enough children in the upper classes as some other schools in nearby hamlets have been allowed to extend their classes to higher levels. A small numbers of students in the school especially in the advanced level classes, supported the idea of obtaining enough teachers qualified in different subjects and also of receiving other facilities. Out of 17 students who qualified last year proceed with their advanced level studies, 14 left the school looking for such opportunities elsewhere because they were not satisfied with the existing facilities.

Looking at the school system and their advancement as a whole, stoppage of erratic promotion of schools is required to solve the problem.

In the Right Bank in some places excess schools were found. According to the locational set up of hamlets 8, 18 and 19 a separate school for each hamlet is not required. One or two common schools would have been a better way to utilize the available resources.

The failure of the project to provide a permanent place of residence for settlers has created a lot of problems in terms of education. Impermanent residency in the settlements or frequent change in residence has become a problem for schools to keep a sufficient number of students. Those who have not permanently settled did not bring their children, who are still schooling in their previous places. This is a reason for the low number of students in schools especially in the Right Bank. The frequent change of one and the same student is caused by their parents mobility which is another problem in the operation of schools. This seems to be a greater problem in the Right Bank hamlet 8 Muslim school where some students have enrolled and left the school several times. To solve this problem some other avenues of income for settlers during droughts should be provided.

A considerable number of permanently as well as impermanently settled allotees of the KOISP has arranged for their children to go to a school outside the project area. In the new area 26 percent and in the old area 6 percent of the sample households have done this. The reasons they have given for that action (see Table 3.6) give us a picture about educational problems in the area.

Table 3.6 Reasons for attending schools outside the project

Reason	New Area No.	New Area %	Old Area No.	Old Area %	Both Areas No.	Both Areas %
	N=74		N=11		N=85	
Expected educational facilities are not available in the project	41	55.4	8	72.7	49	57.6
Continuing education in the pre-project schools	20	27.0	0	0.0	20	23.5
Due to poor health condition of the children	3	4.1	0	0.0	3	3.5
Due to weak economic position and other matters the children stay places of relatives	22	29.7	3	27.3	25	29.4

"N" denotes number of settlers reported that their children attending schools in outside the project percentages are based on N.

Source: ARTI Large Scale Sample Survey, 1994.

According to Table 3.6 the majority of the settlers who have not taken their children to project schools did so as they were not satisfied with the facilities compared to the facilities in the schools where their children were studying already. A considerable proportion of the settlers were from Galle and Matara districts where educational facilities are comparatively better than in the settlement. The low income they are earning in the settlement have also encouraged them to keep their children with relatives and to attend schools there. Thus providing settlers the required economic and social conditions to bring their children into settlements would be a precondition to assure the expected level of student population at the schools.

The households whose children go to schools in the project area have indicated various types of shortcomings, as shown in Table 3.7. In both areas more than 60 percent of the respondents have mentioned the shortage of teachers as a critical issue. The data obtained by the research team from individual schools also show that there is a severe shortage of teaching staff especially in schools in the new area. The shortage of teachers in specific subject matters such as English is more acute. The location of the area and the schools which are far away from major towns, their isolation and difficulties in mode of transport to the schools and also non-availability of proper boarding places close to schools will discourage attracting teachers. The provision of staff quarters has been a proper solution for this problem and most of the quarters are at present well utilized. For some schools, especially in places where transport difficulties exist the provided quarters are not adequate. More teachers staying overnight in one place would solve their isolation and also be a solution for theft and robberies which have become a major hindrance to attract lady teachers. Further, the tap water facilities in the teachers quarters should be developed. The community members should pay more attention to these teachers who have come to serve them.

Table 3.7 Shortcomings of schools in the project area

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
	N=159		N=235		N=76	
Shortage of teachers	104	65.4	41	53.9	145	61.7
Inadequate school buildings	76	47.8	33	43.4	109	46.4
Insufficient equipment (desks, chairs etc.)	81	50.9	44	57.9	125	53.2
Negligence of teachers	30	18.9	6	7.9	36	15.3
Inadequacy of other facilities (water, lavatories, playgrounds etc.)	2	1.3	8	10.5	10	4.3

Source: ARTI Large Scale Sample Survey, 1994.

The inadequacy of school buildings due to the excessive pressure of the student population has become an another major educational problem in the project area. Both households in the new and the old area have mentioned this as a problem Our special survey on schools revealed this has become a problem especially in the new area schools in the Left Bank. The majority of the families are settled, normal life has started and children are attending schools. Now the capacity of the school buildings constructed by the project has become insufficient. As much as 58 percent of the new area schools and 71 percent of Left Bank schools are recorded having more children than the available capacity in school buildings. Some schools have acquired unused project buildings such as produce stores to hold classes as a temporary solution for the problem. The Department of Education has to consider the issue and take action to construct additional buildings for schools where the problem is acute.

The inadequacy of classroom equipment such as desks and chairs is also a problem in schools where an over population of school children exists. This problem could be solved temporary by using under-utilized equipment from other schools.

The playgrounds, lavatory and water facilities are other areas where further action is required. There is a separate space allocated by the project for a playground in each school, but these are not properly prepared; a large work force would be needed. This could be realized by a joint program of the government and the people in the area. Until the piped water scheme was operational most of the schools in the new area did not have water. As a result most of the lavatories constructed by the project were under-utilized and dilapidated. Now there is pipe water in schools, but proper arrangements have not been made to utilize the essential overhead tanks for water distribution.

3.4.4 Benefits of Project Schools

The project schools have different benefits for people in various categories. The alternative farmers who were living in the area before the project started, have profited most of

the project schools. In the pre-project period there were not a proper educational infrastructure in the new area. A limited number of schools was available at more distance places. Physical constraints such as bad roads and jungles and also economic problems discouraged children's participation at school. Poor families by kept their elder children at home to look after younger children while the parents left to look after day to day income earning opportunities. The project schools have been established closer to the settlements and more facilities than at the pre-project schools were available. This removed the aforesaid problem of physical access to schools. The free food of the World Food Program which was given to settlers at their arrival, other free inputs from the Janasaviya Poverty Alleviation Program, and the school midday meal program have strengthened the economic base of the poor families and removed the constraints of schooling of their children.

The other group which benefitted from the new school facilities consisted of children in neighboring traditional villages. Due to the establishment of new schools some of these villages have been able to solve the problem of physical access to schools. One example is the Tambarawa village. Earlier the children in that village had to go to Yoda Kandiya school which is located 4½ miles away. Now they (about 30 students) are coming to Ranminitanna Kanishta Vidyalaya (in LB 8) constructed by the project which is located within 3 miles distance. Their school participation has increased not only due to having a school within a shorter distance but also because of better roads in and around the project.

The KOISP and its school facilities have been beneficial for children especially for girls in the project area because they have contributed mostly to increase school participation of the above mentioned two groups.

The new schools have provided the opportunity for a large number of people to engage themselves as teachers or school staff. This benefit has gone to the new and old area of the project and also to the country in general. In all there are 260 persons working as teaching staff at the project schools. Of those 26 percent and 28 percent are from respectively the new and the old area of the project while the remaining 46 percent come from other areas. As much as 61 percent of this teaching staff is female revealing that women are benefitting most.

3.5 Health

Both the climatic condition and the economic development of an area have direct and indirect influence on the health conditions of that particular area. Since the project area falls in the dry zone and has little economic development, it is obvious that this area has a very poor health condition. However, it is tried to identify the changes and improvements in health conditions after the project has been implemented in this area. This will help to evaluate the health facilities provided by the project.

3.5.1 Health Facilities before the Project

In the pre-project period there was a district hospital at Tissamaharama with one DMO, and one DMA, one doctor and four nurses. In addition there were two dispensaries, one at Uduwila and the other at Pannagamuwa. There was also an *Ayurvedic* dispensary at Magampara.

According to the "Kirindi Oya Irrigation Settlement Project Socio-Economic Condition Study" (1984), there were two district hospitals at Hambantota and Debarawewa with limited facilities. Also there were two mobile dispensaries for Western medical treatment and one *Ayurvedic* dispensary providing indigenous treatment. Other than these there were four midwives and five public clinics with prenatal, postnatal and immunization services. These were managed under aegis of the medical officers of health based at Hambantota.

Public health clinics were held at some specific places within the area on a particular day of the week at each location, but due to lack of transportation which was compounded by the poor roads these clinics and the mobile dispensary services were disturbed or failed to function according to schedule. Due to these problems most of the people were compelled to travel to Debarawewa or Hambantota hospitals. Table 3.8 gives an idea about the hospital facilities in the project area during the pre-project period.

Table 3.8 The facilities available at Debarawewa and Hambantota Districts Hospitals

Personal Facilities	Debarawewa	Hambantota
Number of beds	110	138
Doctors	4	3
Dental surgeons	1	1
Registered medical practitioners		1
Assistant medical practitioners	1	
Nurses	6	14
Attendants (female)	4	4
Attendants (male)	4	4
Out-patients per day	300	250

Source: *ARTI, Pre project socio-economic conditions, 1983, ARTI Research study number:59*

From Table 3.8 it can be observed that the available facilities were inadequate to fulfil the demand of the whole population. Especially in Debarawewa hospital the number of beds and other facilities were inadequate to cater to the needs of the vast number of patients. In the pre-project period 94 percent of the sample households prefer the western treatment to *Ayurvedic* because of the free issue of drugs, the relative convenience of methods of treatment and their efficiency. However, some of the objectives of the KOISP were concentrated on improving the health facilities too. Such as:

(a) Each village center would have maternity home and dispensary.
(b) Each hamlet will have one health clinic.
(c) Malaria eradication with the help of anti-malaria agencies.

The above objectives are directly related to health conditions of the people as the drinking water facilities for example, providing one well for 20 farm families, transportation facilities, toilet facilities and infrastructure development are indirectly helping to improve the health conditions. Due to the dry climatic condition of the area the settlers suffered severely without enough drinking water.

3.5.2 Mid-Project Situation

The health conditions of this area in the mid-project period has been described int the "Kirindi Oya Irrigation and Settlement Mid Project Evaluation" done by ARTI in 1988. The old irrigated area had relatively better health facilities than the new irrigated area.

It has been observed in the KOISP mid-project evaluation study that the health services in the area were managed by the Department of Health. They installed basic physical facilities under the project. The project built a rural hospital at Lunugamvehera was built with the facilities of 3 wards including a maternity ward. Professional medical care had been given on the clinic day at two dispensaries which were located at Beralihela and at Weerawila. Family health workers are also available at these centers.

Even though there were two district hospitals at Hambantota and Debarawewa they ran short of surgical treatment and other specialized care facilities.

There were private practitioners of Western and indigenous medicine closer to the urban centers. According to this study the public opinion about the services provided by the clinics was as follows: nearly 44 percent said that the services were good whereas 37 percent said that the services were average. In the new irrigated area 26 percent of the respondents of the sample of the same study said that the drugs were not available at village level therefore they had to travel nearly 5.5 km. to get the drugs, this distance was nearly 7.3 km. in the old irrigated area.

By this time anti-malarial spraying and the distribution of drugs had been initiated in the new irrigated area.

3.5.3 Present Situation

Availability of hospital facilities in the project area is given in the Tables 3.9 and 3.10.

Table 3.9 The facilities available at Debarawewa Hospital 1985-1994

	1985	1990	1991	1992	1993	1994
Number of beds	119	119	119	119	119	123
Doctors	2	2	2	2	2	3
Dental surgeons	1	1	1	1	1	1
Registered Medical Officers						
A.M.O.	2	2	2	2	2	3
Nurses (male)		1	1	1	1	2
Nurses (female)		15	16	18	19	16
Attendants (male)		4	4	4	4	4
Attendants (female)		11	11	11	9	9

Source: Collected from hospital records

Table 3.10 The facilities available at Lunugamvehera Hospital 1987-1994

	1987	1990	1994
Number of beds	40	40	40
Doctors			2
Dental surgeons			1
Regis. Medical Officers		1	1
Assis. Medical Officers	1	1	2
Nurses (male)			2
Nurses (female)	5	5	4
Attendants (male	2	2	3
Attendants (female)			3

Source: Collected from hospital records

Table 3.10 shows that at the Lunugamvehera hospital there were no changes in number of beds since 1987. There are 2 doctors and 1 registered medical officer available in 1994. The number of AMOs has increased from 1 to 2 in 1994. Apart from these medical facilities, some more dispensaries, clinic centers, family health officers and other health services are available in this area. These facilities did not seem to be adequate to serve the total population. The district hospitals as well as the Lunugamvehera hospital do not have sufficient surgical and special services as noticed earlier. Table 3.11 shows the number of patients treated by some of these hospitals per day and per annum in 1993.

Table 3.11 Number of patients treated (daily) and admitted at hospitals 1993

Number of patients at Hambantota Base Hospital	119,214
Average daily treated	345
Number of patients admitted in 1993	13,051
Tissa District Hospital OPD patients	98,309
Average daily treated	358
Number of patients admitted in 1993	11,731
Lunugamvehera Hospital OPD patients	55,754
Average daily treated	14
Number of patients admitted in 1993	4,089
A Dispensary at Uduwila (old area) OPD patients	16,780
Average daily treated	62
Beralihela OPD (new area)	1,166
Average daily treated	24
Weligatta Health Center in new area OPD patients	3,296
Average daily treated	35
Badagiriya in (old area) OPD patients	21,698
Daily average	90

Source: District health service office Hambantota

It can be observed that the average number of patients daily treated at Hambantota and Debarawewa hospitals have been increased since 1981. It increased by 75 percent from 250 to 345 at Hambantota hospital, and by 83 percent from 300 to 358 at Debarawewa hospital. This could be attributed to two project activities:

(a) The facilities at the hospitals have been increased after the project.
(b) The accessibility to hospitals have been increased after the project.

Out of the sample population only 9.7 percent of the settlers felt that the maternity and children clinics were good, 68 percent found them satisfactorily and 16.7 stated them to be bad. The services of the public mid-wives in the new irrigated area was considered to be good by 11.3 percent, while 67.7 percent was satisfied and 11.0 felt it was bad. In the old area 11.7 percent found the maternity and children clinic to be good whereas 73.7 percent was satisfied and 7.8 percent found it bad. In the same area 12.3 percent said good and 75.3 percent were satisfied and 5.6 percent said bad about the public mid-wives services. If we take both areas 55.5 percent were satisfied and 41.8 percent were not satisfied about the overall health facilities. 2.7 percent was unable to report.

It can be concluded that 41 percent of the respondents were not satisfied about the provided health facilities in the area. The main reason given by 65.1 percent of the NIA settlers was shortage of drugs. The other reason was emphasized by 48.3 percent of NIA settlers: shortage medical staff. But in the OIA shortage of medical staff was the most important reason (47.1 percent) and 39.2 percent of the settlers stated it is due to inadequacy of facilities in the hospital while 33.3 percent of the settlers mentioned shortage of drugs.

In addition there are problems of long waiting time, inadequacy of dispensaries and inadequacy of transport facilities to the health centers.

Malaria and water borne diseases

The number of persons treated for malaria and other water borne diseases since 1988 at Lunugamvehera hospital is given in Table 3.12.

Table 3.12 Number of patients treated for malaria and waterborne diseases at Lunugamvehera Hospital 1988-1994

	1988	1989	1990	1991	1992	1993	1994
No.of patients treated for malaria	150*	697	354	217	74	136	06**
No. of patients treated for diarrhea	20*	74	155	45	75	57	31***

** From 1988 April onwards; ** Up to June 1994; *** Up to May 1994*
Source: Hospital records

Table 3.13 shows the number of patients treated for malaria and water-borne diseases in Debarawewa hospital.

Table 3.13 Number of patients treated for malaria and waterborne diseases at Debarawewa Hospital

	1991		1992		1993	
	PF	PV	PF	PV	PF	PV
Number of malaria patients Total	268	1681 (1,949)	176	743 (919)	159	439 (598)
Number of waterborne disease persons				228		171

Source: Hospital records

Table 3.13 reveals that the number of malaria patients drastically declined. It was 1949 in 1991 and it dropped to 598 in 1993. This decline shows the control of malaria in this area especially by the spraying program of the project. The spraying program of anti-malaria campaign had been increased by the government while more people were settled. Therefore, it is an indirect effect of the malaria eradication program: the project settled the people which attracted the attention to the area. The same trend could be observed for water borne diseases too. The number of patients treated was 228 in 1992 and it dropped to 171 in 1993.

According to doctors in these two areas, the incidence of malaria is very high soon after the rainy seasons. The diarrheal diseases are more frequent during the dry seasons (August, September). This is due to lack of water for drinking, washing and other purposes. Malaria and diarrheal diseases compared to the pre-project situation has dropped significantly.

The settlers opinion about the incidence of malaria in this area is given in Table 3.14. The table demonstrates that the incidence of malaria is very low in the area.

Table 3.14 Settlers opinion about malaria in KOISP area (in 1994)

	NIA (%)	OIA (%)	Both Areas (%)
Very low	45.3	34.1	41.1
Extremely low	41.3	60.9	48.6
No change	9.0	2.8	6.7
Extremely high	3.7	1.7	2.9
Very high	0.7	0.0	0.4
Unable to respond	0.0	0.6	0.2

Source: ARTI Large Scale Sample Survey, 1994

Some more factors influencing health conditions in this area are given below:

3.5.4 Drinking Water

Quality of drinking water has a significant impact on the health condition of the people. The drinking water sources in the KOISP area are given in Table 3.15. 8 percent of the people are going to road pipes for drinking water. This is 76 percent in the NIA and 17 percent in the OIA. Only 25 percent had their own well. This is 62 percent in the OIA and only 3 percent in the NIA. However, the project has provided facilities to get purified tap water to most of the settlers. In addition to these pipes 19 percent of the NIA people do get the drinking water from the project bowsers. Out of them only 37 percent of the people are satisfied about the bowser water. 4 percent of the OIA people are using tube-wells and 18 percent are using other wells. This is 2 percent in the NIA. Only 11 percent of the NIA people and 17 percent of the OIA people are drinking boiled water.

Table 3.15 Source of drinking water

	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Own well	10	3.3	110	61.5	120	25.1
Other's well	5	1.7	32	17.9	37	7.7
Road pipes (new area)	229	76.3	0	0.0	229	47.8
Tank	0	0.0	0	0.0	0	0.0
Stream/canal/oya	0	0.0	1	0.6	1	0.2
Tube well	0	0.0	6	3.4	6	1.3
Project bowsers	56	18.7	0	0.0	56	11.7
Road pipes (old area)	0	0.0	30	16.8	30	6.3

Source: ARTI Large Scale Sample Survey, 1994

3.5.5 Toilet Facilities

Availability of toilet facilities also has influence on the health condition of the people. Nearly 94 percent and 96 percent in the NIA and OIA respectively have toilet facilities. 56 percent of the NIA people and 15 percent of the OIA people are using the pit (concrete) toilets while only 22 percent of the NIA people and 70 percent of the OIA people are using water seal toilets. The project has provided cash and input materials to build up toilets.

3.5.6 Overcrowding

Over crowding is another cause for unhygienic conditions. 61 percent of the sample houses had 3 to 6 persons and 27 percent of the sample houses had 6 to 12 persons. This was 55 percent and 19 percent in the OIA.

3.5.7 Infant and Maternal Mortality

According to data collected at the sample survey the infant mortality is very low in this area. Out of 335 sample births there were only 2 infant deaths. It was nil in the NIA where 242 birth occurred. The two infants deaths occurred in the OIA out of the 93 births during 1982 to 1994 (May).

Out of the 93 births during 1982-1994 in the OIA there were 2 maternal deaths It was nil in the NIA for 242 sample births.

3.5.8 Other Deaths

Suicide is high in this area. Out of 29 deaths in the NIA during 1982 -1994 there were 5 (17 percent) deaths by suicide especially using agro-chemicals. It was 7 (15 percent) out of 48 deaths in the OIA.

Death rates by age are given in Table 3.16. The ages 19-29, 29-39, 49-59 and 59 and over are having high death rates. For the 59 and over it are most probably natural deaths. But for the age groups 19-29, 29-39 it is due to suicide and accidents.

Table 3.16 Number of deaths classified by age

Age Group	NIA	OIA	Total
0 - 1	0.0	6.3	3.9
1 - 5	3.4	0.0	1.3
5 - 9	6.9	0.0	2.6
9 - 19	10.3	4.2	6.5
19 - 29	10.3	12.5	11.7
29 - 39	10.3	10.4	10.4
39 - 49	13.8	6.3	9.1
49 - 59	17.2	12.5	14.3
50 and over	27.6	47.9	40.3

Source: ARTI Large Scale Sample Survey, 1994

The easy availability of agro-chemicals in this area could be one of the causes for suicide by using agro-chemicals. There must be a control or a system for selling the agro-chemicals.

3.5.9 Nutritional Status in the KOISP Area

It has been realized that the success of an agricultural development program cannot be judged by micro-economic gains alone. Attention should be paid to the social and physical impact of the project as well. In this section the nutritional status of the KOISP population is. Malnutrition undermines development in many ways: undernourished people lack the strength and energy to actively take part in a development project. A lack of a balanced diet also causes health problems, which in turn can have serious effects on the family income.

As far as malnutrition is concerned preschool children and pregnant and lactating mothers are most at risk. Therefore the study has focussed on these vulnerable groups.

Protein energy malnutrition (PEM) is the most common nutritional problem among preschool children. PEM disturbs the normal growth and finally leads to serious nutritional diseases such as kwoshiokar and marasmus.

3.5.10 Nutritional Status of Preschool Children

The anthropometric method is widely used to calculate the protein energy malnutrition among preschool children. Two methods to monitor physical growth influenced by protein energy malnutrition in children are:

(a) The decrease of body mass measured by its weight.
(b) Growth is length or height.

The decrease of body mass or gradual slowing of weight gain will be visible already after a short period of nutritional deficiency, while length retardation is visible only after prolonged nutritional deficiency. With accurate height, weight and age determinations and an acceptable reference population, it is possible to estimate the phenomena of stunting (a deficit in height for age) and wasting (a deficit in weight for height). Stunting is malnutrition as a result of chronic undernutrition, while wasting is a sign of acute undernutrition.

Concurrent chronic and acute undernutrition (concurrent stunting and wasting) is an effect of long term protein calorie undernutrition of weight loss by creating a disproportionately low body weight. When the observed height of the child is less that 90 percent of the reference median for its age and the observed weight of the child is less than 80 percent of the reference median for its height, concurrent stunting and wasting is diagnosed.

The obtained data through an anthropometric survey conducted in July 1994 in KOISP area are given below.

Table 3.17 Incidence of chronic undernutrition (stunting)

Area	Sample Size	% Chronic Undernourished
KOISP Project area	508	35.6
Newly Irrigated area	417	33.3
Old area	94	45.7

According to the Table 3.17 incidence of chronic undernutrition is 35.6 percent which is slightly lower than the Sri Lankan figure which is 36.4 (Ratnayake and Weerasinghe, 1990). There is a significant difference of chronic undernutrition between the newly irrigated area and the old area of the project. Landless families and families having a permanent income which have participated in the survey in the old area have resulted in the observed difference.

It is observed that the percentage of acute undernourished is very high in the KOISP: 46 while the average Sri Lanka figure is 18 according to the National Nutritional Survey.

Table 3.18 *Incidence acute undernutrition (wasting)*

Area	% Acute Undernourished
KOISP project area	45.5
Newly irrigated area	48.8
Old area	29.8

Table 3.19 *Incidence of concurrent chronic and acute undernutrition*

Age (months)	Percentage Affected	
	New Area	Old Area
< 12	0.3	
12 - 23	3.8	4.4
24 - 35	1.8	2.2
26 - 47	3.5	3.3
48 - 49	4.8	5.5

Concurrent chronic and acute undernutrition is an effect of long term protein energy malnutrition, (a retardation in height growth) and the effect of an acute deficit in nutrients. The percentage is the sub-sample who had evidence of concurrent chronic and acute undernutrition is shown in Table 3.19. The obtained data indicate a comparatively higher prevalence of both long term and acute undernutrition in the 48 - 59 months age group.

Table 3.20 *Incidence of undernutrition by age groups in KOISP area*

Age (months)	Stunting (%)	Wasting (%)
< 12	35.4	18.7
12 - 23	44.4	45.1
24 - 35	32.0	44.9
36 - 47	33.6	51.8
48 - 59	33.0	59.6

Incidence of undernutrition by age group is given in Table 3.20. Both stunting and wasting are high in all age groups while wasting increases among the age groups of more than 12 months.

3.5.11 Maternal Nutrition and Low Birth Weight

In Sri Lanka, as many third world countries a significant proportion of children begins life with a handicap of low birth weight (LBW). A baby that weighs less than 2.5 kg. is considered to have a low birth weight. A child born with a low birth is more likely to die within the first month of life. For LBW-babies it is difficult to grow fast enough to catch up, due to inadequate nutritional intake and frequent illnesses.

Table 3.21 Average percent incidence of low birth weight in KOISP

Area	Percentage
New area	42.7
Old area	26.2
Average for KOISP	27.4

Source Table 3.17-3.21: Anthropometric Survey on Nutrition, 1994

The percentage of LBW is very high in KOISP which is 27 percent for the KOISP area. There is a significant difference between the percentage of LBW in the new area and the old area of the KOISP.

3.5.12 Conclusion

The overall health conditions have been improved after the project was implemented however, there are still shortages. The public opinion and doctors' opinions indicated the lack of personnel and materials to be predominant in the hospitals. This has resulted a.o. in insufficient family planning services, although this had been requested frequently by the people. Due to the poor transport facilities the health services were felt to be inadequate. Further, complaints about irregularity in providing the services were reported.

Lack of knowledge, and absence of training to the people about the health services are other problems. For example, the people have a little knowledge about the importance of hygiene, especially about nutrition, drinking water, hygiene of environment.

In sum, it can be stated that incidence of children born with a low birth weight is significantly high in the KOISP. The area has a high incidence of undernutrition. Further, wasting is higher in the age groups of over 12 months due to inadequate dietary intake which is mainly associated with household income. The nutritional status in the old area is relatively better than in the new area.

3.5.13 Health Recommendations

On the basis of the findings the following recommendations to improve the health condition of the people have been formulated:

(a) The hospitals have to be provided with enough personnel as well as material facilities.
(b) The accessibility of the health services has to be improved by upgrading the transport facilities within the area and to out station.
(c) There should be regular training to the public about the importance of hygiene. This should be done at different levels: at school level, at staff level and at household level.
(d) Proper family planning should be introduced to this area.
(e) More research has to be undertaken to develop a proper health program.

3.6 Roads

There are three types of roads constructed by the project. The first category is homestead roads, constructed for access to households and travelling in-between households and service centers, which stretches over 200 km. The other category is the linking feeder roads constructed by connecting hamlets with main roads and towns. Their length is about 60 km. Some 44 km. of the linking roads have been tarred. Roads along various channels such as main, branch, distributary and field canals have also contributed to the establishment of the above road network.

3.6.1 Change in Road Network

In the pre-project period the total length of roads came to 175 km. (Land Commissioners Dept. 1980, p.15). With the construction of project roads the length of roads in the area has increased to 435.3 km. It was not possible to take a length breakdown of each road category as relevant statistics are not available.

3.6.2 Current Use and Public Transport

The project road network has become directly beneficial to over 4,900 families or about 27,000 of people settled in the new area of the project. The different categories of project roads are used by settlers for different purposes. In general, the homestead roads or internal roads in hamlets are used to travel to linking roads, service centers in hamlets and also to transport any item onto the doorstep. According to the ARTI large-scale sample survey 96 percent of the households in the new area are accessible by a vehicle. In the old area the percentage of houses which can be reached by a vehicle is lower than that: 93 percent. In the pre-project period a considerable number of households in the new area could not be reached by a vehicle, but the relevant figures are not available. The present level of the road network is a great achievement by the KOISP.

The farm roads (field roads) are normally used to transport inputs to farms and to transport the produce to homes and markets. The linking roads have become useful to attend major towns and service centers and also to travel out of the settlement.

The other group using project roads are the people who are living in traditional villages and on unauthorized lands adjoining the settlement. Some of the encroachers have been given a small piece of land by the project to construct a house on marginal lands at the border of the

settlement. All of these groups are using project roads to visit service centers and main towns in the project area.

The people in the old area as well as outside of the project are using linking roads constructed by the project as short cuts to attend some of their destinations such as main town and fairs.

The data and information of the road survey conducted by the research team has given a picture about the type and volume of public transport and also the purposes for which roads are used. The road survey was based on two roads of two different categories: one main channel road and one linking road. Both are in the Left Bank. The main channel road which is 12½ km. in length runs from the Lunugamvehera tank to the Tissa-Kataragama road by linking hamlets 1 up to 7 in the Left Bank. The linking road is tarred over a length of 2 km. between hamlet 1 and 2, where it again falls to the main channel road. All vehicles and people passing the roads between morning and evening 6 were enumerated by one investigator on a Wednesday at which there was the Pannagamuwa fair.

According to the survey data presented in Table A-3.3 over 400 people are travelling on the main channel road and 330 on the linking road. This indicates that the main channel roads which are closer to people's residences are more used for their day to day purposes. See Table A-3.3.

According to the means of transportation, travelling by push bike is most prominent. The standard of living and the income level of the people show that the majority can afford only a push bike. Also travelling by foot was an important way of using the roads. To reach nearby places people always go by foot.

Most of the four wheel vehicles, like tractors, buses and cars, which are using project roads prefer to use tarred linking roads over the main channel road due to its better condition.

It appeared that most of the vehicles on the project roads cover less than 5 km. distance; approximately 65 percent of the vehicle users reported this. A very low percentage is using the roads for over 20 km. distances. The lorries coming from Beliatta and Walasmulla areas for trading of *cadjans*, coconut and other household items and the settlers travelling between their home towns and the settlement cover long distances.

The bus services in the new as well as the old area have a prominent place in the public transport system. Tissa town located in the old area is the center of the bus services operating in and around the project area. From there bus services are operating to destinations in the new and the old area while some busses are commuting to other towns outside of the project such as Kataragama and Hambantota. Some bus services operate between Colombo - Kataragama, Galle - Moneragala, Matara - Badulla and some other places.

There two kinds of busses: the buses of Peoplised Transport Boards and the private busses owned by individuals.

Table 3.22 gives a picture of the bus services operating in the project area by the Peoplised Transport Board (PTB) in Kataragama. Table 3.23 gives a picture of bus services

operated by the private sector. As shown in the tables the PTB is handling more services in the project area.

Table 3.22 Bus services in the project area operated by Kataragama PTB

Route	Distance	Number of Trips	Running (km)
Tissa - Kataragama (including service of other depots)	19.0	150	2,750
Tissa - Kirinda	11.2	41	459
Tissa - Wellawaya	62.8	8	502
Tissa - Thanamalwila	24.4	12	293
Tissa - Magama	10.0	13	130
Tissa - Andaragasyaya	15.0	8	120
Tissa - Ikkapallama	9.6	8	77
Tissa - Pallemalala	25.0	6	150
Tissa - Beralihela (new area)	13.7	6	82
Tissa - Veherapelessa (new area)	16.2	10	162

Source: Peoplised Transport Board, Kataragama

Table 3.23 Bus services in the project area operated by private bus owners

Route	Distance	Number of Trips	Running (km)
Registered			
Tissa - Tanamalwila	24.4	6	146
Tissa - Kataragama	19.0	16	304
Non-registered			
Tissa - Magama	10.0	10	100
Tissa - Kirinda	11.2	6	67
Tissa - Beralihela	13.7	8	110
Tissa - Veherapelessa	16.2	6	97
Tissa - RB. 6/7 Colonies (through Weerawila new town)	22.5	6	135
Lunugamvehera - Sandagiripawwa (Left Bank)	9.2	8	74
Beliatta - Lunugamvehera (through Weerawila new town, RB 7, 6, 5, 3)	55.0	2	110

Source: Private Bus Owners Association, Tissa

As far as the bus services in the new area are concerned a number of points are to be noted. The bus services are mainly handled by private sector people, these are unregistered. This transport system has a lot of problems: busses are not sufficient and they are not running according to a proper time table: in the early morning and at night they do not run and the available busses are not convenient for the transportation of the people.

The inadequate bus service in the new area has become a constraint for the functioning of service centers such as schools and to attract settlers into the settlements. Hence, a regular bus service has to be assured in the new area in order to solve the passenger transport problem.

According to the Peoplised Transport Board in Kataragama the roads constructed by the project are not suitable to operate a proper bus service; the roads are narrow and in some places no proper culverts have been constructed for long vehicles to be able to pass and also the trees at both sides of the roads are a barrier for vehicles. It would be an immediate requirement to correct mistakes in the construction activities in order to establish a proper passenger transport network in the area.

3.6.3 The Maintenance of Project Roads

The maintenance of the linking roads is supposed to be done by the Land Commissioners Department. Till now maintenance was not required. The Irrigation Department has been allocated Rs. 75,000 a year to maintain the channel roads. It gives priority to the main channel. The field channel roads are maintained by obtaining farmers participation. The farmers organizations will arrange to clear grass and to fill pot-holes. The LSS revealed that 94 percent of the farmers in the new area and 59 percent of the farmers in the old area participated in maintaining field roads on a voluntary basis. The farmers not participating have given reasons as indicated in Table 3.24.

Table 3.24 Reasons for not participating in maintenance of field channel roads

Reason	New Area		Old Area		Both Areas	
	No.	%	No.	%	No.	%
Shortage of family laborers	5	28	33	45	38	42
Better condition of the FC road	4	22	1	1	5	5
As it is done by Irrigation Department	5	28	2	3	7	8
No FC Roads	1	5	35	48	36	40
Lack of enthusiasm	3	17	2	3	5	5
Total	18	100	73	100	91	100

Source: ARTI Large Scale Sample Survey, 1994

Ownership of the project roads have not been handled over to any local body or relevant institute. As a result a problem with regard to their maintenance can be foreseen when the project is over. The attention of the decision makers should be drawn to this.

3.6.4 The Settlers' Views about Project Roads

Field observations have revealed that a considerable number of settlers have appreciated the construction of project roads. The settlers which had been in the new area before the project was started have seen the usefulness of the project road network and transport facilities as compared with the pre-project period. As they explained there was not a good road network in the area to visit people or to bring their produce to major towns or markets. For example to bring their products to the Pannagamuwa fair they had to use bullock carts to travel on muddy roads. They also had to walk back five miles from their village to the fair. In order to cross the Kirindi Oya the cart had to be unloaded and in rainy seasons they had to do this several times. Now there are better and tarred roads available to attend to that fair. These roads have a distance of 8 miles but it takes less time to transport products by modern mode of transport such as four wheel tractors and lorries. The farmers can visit the fair by motor-bikes instead of walking which was done earlier.

As reported by the farmers the share of costs for transporting their produce has also reduced with the changed mode of transport. Earlier they paid Rs. 5/= for a gunny bag of 50 kg. containing green chilies of Rs. 1/= per kg. Now they pay Rs. 20/= for the same while the price per kg. is Rs. 50/= to 60/=. According to the alternative settlers view point the new road system has not only made the public transport easier but also quicker in emergencies. They said in the early project period when it was required to bring a patient to a hospital the patient was kept on a bed to cross over the Kirindi Oya. At the other side of the oya a car was arranged to bring the patient to the hospital. Today the better road network and also the modern modes of transport such as busses, landmasters and motor-bikes which are available in the village itself have cutdown the time for bringing a patient to a hospital.

On the other hand 56 percent of the settlers in the ARTI large sample survey expressed their dissatisfaction about the new roads in the project area. The reasons and the percentages of farmers are indicated in Table 3.25.

Table 3.25 Reasons for not being satisfied with road facilities

Reason	New Area N = 167 (55.7%)	
	No.	%
Pot holes on the gravel roads	97	58.1
Inadequacy of drainage on the road sides	30	18.0
Some settlers encroached to the project roads	1	0.6
Long distance to the motorable road	34	20.4
Roads are not maintained in proper time	24	14.4
Roads are narrow	1	0.6
Roads are submerged	1	0.6

Source: ARTI Large Scale Sample Survey, 1994

Note: Figures in parenthesis indicate percentage number of settlers who have not satisfied with road facilities. "N" denotes number settlers who were not satisfied with road facilities. Percentages based on N.

3.6.5 Evaluation of the Road Construction Program

The main objective of the KOISP road was to make day to day economic activities and life of the settlers easier by assuring a better transport system for the settlements by linking them with service stations and towns. The different types of roads constructed by the project have been able to fulfil this objective to a certain level. Compared with the pre-project period when there were no road facilities to attend many households by a vehicle, today there are motorable roads to every household by connecting these with the project road network which is linked with the area road network.

The project road network has reduced the problems of access to various service stations and also the time period required for it. It should be mentioned that the distances from households to various service stations have tremendously reduced. This is of course due to the new infrastructure service stations established by the project, but the type of project road network has served as well to reduce the physical access and distance to these stations.

Despite the new service facilities in the settlements, people are still depending on some services in the old area due to their qualitative value or more usefulness, e.g. health and weekly fairs respectively in Tissa and Pannagamuwa. The physical access to these places has been made easier by the project roads. The project tarred roads have facilitated a quick journey. It takes around forty five minutes to travel from hamlet 1 in the Left Bank to Tissa via Lunugamvehera by a private bus. But lack of busses and irregularity of their journeys is a problem of the public transport in the project area.

The settlements are connected with the major towns in the project area by better roads but the distances are very long. For example the distance from hamlet 1 in the Left Bank to

Tissa is more than 15 km. This has limited the benefit of project roads for the settlers. The majority of the settlers does not have their own vehicles other than a bicycle. It should be considered to construct cross roads between hamlets and major towns in the area.

3.7 Cooperative Shop Buildings

The construction of cooperative shop buildings for every hamlet and new town has been a main goal of the project infrastructure facilities. There are 25 cooperative buildings constructed by the project; 21 are in hamlets and 4 in new towns.

3.7.1 Operation of Cooperatives

All cooperative buildings constructed by the project have been handed over to the Cooperative Department. These are under the management of the Hambantota and Tissamaharama Multipurpose Cooperative Societies. At present not all cooperative shops are operating. Only 17 (68 percent) are operational; 16 in hamlets and 1 in a new town.

Under the prevailing liberalized economic system there are alternative places to purchase goods, sometimes the open market offers better quality at lower prices. The cooperatives have not always been able to buy the produce from the farmers at attractive prices. Therefore many cooperatives are making a loss. Only shops can be run viably in places where there is a sufficient number of permanent settlers and where there is a large number of food stamp holders. Problems in protecting the cooperative shops from thieves was another important reason for closing shops in hamlets.

In the Left Bank most of the families are permanently settled and there is a sufficient number of customers to be served by the cooperatives. Hence, most of the shops are functioning. In the Right Bank there are often not sufficient customers to serve as many families are not permanently settled. There are many cases where shops were subject to theft. The non-viability of shops has prevented the employment of watchers. The ultimate solution has been to close non viable shops and other shops which are in risky places.

Apart from Lunugamvehera the other new towns are not developed and not functioning as service centers. As a result only the Lunugamvehera cooperative shop is functioning.

Although the people have the freedom to buy goods from the open market many of the settlers are still depending on the cooperatives to buy foodstuff and household items such as kerosine and sugar. Hence, settlers appreciate the services of cooperatives as a retail shop with necessary goods. The cooperative with foodstuff and household items is a blessing for some isolated hamlets.

Another purpose of cooperatives is to function as a center buying people's produce. These shops are allowed to buy paddy and other field crops (OFCs) at given prices. But people's produce is not always of the required quality. Cooperatives have not the flexibility of the private traders to change the purchasing price. Hence, the cooperatives are prevented from buying people's produce.

The field observations and discussions with settlers revealed that in some cooperatives necessary goods and items such as fertilizers are not available. To make the cooperatives popular among settlers they should be able to supply settlers with important requirements. Purchasing produce also could be developed through different strategies such as allowing flexibility to the cooperatives while buying produce thus competing with private traders.

The cooperative shops are also serving people at the borders of the settlement and for encroachers too. The cooperatives have provided employment for 25 people of which 76 percent is male and 24 percent is female. Out of these beneficiaries 64 percent are in the settlement and 36 percent are in the old area of the project

3.8 Produce Stores

23 buildings in each hamlet and new towns are allocated to be used as produce stores. Out of these, 10 have been constructed earlier as World Food Program stores, the others have been directly constructed as produce stores.

The main purpose of providing produce stores was to facilitate storing of inputs such as fertilizer and also outputs such as paddy. Under the free market economy farmers are dependent on private traders for both buying inputs and selling their produces. So, interference of cooperatives or other bodies in these activities have not been compulsory. Therefore, not all the produce stores are used for the intended purpose.

The field observations revealed that only two produce stores (one in RB 7 and the other in RB 1) were opened very recently for the intended purpose respectively by a farm organization and the Multipurpose Cooperative Society in Hambantota. Some parts of the store operated by the latter have been rented out for people to commence an enterprise. At present there are 5 enterprises in that building including a tea boutique, retail store and a vinca. Some of the produce stores, 21 percent, are used to hold classes of overcrowded schools. The provincial secretaries have given permission to take over these buildings for the purpose. It has been a temporary solution for the problem of lack of buildings in project schools.

Around half of the produce stores have been constructed before allotees of new land were settled. They were utilized to store food of the World Food Program. When the free food distribution was reduced they became idle and it was intended to used them as produce stores.

The produce stores could be utilized more effectively by farmer organizations to purchase and stock paddy and other products when their prices are gone down remarkably. The farmer organizations could also utilize these as a sales center for production inputs.

3.9 Drinking Water

The project plan to provide drinking water to the new area, by constructing one dug-well for every 20 families has been unsuccessful due to the high rock table, salinity and severe drought in the area (Gamage, et al.; 1988, p. 14). However, 37 dug-wells were constructed by the project in a number of hamlets, and village centers to provide water for people and service institutions.

As an alternative the project office has supplied bowser water for every household and service center. They were supplied 3/4 barrel of water every other day under phase one of the project. Under phase two each family was given 90 gallons of water per week at two occasions. The project had provided a barrel for every family to store water and 15 bowsers were also arranged to distribute water among households throughout the week under a rotation system. This system was continued until every family was given pipe-borne water.

To solve the drinking water problem it was planned to provide pipe-borne water to all hamlets under phase two of the project. This program consisted of two stages. Stage one was finished in March 1993 and stage two was finished in April 1994. The Water Supply and Drainage Board was involved in designing and construction supervision of this scheme and also undertook operation and maintenance. The construction work was done under contracts. In total Rs. 350 million was spent.

The major output of the tap-water scheme includes water intake and treatment plants (sedimentation tank and two units of slow sand filters, pump house), three water towers, a distribution line and stamp posts. One water tower is at Lunugamvehera with a capacity of 680 cu.m. The second is in Weerawila which has 450 cu.m. capacity and the third is in Beralihela with 300 cu.m. capacity. The length of the distribution line is 237 km. The total no. of stamp posts constructed was 449, one for 15 to 20 households.

The piped-borne water scheme would issue 3,000 metric cube of water per day. This would be enough to supply 165 gallons of water per day per family. Water would be issued during a limited period in order to avoid blocking filters, that is from 6 a.m. to 11 a.m. for the Right Bank and 2 p.m. to 6 p.m. for the Left Bank. Water is supplied for drinking only. But naturally people take water for other purposes too, including bathing. A flat rate of Rs. 11/= per month is charged per family. Water consumers organizations formed for each stamp post are providing support. The charges for house connections in new towns, which would be around 275 will be done according to the national rates and regulations.

3.9.1 Impact of Drinking Water Supply

The bowser water as well as the tap water programs changed the source of drinking water of the households. Table 3.26 shows to what extent that change occurred at different locations. The importance of tanks and other water streams as a source of drinking water has disappeared. According to the LSS as much as 76 percent of households in the new area and 16.8 percent of households in the old area are using water of road pipes at present. As tap-water is systematically distributed the majority of the households have equal access to it. Although the project did not provide facilities to the old area, yet there are tap services at main roads, provided by the government. The percentage of households using either well water or piped water has gradually increased during the project period; from 80 percent in 1991 to 96 percent in 1994 in the old area and from 64 percent to 81 percent in the new area in the same period. The reduction of using tanks or stream water and the increase of using wells and especially piped water is a positive change in terms of using of hygienically better water. Especially the piped water is purified which is a condition for better health. According to a water sample which was tested by PHI in Lunugamvehera from the National Health College in Kalutara on 27th July 1994, less than 2 coliform Microbes was found in 100 milliliter of this water. This

water is recommended for drinking. This resulted in a reduction of water borne diseases in the area. More details and statistics are given in the health section.

Table 3.26 Percentage of households according to the source of drinking water in different years

Source	1981		1986		1994	
	OIA	NIA	OIA	NIA	OIA	NIA
Own well or pipe	39.9	9.5	51.7	10.0	78.3	79.6
Nearby well	39.9	54.5	46.1	32.3	17.9	1.7
Tank/stream	20.3	35.3	3.3	6.0	0.6	0.0
Tube well			0.1	3.0	3.4	0.0
Project bowsers			0.5	78.3	0.0	18.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: ARTI Large Scale Sample Survey, 1994

The water facilities of the project, which has given a permanent solution for the drinking water problem has reduced the distances people had to travel find water. Table 3.27 demonstrates this. Around 98 percent of the households was able to obtain their water within 1/8 miles distance when tap services were provided. Before that even 71 percent of the households in the sample were able to obtain their water within 1/8 miles distance. The provision of bowser water by the project to 48 percent of households has also greatly contributed.

Due to the project water supply, by bowsers as well as tap services the time spent especially by the women for bringing water has reduced. In the pre-project period most of the households (90 percent) in the new area depended on nearby wells or tanks and rivers for water and housewives had to spend around 30 minutes for that. Now the time has reduced to 5-15 minutes. This benefit has been experienced by 71 percent of the households after commencing bowser water supply and by 97 percent of the households after commencing the tap water supply. The saved time has allowed women to spend more time for domestic purposes, to look after children and also for economic activities such as involvement in the family farm. The young women also have been able to spend more time on playing and school activities.

Table 3.27 Distance to place of drinking water before and after providing tap services

Distance (Miles)	Before Tap Service		After Tap Service	
	No.	%	No.	%
0 < = 1/8	199	71.1	290	69.7
1/8 < = 1/4	35	12.5	7	2.3
1/4 < = 1/2	27	9.6	3	1.0
1/2 < = 3/4	2	0.7		
3/4 < = 1	11	3.9		
1 < = 2	6	2.1		
Over 2 miles		0.0		
Total		100		100

Source: ARTI Large Scale Sample Survey, 1994

Although tap water is provided only for drinking purposes people are using it for bathing too. This is convenient and saves time.

3.9.2 Settlers' Opinions and Problems

According to the LSS the majority of the settlers (61.3 percent) expressed their dissatisfaction with the bowser water distribution program. Only 36.7 percent of them was satisfied. Table 3.28 gives reasons for settlers' dissatisfaction. A high percentage of the settlers that expressed dissatisfaction has mentioned that the water supplied was insufficient. In droughts there is no water even in project canals, but expectations from bowsers were high which were difficult to fulfil.

Table 3.28 Shortcomings of bowser water program

Shortcomings	New Area N = 184 (62.0%)	
	No.	%
Inadequacy of water supplied	157	85.3
Water not supplied on regular days	29	15.8
Malpractices of officers who are responsible for water distribution	64	34.8
On certain days the chlorine content is too high	08	4.3
Distributed low quality water	03	1.6

"N" denotes No. of settlers reported the shortcomings of bowser water distribution. Percentages based on N.
Source: ARTI Large Scale Sample Survey, 1994

As stated by a considerable percentage of households malpractices of the officers (such as giving more water to people with whom they have a close relationship) involved in bowser water distribution and also irregularities in distribution have been other problems which need remedial actions. Settlers' participation through water distribution committees or any other organizational structure could have initiated a solution for this type of issues.

The study revealed that most of the alternative farmers expressed tap water supply to be the greatest achievement they had so far experienced due to the KOISP. The majority of the households were satisfied about the service of the tap water scheme. Only 23 percent of the households in the LSS expressed dissatisfaction. Among the reasons given, restriction of water for only a few hours and excessive numbers of families allocated for taps are major ones. To assure continued supply of water at least once in a day blockage of the limited filters should be avoided which at the same time reduces the operational cost. Therefore water is restricted to only a few hours. To provide water continuously more filters and costs are required. Water is issued at certain time periods only, three hours in the morning and three hours in the evening. This has resulted in an excess number of consumers at stamp posts at the same time. A temporarily solution may be the involvement of community organizations of water receivers to fairly distribute water to their stamp post among all members. A permanent solution for this may be construction of more stamp posts or small tanks near stamp posts in places where the situation is worst, to allow a number of people to obtain water simultaneously.

According to the management of the tap water scheme the operational costs of the scheme cannot be covered by the charges paid by the consumers at present. For example, till the end of July 1994 Rs. 359,264 have been spent as operational cost while the income has been only Rs. 150,000. The present charges are very small and could be increased to at least cover the operational costs. The misuse of water by consumers themselves is reported. The consumers are not allowed to use water for cultivation purposes neither for bathing at the stamp post itself. But, there is no strict restriction to use that water for bathing by taking it away from the stamp post. The societies of water consumers should be strengthened and given power to control the use as well as misuse of water.This may minimize the operational cost of the scheme so that the members have to pay a lower amount as water charges.

3.10 Sub-Post Offices

In all 4 new towns buildings for sub-post offices have been constructed. In Beralihela, Lunugamvehera and Weerawila new sub-post offices, grade B, are functioning. In Weligatta the original post office remained functioning in the old town and has not yet been shifted to the new building in the new town.

The new sub-post offices are operating with unequal facilities and several constraints. All four offices have facilities for letter delivery, saving of money, issue of stamps and other general functions such as issuing T.V. licenses. Telegram facilities are only available in two post-offices, Lunugamvehera and Weerawila.

It takes around 3 days to send a letter by normal post from these offices to Colombo. It may take around 30 to 40 minutes to take a telephone call as it has to be done through booking. Nevertheless, it is a great service for the people in the new settlement and the old area close to

Lunugamvehera and Weerawila. Earlier, people closer to both of these towns had to go to Pannegamuwa which is around 2 km. away from Weerawila and 6 km. away from Lunugamvehera.

Per day around 40 to 50 people come for general services and 10 to 15 use the telephone or telegram facilities the Lunugamvehera, Beralihela and Weerawila post offices.

The lack of staff especially postmen is a problem in these post offices which restricts day to day functioning. All offices are short of one postman. Therefore Weerawila area telegrams are delivered by the Pannegamuwa office which causes delays. In Beralihela telegrams are delivered as normal letters.

3.11 Community Centers

In the new area a total of 22 community centers have been established, one in each hamlet. Almost all of the centers are presently used for various purposes such as family clinics, farmers organizations, community meetings and village festivals. In every community center a nursery school is voluntarily conducted by one or two young women from the same hamlet. Some of them have been trained as nursery teachers by NGOs like Sarvodaya. The nursery schools generate a temporary income for the teachers. Around 20 to 30 pre-school children are attending the classes.

3.12 Agrarian Services Centers

The project has constructed Agrarian Services Centers to assist settlers obtaining input requirements. Two centers in Weerawila and Beralihela are operational. These centers supply seeds and fertilizer to farmers. But today inputs are available in the open market as well. As a result the important of the Agrarian Service Center has been reduced. However, in isolated areas like Beralihela these centers are still beneficial. According to discussions with staff of the Beralihela Agrarian Services Center around 90 percent of the seed requirements of farmers in that area are supplied through the Agrarian Service Center. Around 40 - 60 mt. of fertilizer per year are be supplied. Other services provided by these centers are advises for agricultural activities and crop insurance. The non availability of water and electricity especially for the Beralihela center has discouraged the officers enthusiasm to work.

3.13 Market Places and Fair

Construction work for four sales centers in 4 new towns have been finalized partly or completely. These centers contain 15 market stalls, 10 stalls are being opened. These market places are not yet functioning because the townships are not yet developed and not enough customers are visiting the place.

One weekly fair is constructed in the Lunugamvehera township. This is functioning now two days in a week: Saturday and Wednesday. The major objective of this fair does not seem to be fulfilled. This was to provide an opportunity for the settlers to sell their products and to buy their requirements.

3.14 Police Station

The project has established one police station in the Lunugamvehera township. This has been functioning since 1985. The Lunugamvehera new police area originally covered 9 GS divisions which has increased to 20 GS divisions. Before the establishment of the Lunugamvehera police station the relevant area was covered by the Tissa police.

The new police station provides a service to the area which earlier could not be provided by the Tissa police which had a larger area to cover. In the pre-project period a large part of the Lunugamvehera police area was under forest cover. There was also the problem of accessibility of internal villages due to the poor road network. Because the area was under the Tissa police station which was located around 8 km. away there was no close supervision by the police. Consequently, there were illicit activities prevailing such as the cultivation of *Ganja* and thefts.

The new police station and the new road network of the project strengthened the supervision by the police in villages resulting in a reduction of illicit activities in the area.

Table A-3.4 shows the number of offenses in the Lunugamvehera new police area after its inauguration and also the number of offenses solved. It gives an erratic picture about the number of offenses in the 1986-1993 period. Generally, in 1988 and 1989 all types of offenses have increased as a result of the bad political situation in the country. However, the number of offenses solved by the police has increased in recent years. For example, in 1986 only 48 percent of cattle thefts have been solved while this increased to 78 percent by the year 1993.

3.15 Agricultural Research Station

The KOISP has established an agricultural research station in Weerawila New Town to enhance agricultural research on area specific issues in the project area. The center has 10 acre of irrigated land and 5 acres of highland available to conduct experiments with various crops, soil conditions and water management practices. There is only one research officer to conduct research although two more officers were initially planned.

Recently this research station was involved in conducting a research to identify suitable crops for the area maximizing productivity and income from the land under the existing condition of water shortage.

This station at present provides advises and immediate solutions for salinity problems of farmers in the new and the old area. It will test soil and recommends suitable crops. According to the statistics of the research station 500 to 1000 farmers a year got their soil tested. In addition the soil and water in the area and the reservoirs are continuously tested by the station.

3.16 Extension Unit

An extension unit has been established, to provide extension services to the project area, linking in with the normal extension system of the Agriculture Department. This unit had one Agriculture Officer and two Subject Matter Officers one for paddy and one for OFCs. They disseminated knowledge through the Agricultural Inspectors and *Grama Niladharies* at village

level. There were four Agricultural Inspectors for the whole project area 40 agricultural extension officers at the village level. The post of agricultural extension officer is abolished while the relevant functions are performed by *Grama Niladharies*. This appeared to be unsuccessful and led to the break-down of the prevailing extension system.

Preparation and implementation of an agricultural extension program for each season is the main function of the extension unit. This service covers both the new and the old area of the project. The extension program organizes experimental plots and conducts training. When the large number of extension officers at village level were still working around 40 demonstration plots and more training programs were set up, but today more than 15 demonstration plots are deserted. Experienced village level officers should be appointed for extension work to re-establish the extension system.

Some of recent useful demonstrations included the cultivation of maize and ground nuts, upgrading land with a combination of chemical fertilizer and paddy straw, use of pure fertilizer by mixing and the successful cultivation of saline land.

3.17 Staff Quarters

Two types of staff quarters were constructed by the project to enable service staff to stay in the project area itself. The first type of quarters are constructed at the sites of various service centers such as schools, hospitals and new towns. The second type are quarters constructed in each hamlet for Field Inspectors and Colony Officers etc. The first category of quarters are generally being used except the ones constructed in new towns. The latter category is presently not well used by the intended officers, but has been used well at the initial stage of the new settlements by the relevant officers. The presence of these officers at hamlet level quarters has been very useful in the initial stages of the settlement when the services of these officers were vital for the settlers. The cadre of hamlet level officers has been reduced today as their services are less required. Consequently, the hamlet level quarters are less used but other officers involved in other services are now using the same quarters.

3.18 Farmer Training Center

The District Farmer Training Center constructed by the KOISP has a capacity of 150 farmers. Among the available facilities are a hostel building where over 50 farmers can stay, an administrative block, 7 quarters, a canteen and a lecturer hall.

This training center conducts programs for various groups such as farmers, *Janasaviya* beneficiaries and school children to improve their knowledge about agriculture. The subjects covered include selection of suitable crops, methods of cultivation, application of fertilizer and agro-chemicals, ways and means to improve productivity.

The number of training programs held since 1990 and their participants is given in Table 3.29. People in both the old and the new area have benefitted from these programs.

Table 3.29 Number of training programs and their participants in each year

Year	Number of Programs	Number of Participants
1990	38	2,167
1991	77	2,450
1992	64	1,926
1993	33	1,050
Total	212	7,593

Source: Statistics of Farmer Training Institute in Weerawila

The hall and the other resources of the training institute are also used to hold meetings relevant to the project such as project sub-committee meetings. Programs of other departments can be held here by renting out the lecturer hall and the hostel.

3.19 The Overall Impact of the Project Infrastructure

In addition to the specific benefits and effects of each component the infrastructure development of the KOISP has also general effects and impacts. The availability of accessible infrastructure services within shorter distance for the majority of households is one major achievement of the project infrastructure services. For example in the new area around 90 percent of the households have today a primary school, secondary school, co-operative and a temple within 3 km. from their homes. In the pre-project period not more than 70 percent of households could attend to most of these institutions within the same distance. See Table A-3.5 for more details about changing distances to various service institutions.

A lot of people in the project area, Hambantota district and country have benefitted from the infrastructure construction activities as they were involved as designers, administrators, supervisors, contractors, skilled and unskilled workers on permanent and temporary contracts. According to the reappraisal report of the project one of the objectives of the KOISP was creation of employment for a large number of people as a means of asset creation. It was expected to create about 6.2 million person days of employment over a period of seven years (as it can be estimated regular employment for about 3,200 workers during this period).

The relevant government departments and organizations which were responsible for the different activities (Irrigation Department, Land Development Department, Land Commissioner's Departments and the River Valley Development Board) had their own staff to perform construction activities. Some activities were carried out by contractors from within and outside the Hambantota District, who brought a large work force with them. (Senanayake S.M.P. et.al, 1987, p. 37).

It has been estimated that the number of person days employed during the period 1980 - 1985 by the four government agencies reached 7.2 million. That is one million more than the

person days projected at the appraisal stage (Senanayake, S.M.P. et.al., 1987, p. 41). The ratio of professional, skilled and unskilled laborers has been 1:3:13 indicating a higher demand for seasonal employees on a casual basis. However, people from outside the project area have benefitted most the employment generated. 100 percent of the professional and clerical grades, 88 percent of the skilled laborers and 73 percent of the unskilled laborers came from outside (Ibid, p. 39).

According to the same study (Ibid, 1987) the minor contractors have used a smaller number of workers ranging from 10 to 100. In 63 such contracts 1,358 workers were employed of which 53 percent came from the project area. Around 70 percent of workers were unskilled out of which 58 percent was hired from project area. Around 58 percent of skilled workers were hired from outside the project.

According to the ARTI LSS conducted for this study 56 percent of the households in the new area and 13 percent of the households in the old area participated in project construction work as hired laborers, on *Shramadana* basis or under the World Food Program. From these households 90 percent and 54 percent in the new and the old area respectively worked as hired laborers. About 29 percent of the households in the new area participated under the World Food Program. More than 53 percent of the households in the new area, who were involved in project construction activities have worked for more than 90 days. For the old area this figure comes to 61 percent. In the new area 17 percent of households and 31 percent of households in the old area have worked for more than 365 days. As revealed by people in the new area 60 percent of them have earned over Rs. 6,000, 18 percent have earned over Rs. 24,000 and 6 percent have earned over Rs. 48,000. In the old area these figures are as follows 58 percent earned over Rs. 6,000, 25 percent more than Rs. 24,000 and 8 percent of the households have earned more than Rs. 48,000. The income earned has been spent mainly for daily consumption. As much as 98 percent in the new area and 96 percent in the old area has mentioned they spent their money for day to day consumptions. Especially for the people in the new area this was a good source of income when there was drought and crop failures at the beginning of their settlement.

The percentage of households which reportedly invested in profitable ventures has been negligible. Only 2 percent of households in the new area and 4 percent of households in the old area have invested on cultivation and other business activities.

The project infrastructure has created a number of permanent and temporary employment opportunities of different types: professionals, skilled and unskilled, in various service institutions such as schools, cooperative shops, hospitals, police, water services etc.

An estimated 400 permanent employment positions have been created in the new service institutions of which 30 percent has been occupied by new area employees, 27 percent by old area employees and 43 percent by people from elsewhere. 46 percent of the employees are female.

Annex 3.1 ***Tables***

Table A-3.1 *Age specific school participation rates by sex and income of household - Pre-project period*

<table>
<tr><th rowspan="2">Sex or monthly Income (Rs)</th><th colspan="3">Unirrigated Area</th><th colspan="3">Irrigated Area</th><th colspan="3">Both Areas</th></tr>
<tr><th>5-9</th><th>10-14</th><th>15-19</th><th>5-9</th><th>10-14</th><th>15-19</th><th>5-9</th><th>10-14</th><th>15-19</th></tr>
<tr><td>Male</td><td>71.1</td><td>84.4</td><td>45.9</td><td>82.8</td><td>86.3</td><td>30.8</td><td>78.1</td><td>85.6</td><td>37.0</td></tr>
<tr><td>Female</td><td>71.8</td><td>91.5</td><td>40.3</td><td>74.0</td><td>81.2</td><td>41.7</td><td>73.1</td><td>85.0</td><td>41.2</td></tr>
<tr><td>Both Sex</td><td>71.4</td><td>88.1</td><td>43.5</td><td>78.7</td><td>83.6</td><td>36.2</td><td>75.8</td><td>85.5</td><td>39.0</td></tr>
<tr><td>Less than 100 M</td><td>-</td><td>-</td><td>-</td><td>83.3</td><td>75.0</td><td>20.0</td><td rowspan="2">87.5</td><td rowspan="2">88.9</td><td rowspan="2">14.3</td></tr>
<tr><td>F</td><td>-</td><td>100.0</td><td>0.0</td><td>100.0</td><td>0.0</td><td>0.0</td></tr>
<tr><td>100 - 199 M</td><td>100.0</td><td>75.0</td><td>37.5</td><td>83.3</td><td>87.5</td><td>75.0</td><td rowspan="2">78.3</td><td rowspan="2">77.8</td><td rowspan="2">35.0</td></tr>
<tr><td>F</td><td>100.0</td><td>100.0</td><td>50.0</td><td>42.9</td><td>50.0</td><td>0.0</td></tr>
<tr><td>200 - 399 M</td><td>70.7</td><td>100.0</td><td>68.8</td><td>75.0</td><td>87.5</td><td>27.8</td><td rowspan="2">70.9</td><td rowspan="2">87.7</td><td rowspan="2">37.6</td></tr>
<tr><td>F</td><td>69.4</td><td>87.5</td><td>50.0</td><td>68.1</td><td>82.4</td><td>24.2</td></tr>
<tr><td>400 - 599 M</td><td>75.9</td><td>84.6</td><td>45.5</td><td>84.0</td><td>83.3</td><td>21.2</td><td rowspan="2">79.7</td><td rowspan="2">81.4</td><td rowspan="2">36.0</td></tr>
<tr><td>F</td><td>72.0</td><td>80.0</td><td>36.8</td><td>83.9</td><td>77.5</td><td>42.5</td></tr>
<tr><td>600 - 799 M</td><td>50.0</td><td>92.3</td><td>-</td><td>79.2</td><td>81.0</td><td>25.0</td><td rowspan="2">71.9</td><td rowspan="2">86.4</td><td rowspan="2">34.3</td></tr>
<tr><td>F</td><td>81.8</td><td>-</td><td>44.4</td><td>66.7</td><td>76.2</td><td>35.3</td></tr>
<tr><td>800 - 999 M</td><td>50.0</td><td>50.0</td><td>57.1</td><td>100.0</td><td>77.8</td><td>42.9</td><td rowspan="2">73.9</td><td rowspan="2">84.4</td><td rowspan="2">48.9</td></tr>
<tr><td>F</td><td>0.0</td><td>100.0</td><td>50.0</td><td>70.0</td><td>100.0</td><td>50.0</td></tr>
<tr><td>1000 over M</td><td>66.7</td><td>75.0</td><td>38.9</td><td>95.0</td><td>96.2</td><td>-</td><td>-</td><td>81.4</td><td rowspan="2">45.3</td></tr>
<tr><td>F</td><td>66.7</td><td>50.0</td><td>26.7</td><td>88.9</td><td>81.3</td><td>64.5</td><td>-</td><td></td></tr>
</table>

Source : Ananda Wanasinghe & et. el, 1983

Table A-3.2 *Age specific school participation by sex and income of household - Post-project period*

Monthly Income (Rs)		New Area			Old Area			Both Area		
		5-9	10-14	15-19	5-9	10-14	15- 19	5-9	10-14	15 - 19
Male		98.6	95.9	57.4	100.0	100.0	55.4	99.0	96.9	56.7
Female		100.0	98.6	66.1	100.0	100.0	66.7	100.0	99.0	66.2
Both Sex		99.4	97.2	62.1	100.0	100.0	60.7	99.5	98.0	61.7
Less than 1000	M	100.0	100.0	22.2	100.0	100.0	100	100.0	100.0	36.4
	F	100.0	100.0	60.0	-	100.0	60	100.0	100.0	60
1000-1999	M	100	91.7	69.6	100	100	50	100	93.3	64.5
	F	100.0	97.8	69.2	100.0	100.0	50	100.0	98.3	65.6
2000 -2999	M	100.0	95.3	50.0	100.0	100.0	-	100.0	95.9	39.1
	F	100.0	100.0	63.6	100.0	100.0	61.5	100.0	100.0	62.9
3000-4999	M	100.0	100.0	68.8	100.0	100.0	65	100.0	100.0	67.3
	F	100.0	100.0	66.7	100.0	100.0	60	100.0	100.0	64.7
5000-7999	M	85.7	100.0	42.9	100.0	100.0	46.7	90.0	100.0	44.8
	F	100.0	95.0	72.0	100.0	100.0	75	100.0	96.7	73
8000 & Over	M	100.0	75.0	60.0	100.0	100.0	83.3	100.0	91.7	72.7
	F	100.0	100.0	50.0	100.0	100.0	100	100.0	100.0	72.7

Source : ARTI Large Scale Sample Survey

Table A-3.3 The use of project roads

According to mean of transport

Mean	Main Channel Road		Feeder Road	
	No	%	No	%
Busses	1	0.31	11	4.20
Lorries	4	1.25	-	-
Vans	1	0.31	3	1.10
Tractors (2W)	1	0.31	3	1.10
Tractors (4W)	3	0.94	20	7.60
Motor Bikes	46	14.42	49	18.80
Foot Cycle	168	52.66	89	34.20
Pedestriants	83	26.01	72	27.60
Double Cabs	3	0.94	2	0.76
Dozers	4	1.25	1	0.38
Jeeps	4	1.25	4	1.53
Cars	1	0.31	6	2.30
Total	319	100.00	260	100.00

According to purpose of destination

Purpose	Main Channel Road		Feeder Road	
	No	%	No	%
Go to town	54	13.43	60	18.00
Go to fair	6	1.49	6	1.80
Paddy field	48	11.94	27	8.10
Botique	102	25.38	73	21.90
Working Place	32	7.96	43	12.90
Go to hospital	3	0.75	7	2.10
Neighbours	39	9.7	20	6.00
Bring Water	8	1.99	3	0.90
Cut grass	6	1.44	2	0.60
Bathing	23	5.72	5	1.50
Meet friends	13	3.24	15	4.50
Education	34	8.46	35	10.50
See Cattle	5	1.25	3	0.90
Trade	14	3.48	12	3.60
Political activ:	8	1.99	-	-
Work of Socie:	3	0.75	15	4.50
Go to police	1	0.23	-	-
Go to bank	1	0.23	-	-
To meet G.S.	2	0.5	6	1.80
Total	402	100.00	332	100.00

According to distance travel

Distance Km	Main Channel Road		Feeder Road	
	No	%	No	%
0 - 0.125	13	4	11	4
0.125 - 0.25	11	4	21	8
0.25 - 0.50	30	9	35	14
0.50 - 1.00	68	21	53	20
01 - 05	98	31	52	20
05 - 10	53	16	35	14
10 - 20	35	11	42	16
Over 20.0	11	4	11	4
Total	319	100	260	100

Source : Road Survey, 1994

Table A-3.4 Number of offences occurred and solved by the police in Lunugamvehera area

Reported Offences	1986		1987		1988		1989		1990		1991		1992		1993	
	No	Solved Problems	No	Solved Problems	No	Solved Problems	No	Solved Problems	No	Solved Problems	No	Solved Problems	No	Solved Problems	No	Solved Problems
A. Offence Against Property																
1. Burglary	06	02	06	01	06	-	16	-	16	-	05	03	05	02	04	04
2. Looting	05	03	07	05	11	01	14	-	14	-	02	01	07	03	08	05
3. Theft of property worth over Rs. 100	11	05	03	01	07	02	02	-	02	-	06	02	-	-	-	-
4. Arson of houses and other offences exceedingly Rs. 200	05	03	06	02	03	-	08	-	08	-	-	-	03	03	03	03
5. Misuses and break of trust	03	03	04	04	02	01	02	02	02	02	06	06	11	08	14	09
6. Bicycle theft	03	-	05	01	-	-	02	-	02	-	-	-	01	01	01	01
7 Cattle theft	-	-	03	03	01	-	-	-	-	-	03	03	03	03	10	09
Total	33	16	34	17	30	04	44	02	44	02	22	15	30	20	40	31
B. Offence related to human beings																
1. Murder	04	03	01	01	19	02	17	01	17	01	01	01	02	02	02	02
2. Attempted murder	01	01	01	-	03	01	01	01	01	01	01	01	01	01	03	02
3. Stabbing	10	09	07	07	05	04	-	-	-	-	02	02	07	07	03	03
4. Caused severe injuries	02	02	02	02	-	-	-	-	-	-	01	01	01	01	02	02
5. Rape	-	-	01	01	01	-	-	-	-	-	01	01	-	-	03	03
6. Kidnapping	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	01
Total	17	15	12	11	28	07	18	02	18	02	06	06	11	11	14	13

Source : Statistics obtained from Lunugamwehera Police station.

Table A-3.5 *Closeness of households to various basic service institutions/facilities - Pre- and post-project*

Service Institution facility		1.5 km (1 mile)		3 km (2 miles)		5 km (3 miles)		8 km (5 miles)	
		B	A	B	A	B	A	B	A
School Primary	OA	56	83	84	91	96	95	100	96
	NA	47	98	74	100	97	-	98	-
School Secondary	OA	50	82	78	98	92	99	98	100
	NA	42	80	68	92	90	100	96	100
School Science (O.L)	OA	34	40	58	77	77	91	92	100
	NA	29	23	45	56	60	80	75	99
School Science (A.L)	OA	12	15	33	40	53	68	85	82
	NA	6	0	7	3	10	7	23	38
Bazaar	OA	24	60	51	83	70	94	88	100
	NA	24	36	39	50	53	61	74	88
Co-operative	OA	49	79	76	99	89	99	97	100
	NA	37	98	62	99	83	100	94	-
Village fair	OA	16	32	34	60	52	74	76	89
	NA	6	3	6	19	12	43	30	69
Bus route	OA	61	79	81	96	91	99	97	100
	NA	80	66	85	80	93	94	94	99
Health centre	OA	14	-	36	-	51	-	81	-
	NA	12	-	20	-	26	-	36	-
Dispensary	OA	15	49	40	79	59	83	84	90
	NA	16	16	30	37	39	49	47	73
Hospital	OA	6	15	24	42	42	65	78	83
	NA	4	1	5	17	8	28	14	59
Post office	OA	15	51	45	89	69	99	94	100
	NA	34	17	66	55	85	79	92	97
Police station	OA	4	15	15	42	41	65	71	88
	NA	7	11	10	30	13	40	23	62
Bank	OA	5	23	20	53	44	69	75	88
	NA	1	2	3	11	11	16	28	49
Ag. Service Centre	OA	5	6	13	21	27	52	66	96
	NA	0	13	10	28	2	48	16	77
A.G.A. Office	OA	4	10	18	37	34	63	74	81
	NA	0	0	0	13	0	25	8	40
Temple	OA	50	71	81	94	93	100	98	-
	NA	44	74	65	92	83	98	93	100

OA - Old Area   B - Before project

NA - New Area   A - After project

Source : ARTI Pre Project Study 1983 & Large Scale Sample Survey 1994

CHAPTER 4

SOCIO ECONOMIC CONDITIONS

4.1 Introduction

Sri Lanka has a wealth of experience in designing, planning and implementing land settlement schemes and irrigation development programs. The experiences from the government sponsored irrigation and land settlement programs are more than 65 years old as they have been in operation since the 1920s. The final goal of these settlement schemes is to transfer assets to the rural poor and these schemes are primarily designed to provide better irrigation facilities and land to the people. Therefore irrigated plots of land holdings were given free of charge to landless and poor peasants for farming and living purposes. The other major objectives of the programs were the preservation of the peasantry as a social class, reduction of the high population pressure by shifting the dense population from the Wet Zone to the Dry Zone, and increasing food production. Many settlement schemes in Sri Lanka were designed to provide a unit of land and a house to the settlers while the plot of land was supposed to be adequate to make them socially as well as economically independent. During the period of 1930-1980, more than 750,000 acres have been allocated among 100,000 settler families in various settlement schemes on the island.

Benefit monitoring and evaluation studies as well as cost benefit analyses of irrigation settlement projects in Sri Lanka show that most settlement projects have not achieved their objectives and goals at the national level. The realization of most settlement schemes was rather below expectations (Wickramasekara, P. 1985:255, David Dunham 1986:3, Gunarathna, L. 1987:254).

The Agrarian Research and Training Institute (ARTI) has undertaken the responsibility of monitoring and evaluating the Kirindi Oya Irrigation Settlement Project (KOISP) since 1981. The main objective was to assess the socio-economic conditions of the beneficiaries living in the project area once the project was completed.

4.2 Scope of the Study

This study was undertaken to assess the benefits and evaluate the impact on the overall socio-economic conditions in the project area. It indicates the effects and impacts of the project on the following social categories:

(a) Settler families, women and youth in the new area.
(b) Farmer families in the old area.
(c) Employees of implementing state agencies.
(d) Employees in the private sector.

Special attention has been given to women and the second generation setter families. It will be attempted in this study to compare the benefits with those anticipated when the project was appraised and explain the major deviations.

The main objectives of this section of the study are:

(a) Identify and measure the indicators for estimating the changes in socio-economic characteristics of the area.

(b) Establish profiles of households among different categories of settlers in the new area, farmers in the old area and wage labors. This should cover composition, education level in work force etc.

(c) Identify the position of housing and sanitation. This should include, the type and size of house, area per occupant, source of water, type of lavatory, incidence of multiple families, cost of construction and sources of funds.

(d) Identify the availability of specific household durable and other items which may allow estimation of relative prosperity or poverty.

(e) Ascertain the employment position of household members by age, education, source of employment and wages. Give specific attention to determine project-generated employment and the income status of women.

(f) Assess the amount and sources of household income, level of savings and assets held.

(g) Estimate household budgets for the different categories of households.

(h) Examine the changes in trend of labor migration in relation to changes in economic activities prevailing in the area.

(i) Estimate the growth of private enterprises in the area as a result of project activities.

(j) Identify sources of private sector employment and estimate the change in their employment generation capacity as a result of project-related activities.

(k) Identify the employment and income generation by the state sector agencies in implementing the project.

(l) On the basis of these findings, assess the project-generated benefits derived by settlers in the new area, farmers in the old area , youths and women.

4.3 Methodology

The study is based on the information gathered from 479 households in the Kirindi Oya Irrigation Scheme. A sample survey was carried out during March and April 1994. The detailed methodology of sampling is shown in Annex 4.1. The sample design was stratified with a two-stage simple random sample with hamlet units as the prime sampling units. In the first stage of the sampling, the KOISP settlement was sub-divided into two strata, namely Newly Irrigated

Area and Old Irrigated Area. The old irrigated lands mainly consist of five tanks, namely Weerawila, Pannagamuwa, Tissa, Debarawewa and Yodawewa. The Newly Irrigated Area refers to the new lands coming within the Left and Right Banks of the Lunugamvehera reservoir in the KOISP. The total number of farm families of the project is made up as follows:

Left Bank	3,237	families
Right Bank	1,757	families
Old Area	2,985	families
Total	7,979	families

Out of the 7,979 farm families, 479 households were selected for the sample, which represented 6 percent of the total number of farm households. The distribution of the sample was: 14 hamlets on the Right Bank, 8 hamlets on the Left Bank, and 5 tank areas. The field survey was launched during the first quarter of 1994 and the field work continued for five weeks. Based on a single-visit-personal-interview a structured questionnaire was administered to each selected farm household. The interviews were performed by 15 trained field investigators recruited by the ARTI, IIMI and the University of Ruhuna. One Statistical Officer and four Research and Training Officers from the ARTI, two Senior Lecturers of the University of Ruhuna and one Research Officer from IIMI supervised and checked the data collection work during the entire five week period of the survey. Some production data related to the paddy cultivation in 1993/1994 yala and 1994 maha were also collected.

Additionally, the following two studies are used as sources of data and information on the KOISP: "Pre Project Socio- economic conditions" in 1980 and the "Mid-Project Evaluation" in 1985/1986. In the historical context, these two reports are extremely important and useful for the final evaluation of the project. These two studies were completed by the Agrarian Research and Training Institute in April 1984 (Research Study 59) and May 1988 (Research Study 85) respectively.

Additional information and data were collected from several other sources, such as:

(a) Department of Census and Statistics.
(b) Central Bank of Sri Lanka.
(c) Government officials in the project, Land Commissioner, Departments of Agriculture and Irrigation, Education Department, KOISP Project Office, Hambantota *Kachcheri* and Divisional Secretariat Office of the project areas.
(d) Other relevant studies relating to the KOISP published by ARTI, IIMI, Land Commissioner, individuals, National and International agencies.

Limitations

Benefit assessment and impact evaluation in the KOISP is a complex exercise because the effects are not only due to project activities, but also to some micro-economic and social policies which are introduced by the government. Therefore the study analyses have been done within the macro level socio-economic framework instead of limiting the analyses tot he framework of the KOISP.

Furthermore, since some data and information regarding expenditure and income, particularly with regard to credit marketing transactions and household expenditure were not available, the finding reflect only the general trend. Consequently, the long term behavior of the sample population could not be examined.

The main objective of this chapter is to analyze the long-term social and economical changes that have taken place among the target population after the project's completion. To evaluate the socio-economic conditions of the KOISP, the study group used variables and indicators for each analytical study theme derived from the objectives as described in 4.2. The detailed list of relevant indicators is given in Annex 4.2. Each variable has its own indicator. There are some indicators which are both indirect and direct by nature. Nevertheless, all indicators are measurable and they are expressed in quantitative terms or in terms of a time frame. Therefore, the indicators are closely related to the survey questionnaire.

4.4 Demographic Characteristics of the Project Area

The KOISP is mainly located in Hambantota District in the Southern part of the Island. The total land area of the district is 2,512.8 square kilometers with a population of in 524,000 persons which represents 3 percent of the total population of 17.4 million in Sri Lanka. The density of the population is 208 persons per square kilometer in Hambantota district, while the average population density in Sri Lanka is 279 persons per square kilometer. The highest population density in Sri Lanka is 2,956 in Colombo District and the lowest is 39 in Meelativu District.

According to the observations of the study group, the estimated farm population in the project area is 52,124 which represents 10 percent of the district population in 1993. The estimated population during the pre-project in 1980 also represented 10 percent of the total Hambantota District population which was 438,000.

The ethnic-religious composition of the population in the project area is highly homogeneous. The settlers can be grouped into major ethnic categories, namely Sinhalese, Tamils and Muslims. The largest category is Sinhalese (98 percent) while Muslims comprise 2 percent. The first group is evenly distributed throughout the project area while the other categories live only in Hamlet 8 at the Right Bank. A very small number of Tamils live in the project area but they were not included in the sample.

The average family size in the KOISP area is 5.5 persons, which is only marginally higher than the national average of 5 persons per family. The average family size is 5.6 and 5.4 persons in the new and the old area respectively. During the pre-project period the family size came to 5.7. The declining trend is similar to the national pattern. Two additional reasons specifically applicable in the KOISP area should be noted. Firstly, the health and education facilities in the area gradually improved during the last 15 years. Consequently, the younger families preferred to have small families due to their economic and social limitations. Secondly, some settlers in the higher income groups did not bring all their family members to the project area because of a lack of educational, residential and infrastructure facilities. Table 4.1 depicts the changing pattern of family sizes during the project period.

Table 4.1 Average family size of the household

		OIA Area	NIA	Project
1.	Baseline survey (pre-project)	5.75	5.69	5.7
2.	Mid-project evaluation (1985-86)	6.61	5.28	5.9
3.	Benefit assessment and impact evaluation (1994)	5.56	5.40	5.5

Sources: 1. Wanasinghe A. (1984). KOISP Pre-project Socio-Economic Conditions, ARTI; 2. ARTI (1986). KOISP Mid-project Survey 3. ARTI (1994). KOISP-Final Impact Assessment Survey

4.4.1 Age Structure of the Population

The percentage distribution of the sample population according to age groups and sex is presented in Table 4.2 and these figures provide rough estimates of sex composition, the potential labor force and the dependency rates in the sample population of the total project area.

Table 4.2 Age structure of members in the sample household (KOISP area)

Age Groups	Total				Male				Female			
	No.	Cum. No.	%	Cum %	No.	Cum. No.	%	Cum. %	No.	Cum. No.	%	Cum. %
0 - 5	119	119	8.9	8.9	96	96	7.4	7.4	215	215	8.2	8.2
5 - 15	327	446	24.4	33.3	59	455	27.7	35.1	686	901	26.0	34.2
15 - 25	273	719	20.4	53.7	280	735	21.6	56.7	553	1,454	21.0	55.2
25 - 40	307	1,026	22.9	76.6	305	1,040	23.5	80.2	612	2,066	23.2	78.4
40 - 55	177	1,203	13.2	89.8	171	1,211	13.2	93.4	348	2,414	13.2	91.6
55 - 65	78	1,281	5.8	95.6	59	1,270	4.5	97.9	137	2,551	5.2	96.8
65 - 95	57	1,338	4.3	100.0	27	1,297	2.1	100.0	84	2,635	3.2	100.0
Total	**1,338**		**100.0**		**1,297**		**100.0**		**2,635**		**100.0**	

Table 4.3 Age structure of members in the sample household (new area)

Age Groups	Total				Male				Female			
	No.	Cum. No.	%	Cum %	No.	Cum. No.	%	Cum. %	No.	Cum. No.	%	Cum. %
0 - 5	87	87	10.6	10.6	69	69	8.2	8.2	156	156	9.3	9.3
5 - 15	241	328	29.3	39.9	269	338	31.8	40.0	510	666	30.6	39.9
15 - 25	166	494	20.2	60.1	175	513	20.7	60.7	341	1,007	20.4	60.3
25 - 40	153	647	18.6	78.7	195	708	23.0	83.7	348	1,355	20.9	81.2
40 - 55	124	771	15.1	93.8	111	819	13.1	96.8	235	1,590	14.1	95.3
55 - 65	40	811	4.9	98.3	19	838	2.2	99.0	59	1,649	3.5	98.3
65 - 95	12	823	1.5	100.0	8	846	0.9	100.0	20	1,669	1.2	100.0
Total	823		100.0		846		100.0		1,669		100.0	

The percentage distribution of the male and female population in the KOISP area is 51 percent and 49 percent respectively, with no significant differences between the old and the new area. This is slightly lower than the national figure of 50.6 percent for males and 49.4 percent for females. The composition of the population in Hambantota District is almost similar: 50.2 percent for males and 49.8 percent for females. Table 4.3 illustrates the male and female composition in the new area while Table 4.4 shows the same for the old area.

Table 4.4 Age structure of members in the sample households (old area)

Age Groups	Total				Male				Female			
	No.	Cum. No.	%	Cum %	No.	Cum. No.	%	Cum. %	No.	Cum. No.	%	Cum. %
0 - 5	32	32	6.2	6.2	27	27	6.9	6.9	50	59	6.1	6.1
5 - 15	86	118	16.7	22.9	90	117	20.9	26.0	176	235	18.2	24.3
15 - 25	107	225	20.8	43.7	105	222	23.3	49.3	212	447	21.9	46.2
25 - 40	154	379	29.9	73.6	110	332	24.4	73.7	264	711	27.3	73.5
40 - 55	53	432	10.3	83.9	60	392	13.3	87.0	113	824	11.7	85.2
55 - 65	38	470	7.4	91.3	40	432	8.9	95.9	78	902	8.1	93.3
65 - 95	45	515	8.7	100.0	19	451	4.2	100.0	64	966	6.6	100.0
Total	515		100.0		451		100.0		966		100.0	

Source Tables 4.2-4.4: ARTI (1994). KOISP Final Evaluation Survey.

According to these two tables there were no significant changes or differences in the population composition and the age structure in the sample within the new and old areas.

4.4.2 Masculinity Ratio

The male and female composition of the population also reflects its masculinity ratio. The masculinity ratio indicates the number of males per 100 females in the target population. The masculinity ratio of the project is as follows:

Table 4.5 The masculinity ratio of the project area

	1994	1986	1980
Project area (sample population)	103.2	115.0	106.4
Hambantota	100.8	105.2	104.4
Sri Lanka	103.4	104.3	104.7

Sources: Sample survey in 1994/1986 and 1980 and ARTI Data Bank (1992 data)

4.5 Educational Status of the Population

Sri lanka had a high literacy rate (89 percent) in 1992 compared with other Asian countries as well as other developing countries. In the project area men have a higher literate rate than women. Table 4.6 demonstrates the literacy rates in the project area during the pre-, mid-, and final periods.

Table 4.6 Literacy rates by sex and by area

Sex	1981		1986		1994	
	OIA	NIA	OIA	NIA	OIA	NIA
Male	92.2	88.7	98.0	94.0	97.7	96.7
Female	79.1	79.4	81.0	88.0	94.5	93.4
Both Sexes	85.7	84.1	89.5	91.0	96.1	95.1

Source: Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ARTI (1994). KOISP Final Evaluation Survey

Table 4.7 Comparative literacy rates (1992 data)

	1981	1986	1994
KOISP	84.9	90.3	95.8
Sri Lanka	87.2	88.0	89.0

Source: Central Bank of Sri Lanka

The literacy rate is considered as a key achievement indicator in the context of socio-economic development in the KOISP. The KOISP authorities, the Integrated Rural Development Program in Hambantota and several other development authorities and institutions have laid emphasis on developing education in the project area. The literacy rate in both areas observed during the baseline survey has further increased over time, moreover a significant increase is seen among the women of the KOISP.

Age-specific school attendance is an important indicator which illustrates the level of education and accessibility to basic educational facilities. It also reflects physical and social facilities of the project as well as parental awareness of the importance of education. An improvement of the age-specific school attendance rate in the KOISP (that is the number of school going children in a particular age group per 100) is observed during the last 15 years. Table 4.8 gives the age-specific school attendance rates by sex and by area of the sample population.

Table 4.8 Age specific school attendance

Age and Sex		1981*		1986**		1994**	
		OIA	NIA	OIA	NIA	OIA	NIA
5-9 years	Male	82.8	71.1	74.5	78.2	100.0	98.6
	Female	74.0	71.8	77.1	79.0	100.0	100.0
10-14 years	Male	86.0	84.4	93.4	88.1	100.0	95.9
	Female	81.2	91.5	91.3	93.5	100.0	98.6
15-19 years	Male	50.8	49.9	42.6	47.0	55.4	57.4
	Female	41.7	40.3	65.5	53.3	66.7	66.1

*Sources: * Wanasinghe, A. (1984). KOISP Socio-economic conditions; ** ARTI (1986). KOISP Mid-Project Survey*
**** ARTI (1994). Final Impact Assessment Survey*

School attendance was very high in the project area, mainly due to the higher availability of school facilities in the area. In the new area new school buildings were part of the infrastructure facilities provided for the new settlers. It is also due to the general upgrading of schools in the island including the provision of equipment, teaching staff, books, uniforms and mid-day meals for the school children free of charge. Most of these facilities were provided by the Department of Education and the Integrated Rural Development Program in Hambantota.

The number of children not attending school has decreased too over the given time period. The rate of non-attending school in the age of 5 to 14 years in the project area is indicated in Table 4.9. Reasons for not attending school vary from lack of enthusiasm to weakness and inability to meet basic needs. In the pre-project period also absence of schools and economic constraints were mentioned as reasons for not attending schools, today these factors have lost their significance.

Table 4.9 Non attendance rate of school going children (ages 2-14)

	Male	Female	Both (%)
New area	3.2	0.8	1.9
Old area	0.0	0.0	0.0
Both areas	2.4	0.6	1.4

Source: ARTI (1994). KOISP Final Evaluation Survey

4.6 Labor Force

This section discusses the characteristics of the labor force in order to identify the educational level, the economically active population and the employment and unemployment level of the population of the KOISP.

The labor force is defined to include all those in the age group 15 to 64 years. The labor force of the project areas has significantly increased during the last few years as demonstrated in Table 4.10.

Table 4.10 Major characteristics of the labor force

	1981*	1986*	1994**
Proportion of the labor force in the sample (percentage)	58.7	64.0	62.0
Proportion of males in the labor force (percentage)	52.6	53.5	50.5
Size of labor force in the sample	2,188	2,691	1,635

*Source: * Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

The size of the labor force has decreased over the years due to a high death rate and out-migration, the latter being the most important factor. The majority of the labor force is relatively young while the age groups of 15-25 and 25-40 years are represented most with 25 percent 23 percent respectively.

4.7 Housing and Sanitation

Housing and sanitation facilities are priority basic needs for a better quality of life. The modern definition of housing includes the living environment which consists of the dwelling unit and supporting facilities such as water supply, and sanitation This section will examine the quantitative and qualitative aspects of the housing and sanitation conditions in the KOISP.

4.7.1 Type of houses

31 percent of the houses in the KOISP area are permanent while 69 percent are semi-permanent houses. The percentage distribution of permanent and semi-permanent houses of the sample in the KOISP is as follows:

Table 4.11 Percentage of permanent[1]/semi-permanent[2] houses in the KOISP

Housing Conditions	1981*		1986*		1994**	
	OIA	NIA	OIA	NIA	OIA	NIA
Permanent	58.5	16.5	59.8	1.7	62.0	14.0
Semi-permanent	41.5	83.5	40.2	98.2	38.0	86.0

Note: (1) *Permanent houses are those with tiles/asbestos/metal sheets for the roof and cement blocks/stone, cabook walls and cement floors.*

(2) *Semi-permanent houses are those with cadjan/palmyrah, straw for the roof and clay/mud walls, mud/cement floors.*

*Source: * Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

Permanent houses were found frequently in the old area while most of the semi-permanent houses were located in the new area. This was mainly due to the fact that initially most of the families were rather unsettled in the project area.

Size of houses

The project area is characterized by the presence of a large proportion of small houses with floor area of below 250 square feet. Houses with a floor area between 250 and 500 square feet are most frequently found (39 percent of households). The type of houses in the project area mainly depends on economic conditions and income levels of the households. Table 4.12 indicates the distribution of the households by floor area in 1994, while Table 4.13 shows the same for 1981 and 1986.

Table 4.12 Percentage distribution of households according to the floor area

Floor Area (sq. ft.)	New Area	Old Area	Both Areas
250 and below	42.0	15.6	32.2
251 - 500	42.0	34.6	39.2
501 - 1000	14.3	36.9	22.8
1001 - 2000	1.3	9.5	4.4
2001 and over	0.3	3.4	1.5

Table 4.13 Distribution of household according to the floor area in 1981 and 1986

Floor Area (square feet)	1981		1986	
	Old	New	Old	New
250 and below	17.0	16.0	20.1	38.6
251 - 500	66.7	72.0	39.1	50.6
501 - 1000	10.8	8.8	33.1	10.0
1001 - 2000	5.2	1.9	5.0	0.3
2001 and above	0.5	-	1.7	-

The above two tables illustrate a development in both areas; houses have gradually enlarged. The number of rooms in the houses varied from 1 to 12, the higher number (ranging from 6-12) are found in the 2000 square feet category of houses. The distribution of houses according to number of rooms in the KOISP is as follows:

Table 4.14 Distribution of households according to number of rooms

Number of Rooms	New Area		Old Area		Both Areas	
	Number	%	Number	%	Number	%
0 - 2	78	26.2	10	5.6	88	18.4
2 - 4	177	59.4	79	44.1	256	53.7
4 - 6	37	12.4	63	35.2	100	21.0
6 - 12	6	2.0	27	15.1	33	6.9
Total	298	100.0	179	100.0	477	100.0

Note: Two farmers in the new area reported that they do not have houses
Source Tables 4.12-4.14: ARTI (1994). KOISP Final Evaluation Survey

Most of the houses have 2-4 rooms (54 percent). The number of rooms in each household had increased over time due mainly to the favorable levels of income and other facilities of the project.

Area per occupant

About 99 percent of the houses are owner-occupied. During the initial period nearly 88 percent of the houses were owner-occupied in both the new and the old area. This increased to 93 percent in the old area and to 98 percent in the new area in 1986. This was mainly due to legal activities and the alienation process undertaken by the KOISP authorities, government departments and other institutions.

In order to estimate the degree of overcrowding in the houses, the percentage distribution of houses according the number of occupants is examined in Table 4.15. It is assumed that all members of a household reported as actually occupying the houses at the time of the field survey in March 1994 were actually living in these houses.

Table 4.15 *Percentage distribution of households according to the number of occupants*

Number of Occupants	1981*		1986*		1994**	
	OIA	NIA	OIA	NIA	OIA	NIA
1 - 3	18.0	16.4	-	-	19.0	11.7
4 - 6	47.2	49.6	-	-	54.0	61.0
7 and over	34.8	34.8	34.0	-	26.3	27.3

*Source: * Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

About 59 percent of the households in the entire project area are occupied by 4-6 persons The comparable figure for Sri Lanka according to the Census of Housing (1971) is 36 percent.

To estimate the extent of overcrowding in houses and the proportion of overcrowded houses, "a minimum floor area per person" as well as "three persons or more per room" were considered as important parameters in the study. Consequently, overcrowding of houses is as follows:

Table 4.16 *Incidence of overcrowding: percentage of household (proportion of overcrowding houses of KOISP Area)*

	1981*			1994**		
	NIA	OIA	Both	NIA	OIA	Both
Three or more persons per room	35.9	28.1	31.2	16.6	4.4	12.1
Minimum floor area per person	38.9	32.7	35.2	40.3	22.9	33.8

*Source: * Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

As evident from the foregoing table, approximately 34 percent of the houses in the project area are overcrowded on the basis of a 'minimum floor area per person", while 12 percent of the households are overcrowded on the basis of "three persons or more per room". It is observed that houses in the new area are more overcrowded than those in the old area. A declining trend in terms of "three or more persons per room" is recorded. The rate of this declining trend in the old area is higher than in the new area. However, the indicator of a minimum floor area per person has increased from 39 percent in 1981 to 40 percent in 1994, in the new area. The problem of overcrowding in terms of "minimum floor area per person" has increased in the newly irrigated area, over time due to increase in population, lack of houses and other economic problems related with the construction of houses.

4.7.2 Source of Water

The availability of clean water is an essential facility that contributes to better living conditions of people in any country. Water supply in the KOISP area was satisfactory during the concerned period of 1981 to 1991. Table 4.17 indicates the percentage distribution of water supply according to different sources.

Table 4.17 Sources of drinking water

Sources of Drinking Water	1981		1986		1994	
	OIA	NIA	OIA	NIA	OIA	NIA
Own well or pipe	39.9	9.5	51.0	10.0	78.4	80.0
Other's wells	39.8	54.5	46.1	23.0	17.9	1.7
Tank or river or canal/oya	20.3	35.8	3.3	6.0	-	-
Tube well	-	-	1.1	3.0	3.4	-
Project bowsers	-	-	0.5	58.0	-	18.3

Sources : 1. Wanasinghe, A. (1984). KOISP Pre-project Socio-economic conditions; 2. ARTI, (1986). KOISP Mid-project survey 3. ARTI (1994). KOISP Final Impact Assessment Survey

The above table shows that nearly 80 percent of the households in the area obtain their drinking water from own wells or pipes, which can be considered as a good achievement.

4.7.3 Type of Lavatory

Lavatory facilities are an important aspect of a better sanitation system. It is also an indicator of a better standard of living of the people in an area. About 95 percent of the households in the project area have toilet facilities. Details relating to the availability of lavatories of the project area are as follows:

Table 4.18 Availability of lavatories in the project area, 1994

	Old Area		New Area		Both Areas	
	Number	%	Number	%	Number	%
Yes	171	85.5	283	943	454	94.8
No	8	4.5	17	5.7	35	5.2
Total	179	100	300	100	479	100

Source: ARTI (1994). KOISP Final Evaluation Survey

Comparing the details in Table 4.18 with the pre-project period (1981) and mid-project (1986) data (Table 4.19), it is noted that there have been significant improvements to the toilet facilities in the project area during that period. The present situation with appeared to be good.

Table 4.19 The percentage distribution of lavatories in the project area

	1981		1986		1994	
	OIA	NIA	OIA	NIA	OIA	NIA
Yes	75	49	89.4	70	95.5	94.3
No	25	51	10.4	30	4.5	5.7

*Source: * Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

The types of toilets available are an indicator of the general status of health of the people in the area. The different types of lavatories in the project area are given in Table 4.20.

Table 4.20 Type of lavatories in KOISP in 1994

Type of Lavatories	Old Area		New Area		Both Areas	
	Number	%	Number	%	Number	%
Water seal	119	69.6	62	21.9	189	39.9
Pit (concrete/slab)	25	14.6	157	55.5	182	40.1
Pit (others)	27	15.8	64	22.6	96	20.0

4.7.4 Cost of House Construction

Information on the cost of house construction is scarce because most of the houses were built more than 5-10 years ago. Further, family labor and materials such as *cadjans*, bricks and timber available free of charge from own gardens or from outside areas have not been taken into account. However, the expenditure pattern for the constructing of houses in the project area is estimated as follows:

Table 4.21 Expenditure pattern for constructing the houses

Expenditure Pattern	OIA		NIA	
	Number Reported	Average Amount (Rs.)	Number Reported	Average Amount (Rs.)
Government subsidies only	0	-	3	883.33
Farmer himself only	73	73,054.79	114	25,785.09
Both	3	26,667.00	181	15,229.20
Total	76	71,233.79	298	19,122.94

Sources of funds

Sources of funds for house construction in the project area are given in Tables 4.22 and 4.23.

Table 4.22 Source of funds utilized for housing construction after 1986, KOISP (new area)

Source of Funds	Number	% Reporting	Average	% Amount Utilized (Rs.)
Savings in the pre-project period	174	59.0	5,883	32.0
Earnings after settling into the project	163	55.3	9,049	49.3
Formal loans	66	22.4	2,093	11.4
Informal loans	24	6.1	482	2.6
Foreign employment	2	0.7	186	1.0
Others	18	6.1	675	3.7
Total			19,370	100.0

Note : Farmers reported more than one source

Table 4.23 Source of funds utilized for housing construction after 1986, KOISP (Old Area)

Source of Funds	Number	% Reporting	Average	% Amount Utilized (Rs.)
Savings before 1986	4	5.3	1,974	2.8
Earnings after 1986	73	96.1	61,816	87.0
Formal loans	16	21.1	5,691	8.0
Informal loans	2	2.6	921	1.3
Foreign employment	0	0.0	0	0.0
Others	18	6.1	675	3.7
Total			71,092	100.0

Note : Farmers reported more than one source

4.8 Household Durables

Availability of specific household durables and other valuable items can be taken as a reasonable indicator for the economic status of households. Rural household resources in any area can be grouped into two main categories: (a) farm implements and tools and (b) household utilities. These items are often considered as a crude indicator of household's affluence. At the same time, ownership of durable items also indicates the income level of the households. The most common household items in the study area were radios, bicycles, petromaxes, lamps, televisions, wall clocks, sewing machines, water pumps, and valuable furniture.

The study revealed that old area farmers are relatively wealthier than new area farmers; a large number of durable household items were found in the old area houses. The distribution of the household durables, both agricultural implements and household instruments, in the project area is as follows:

Table 4.24 The percentage of households that had durable household items

Items	New Area	Old Area	Both Areas
Wristwatches	72.3	87.2	77.9
Other clocks	65.0	89.4	74.1
Torches	95.7	97.2	96.2
Petromax lamps	41.3	60.3	48.4
Radios	41.0	58.1	47.4
Cassette radios	26.7	48.6	34.9
Televisions	6.7	40.8	19.4
Sets of furniture	21.3	52.0	32.8
Beds	90.7	99.4	93.9
Chairs	78.7	97.2	85.6

Table 4.25 Percentage of households owning agriculture implements and average number of implements owned per reporting household

Type of Agriculture Implements	New Area		Old Area		Both Areas	
	%	Number Owned	%	Number Owned	%	Number Owned
Mammoty	99.7	2.6	94.4	3.0	97.7	2.7
Crowbar	77.7	1.0	73.2	1.1	76.0	1.1
Wooden Plough	0.3	1.0	1.1	1.0	0.6	1.0
Iron Plough	2.7	1.0	7.8	1.4	4.6	1.2
Sprayers	26.0	1.0	43.6	1.1	32.6	1.0
2 Wheeled Tractors	3.3	1.0	16.2	1.2	8.1	1.2
4 Wheeled Tractors	0.3	1.0	3.9	1.0	1.7	1.0

As shown in the Tables 4.24 and 4.25 ownership of both household durable items and agricultural implements has increased. Most of these items are purchased in the event of a good harvest or an increase of household income. In addition there was a significant growth in the ownership of vehicles among the sample farmers. The situation is presented in Table 4.26.

Table 4.26 Percentage of households owning vehicles for transport and average number of vehicles owned per reporting household

	New Area		Old Area		Both Areas	
	%	Number Reporting	%	Number Reporting	%	Number Reporting
Carts	0.3	1	0.6	1	0.4	2
Bicycle	79.7	239	84.4	151	81.4	390
Motor Cycles	7.0	21	22.9	41	12.9	62
Cars	0.0		1.1	26	0.4	2
Lorry	0.0		1.1	26	0.4	2
Vans	0.0		2.2	4	0.4	4

Source Table 4.20 - 4.26: ARTI (1994). KOISP Final Evaluation Survey

Absolute ownership of vehicles is very low in the area. The most common vehicles are bicycles and motorcycles. Out of the total 479 households studied, 81 percent of the families had bicycles and 13 percent had motorcycles. All other vehicles such as bullock carts, cars, lorries and vans accounted for less than 1 percent.

4.9 Relative Prosperity or Poverty

To estimate prosperity or poverty in a society no unique indicator or measurement is available. However, there are a large number of definitions as well as indicators to estimate prosperity or poverty. Most of these definitions and indicators have been developed on the basis of income levels, nutrition, and availability of basic needs. In this sense, household durables constitute a basic and crude indicator of household affluence as well as the levels of prosperity or poverty.

However, estimation of the levels of prosperity or poverty in the KOISP, on the basis of household durables is a difficult as well as a complicated task. The situation with regard to the ownership of household durables is not clear in all levels of society in the KOISP. Nevertheless, it has been observed that there are positive changes in the socio-economic conditions of the people who have settled in the scheme. This is not only the result of the project's activities, but also of the micro-macro level socio-economic policies implemented in the country.

Comparing the data and other information gathered through the pre-project evaluation (1981), mid-project evaluation (1985) and the final assessment of the project (1994), a decreasing trend in relative poverty and an increasing trend in prosperity of the people in the KOISP is found. This is due to increased income levels and production, development of infrastructure facilities, and some other benefits provided by the project as well as by the central government. However, it is important to note that adequate data and information to estimate absolute poverty are lacking.

4.10 Employment

Characteristics of labor force

The characteristics of the labor force constitute a vital phenomenon in any employment pattern. Labor force characteristics in the KOISP area are given in Table 4.27.

Table 4.27 Characteristics of the labor force

Characteristics (%)	1981		1986		1994	
	Old Area	New Area	Old Area	New Area	Old Area	New Area
Labor force in the sample	58.4	59.2	69.0	59.0	66.4	59.6
Females in the labor force	47.8	46.9	46.0	47.0	47.1	51.1
Employed in the labor force	28.9	31.7	34.6	28.9	63.0	70.8
Employed in the economically active sector	83.6	86.6	86.0	88.0	80.2	90.5
Crude activity rate	35	39	40	33	52	46
Net activity rate	60.8	60.5	68.5	57.1	78.6	78.3
Economic dependency ratio	235.6	193.7	-	-	139.1	137.1

Source: Gamage, D. et.al. (1988). KOISP Mid-Project Evaluation; ARTI (1994). KOISP Final Evaluation Survey

As shown in Table 4.27, the percentage of the labor force did not change during the 1981-1994 period. The old area continued to record a higher percentage of the labor force than the new area. This could be attributed to the employment opportunities available in the old area compared with the meager opportunities in the new area.

Note should be taken of the growth in the percentage employed in the labor force. The employed population of the new area increased from 29 percent in 1986 to 71 percent in 1994, while the old area recorded an increase in this sector from 35 to 63 percent. These increases are mainly due to the employment opportunities provided upon completion of the project. This is well revealed when we look at the comparison between the mid-project evaluation data of 1986 and the final evaluation data of 1994. Both areas continued to maintain a high economically active ratio. The new area registered an increasing trend over the period 1981-1994, whereas the old area registered a downward trend. Project-generated economic endeavors in the latter stages could have provided avenues in the new area for the increasing trend of economically active sector.

Activity related variables

Activity-related variables have been categorized into groups such as employed, students, unemployed and discouraged workers. Employment opportunities have been increased considerably. During the period 1986-1994 the employment opportunities in the new area have grown faster than in the old area. This is due to the completion of the project and the creation of many employment opportunities in the latter stages of the project. The increase shown in the number of students in both areas is also a noticeable factor along with the downward trend in unemployment. Both in the old and new areas, the number of discouraged workers has increased from 1 percent in 1986 to 12 percent and 6 percent respectively in 1994. Although this increase is unavoidable, it can be considered as a serious threat to any development process.

Table 4.28 Activity related variables

Activity	1981*		1986*		1994**	
	Old Area	New Area	Old Area	New Area	Old Area	New Area
Employed	28.8	31.7	34.0	28.1	41.8	42.2
Student	25.8	24.3	23.7	30.3	24.5	36.7
Unemployed	5.7	5.0	5.1	5.7	10.4	4.0
Discouraged workers	1.6	0.7	1.0	1.1	11.7	5.7
Others (retired, disabled, too young and too old)	20.0	21.1	14.9	18.4	11.6	11.0

*Source: * Gamage, D et al., (1988). KOISP Mid-project Evaluation; ** ARTI (1994). KOISP Final Evaluation Survey*

Type of employment

The types of employment have been categorized as agriculture-related employment and non-agricultural employment. During the time span of eight years from 1986 to 1994 agriculture-related employments opportunities have decreased from 76 percent to 74 percent in the old area and from 83 percent to 82 percent in the new area. This decrease is attributed to the persisting drought and the consequent inadequate water supply during that period. Salaried employment, including the private sector and the state sector, has registered a sharp upward trend during the same period. Factors which hindered the agricultural activities in the project have encouraged the people to look for other employment. Self-employment was found more in the old area, whereas skilled employment showed a downward trend in both areas. According to the 1994 survey conducted by ARTI, 2 percent of the population has also found foreign employment. For details see Table 4.29.

Nearly 93 percent of the heads of households in the new area are engaged in occupations connected with agricultural activities. This is a considerable and commendable increase compared to 83 percent in 1986. In the old area this percentage increased from 79 percent in 1986 to 91 percent in 1994.

Table 4.29 *Percentage of employed in main occupations by type of occupation*

Occupation	1986*		1994**	
	Old Area	New Area	Old Area	New Area
Agricultural operator	66.7	80.6	43.3	40.9
Farm helper			29.1	37.9
Agricultural laborer	12.6	2.8	1.2	3.1
Non-agricultural laborer	0.7	2.8	2.0	1.8
Self employment	3.7	3.4	4.2	1.3
Skilled employment	1.5	2.2	0.0	1.7
Salaried employment	13.3	7.3		
Government employment			11.3	5.4
Private employment			6.9	5.8
Foreign employment			2.0	2.0

*Source : * Gamage, D. et al. (1988). KOISP Mid-project; ** ARTI (1994). KOISP Final Evaluation Survey*

Female dominance is found in farm helping, while males were dominant in agricultural operations. This was true in both areas. Women are more involved in the government and private sector in the old area as compared to the new area. The old area experienced less female participation in agricultural related activities.

Table 4.30 *Gender-wise percentage of employment*

	Old Area		New Area	
	Male	Female	Male	Female
Agriculture operator	57.7	6.2	63.2	7.1
Farm helper	19.5	54.0	17.2	69.3
Government	9.0	15.0	5.7	5.0
employment	4.1	14.2	3.8	8.9
Private employment	4.4	3.5	1.4	1.1
Self employment	0.0	0.0	2.6	0.4
Skilled employment	1.0	1.8	2.8	3.6
Agriculture labor	2.4	0.9	2.6	0.7
Non-agriculture labor	1.0	4.4	0.7	3.9
Foreign employment				

Source : ARTI (1994). KOISP Final Evaluation Survey

Income and Assets

Both old area farmers and new area settlers have experienced a growth in their income patterns, although this increase in only marginal. The increase is not proportional to the current cost of living and expenditure patterns. Table 4.31 gives a comparative picture of income in the last two decades.

Table 4.31 Comparison of average monthly household income

Period	OIA (Rs./month)	NIA (Rs./month)
1979-1980*	654	540
1985-1986*	2,746	1,086
1994**	5,566	3,006

*Source: * Gamage, D. et al. (1988). KOISP Mid-project; ** ARTI (1994). KOISP Final Evaluation Survey*

4.10.1 Settlers in the New Area

Agriculture-oriented operations are responsible for the major part of the incomes. The households can be classified according to level of income. Table 4.32 presents a breakdown of the average monthly household income by income classes. More than one-third of the households received less than Rs. 2,000/= as average monthly income. The highest monthly income of over Rs. 4,000/= has been received by only 24 percent of the households. Since most of the income is from agriculture-related activities, the release of adequate water at the proper time would have further increased the income levels.

Table 4.32 Distribution of households by income class

Income Class (Monthly)	Average Monthly Income (Rs.)	%
< 1000	645	13.7
1000 - 1500	1,296	13.0
1500 - 2000	1,693	12.7
2000 - 3000	2,447	24.7
3000 - 4000	3,505	11.7
> 4000	6,258	24.3
Average	3,006	100.0

Source : ARTI (1994). KOISP Final Evaluation Survey

Table 4.33 presents a breakdown of the household income by sources during the survey period for the new area.

Table 4.33 Composition of average annual household income by its sources

Source of Income	Amount (Rs.)	%
Paddy	9,658.82	26.8
Other field crops	2,906.11	8.1
Livestock	1,537.21	4.3
Government employment	3,966.50	11.0
Private sector employment	2,801.07	7.8
Agricultural laborer	3,770.42	10.5
Non-agricultural laborer	1,351.52	3.7
Skilled jobs	1,799.83	5.0
Self employment	2,185.67	6.1
Middle East employment	1,973.33	5.5
Other crops	948.95	2.6
Hiring agricultural implements	243.37	0.6
Pension/rate/lease	524.83	1.5
Government subsidiaries	199.07	0.6
Food stamps and school food stamps	1,926.73	5.3
Janasaviya	77.08	0.2
Others	210.50	0.6
Total	36,072.00	100.00

Income derived from paddy and other agriculture-related activities has contributed considerably to the income pattern as nearly 38 percent of the income is received from these activities. Further, it is observed that the income from OFC cultivation and livestock production has relatively decreased. The main reasons attributed to this gradual decline are the growth of income from paddy and other salaried employment while the number of animals reared along with lands brought under OFC cultivation have decreased. Although agriculture is the major source of income, its level is much lower than expected due to the problems faced in water releases.

Salaried employment and self-employment are the second major sources of income. Also government subsidies and food stamps have contributed a considerable amount to the income levels. This is applicable to the new area settlers rather than to the old area farmers. The major part has come from food stamps and students food stamps, *Janasaviya* and other subsidies had less influence on the income levels. Therefore, a careful assessment should be carried out before reviving or removing the food stamps scheme. This could be done gradually while consolidating a complete and sustainable income from paddy and other activities.

Table 4.34 present several income-related variables according to income categories. These variables are: (a) number of income receivers per household, (b) monthly income per receiver, (c) average household size, (d) average size of highland plot, and (e) percentage of households that operated a highland plot.

Table 4.34 Income related variables according to income classes

Variable	< 1000	1000-1500	1500-2000	2000-3000	3000-4000	> 4000
% distribution of households	13.7	13.0	12.7	24.7	11.7	24.3
Number of income receivers/households	1.8	1.9	2.1	2.1	2.5	3.2
Monthly income/income receiver (Rs.)	353	662	814	1,176	1,394	1,969
Average household size	4.7	4.8	6.0	5.4	6.0	6.2
Average size of operated highland for yala 1993 (ac.)*	0.0	0.0	0.0	0.0	0.25	0.80
% of households that operated highland for yala 1993*	0.0	0.0	0.0	0.0	2.9	4.1

* *Excluding the cultivation of mixed homegarden crops or permanent crops.*
Source: ARTI (1994). KOISP Final Evaluation Survey

About 65 percent of the households in the new area fall into the low and middle income groups (below Rs. 3,000/= per month). The low income groups had less paddy holdings. Further, the number of income receivers per household, the income per income receiver as well as the household income increase with the size of household which is a natural pattern elsewhere too.

Household-related variables and housing conditions in the new area

Permanent houses are those houses with roofs of tiles/asbestos or metal sheets, cement blocks/stone, *cabook* walls and cement floors. Semi-permanent houses are those houses with roofs of *cadjan/palmyrah* or straw, clay/mud walls and mud cement floors. In the new area 14 percent of the houses are permanent houses while 86 percent are semi-permanent houses. Table 4.35 illustrates the housing pattern and toilet facilities per income class.

Table 4.35 Distribution of housing patterns

Income Class (Rs./Month)	Permanent House	% Average Square Area (Sq. Ft.)	Toilet Facilities
> 1000	4.9	240	92.7
1000 - 1500	7.7	304	92.3
1500 - 2000	15.8	309	94.7
2000 - 2500	8.1	317	90.9
2500 - 4000	17.1	380	95.4
< 4000	26.0	457	97.3

Source: ARTI (1994). KOISP Final Evaluation Survey

A clear association of improved housing conditions and toilet facilities with increasing income is revealed in the above table. Permanent houses are not much found in the low income classes, but they are provided with toilet facilities.

4.10.2 Farmers in the Old Area

Also in the old area agriculture-related activities are the major contributor to the income of the farmers, although other employment opportunities contributed a considerable proportion too. Table 4.36 gives the breakdown of the average monthly income by income class.

The majority of the population in the old area (65 percent) received an income of more than Rs. 3,000/=. Better infrastructure facilities and related education facilities further encouraged and strengthened the possibilities in seeking employment other than agriculture, which however still remains the major source of income. Compared to the new area settlers, the farmers in the old area are better off in most of the domestic departments.

Table 4.36 Distribution of households by income class

Income Class (Rs./Month)	Average Monthly Income (Rs.)	%
< 1000	700	6.7
1000 - 1500	1,260	10.7
1500 - 2000	1,800	5.6
2000 - 3000	2,496	13.4
3000 - 4000	3,534	16.2
> 4000	9,126	48.0
Average	5,566	100.0

Source: ARTI (1994). KOISP Final Evaluation Survey

Table 4.37 presents a breakdown of the household income by its source during the survey period for the old area farmers.

Table 4.37 Composition of average annual household income by its sources

Source of Income	Amount (Rs.)	%
Paddy	21,971.23	32.9
Other field crops	1,952.77	2.9
Livestock	2,463.50	3.7
Government employments	8,827.93	13.2
Private sector employments	3,178.77	4.8
Agricultural laborers	1,877.37	2.8
Non agricultural laborers	1,256.98	1.9
Skilled jobs	405.59	0.6
Self employments	11,683.80	17.5
Middle East employments	3,002.01	4.5
Other crops	3,228.77	4.8
Hiring agricultural implements	3,976.26	6.0
Pensions/rents/leases	2,118.44	3.2
Government subsidies	4.19	
Food stamps and school food stamps	144.46	0.2
Janasaviya	586.65	0.9
Others	111,73	0.2
Total	66,800.45	100.0

Source : ARTI (1994). KOISP Final Evaluation Survey

Paddy remained the most important source of income, while other employment opportunities both in the government and the private sectors along with self-employment dominate the income flow among the old area farmers. Income derived from paddy has contributed 33 percent, whereas the other three categories together have contributed 36 percent. Cultivation of other field crops contributed very little and the livestock sector showed a declining trend. The decrease could be due to the growing influence of other salaried employment, both government and private sector, and to the income from paddy as these activities remained the major income sources. Another reason could be the decrease in number of animals reared and in the lands brought under OFC cultivation.

Since the old area farmers are generally in a relatively better position than the new area settlers, their dependence on government subsidies, food stamps, school stamps and *Janasaviya* is negligible. About 1 percent of the monthly income comes from food stamps and the *Janasaviya* scheme. Hence, the removal of food stamps and other subsidies, will not affect the people in this area. However, the removal of agricultural subsidies will have an adverse effect as it remains the single major source of income. Further, Middle-East employments started its headway to the old area since 4.5 percent of the monthly income has come from this source.

Another source of income is the renting out of agricultural implements, since this contributes nearly 6 percent to the income, which is almost ten times higher than in the new

area. Mostly tractors and other agricultural machinery are the items which are used for this purpose. Since the old area farmers enjoy a better life style, hiring out equipment seemed to be affordable not only to the high income class, but also to the middle income class.

Table 4.38 present the income-related variables according to income categories.

Table 4.38 Income related variables according to income class

Variable	< 1000	1000-1500	1500-2000	2000-3000	3000-4000	> 4000
% distribution of households	6.7	10.1	5.6	13.4	16.2	48.0
Number of income receivers/household	1.3	1.4	2.0	1.9	2.0	2.8
Monthly income/income receiver (Rs.)	525	908	900	1332	1737	3284
Average household size	4.0	4.4	6.2	5.1	5.6	5.7
Average size of operated highland for yala 1993 (ac.)*	0.0	0.0	5.0	-	-	-
% of households that operated highland for yala 1993*	0.0	0.0	0.0	4.2	-	-

* *Excluding the cultivation of mixed homegarden crops or permanent crops.*
Source: ARTI (1994). KOISP Final Evaluation Survey

The majority of the population in the old area (65 percent) received an income of more than Rs. 3,000/=, which is almost double the figure of the new area. According to Gamage, D et al (1988), this was nearly four times higher than the new area in 1988. Hence, it appeared that the gap between the two areas has decreased considerably in the course of time. As in the old area the number of income receivers per household, the income per income receiver as well as the household's income increase with the household size. Further to our observations, the fact that the majority of the settlers in the old area have attained relatively high income levels reveals the potential which may be realized by the new area settlers with similar facilities.

Household-related variables and housing conditions in the old area

In the old area 62 percent of the respondents owned permanent houses while 38 percent owned semi-permanent houses. This is in contrast to the situation observed in the new area, mainly due to the better life style and higher income flow. The distribution of housing patterns per income class is presented in Table 4.39.

Table 4.39 Distribution of housing patterns

Income Class	Permanent Home	% Average Square Area (Sq. Ft.)	Toilet Facilities
< 1000	33.3	336	100.0
1000 - 1500	44.4	375	93.0
1500 - 2000	30.0	511	100.0
2000 - 2500	62.5	534	100.0
2500 - 4000	48.3	457	93.1
> 4000	77.9	837	96.5

Source : ARTI (1994). KOISP Final Evaluation Survey

A positive association of improved housing conditions and basic facilities with increasing income is revealed in the above table. Hence, the farmers face less confrontation between resource investment choices and immediate consumption needs along with, to some extent, production needs, which is due to their better living conditions compared to the new area population.

Other assets

A comparison between the settlers of the new area and the farmers of the old area with regard to their other assets, both household and transport related is given in Table 4.40. As would be expected, the old area recorded a higher percentage of ownership of assets, again indicating the relatively better position of the population. In both areas bicycles are found to be the best mode of transportation. Motorized vehicles for transportation and tractors, both 2 and 4 wheels are more common in the new area than in the old area.

Table 4.40 *Comparison of other assets*

Items		New Area (%)	Old Area (%)
Household	Wristwatches	72.3	87.2
	Other clocks	65.0	89.4
	Torches	95.7	97.2
	Petromax lamps	41.3	60.3
	Radios	41.0	58.1
	Cassette recorders	26.7	48.6
	Televisions	6.7	40.8
	Sets of furniture	21.3	52.0
	Beds	90.7	99.4
	Chairs	78.7	97.2
Vehicles	Bullock carts	0.3	0.6
	Bicycles	0.6	84.4
	Motor cycles	79.7	22.9
	Cars	7.0	1.1
	Lorries	-	1.1
	Vans	-	2.2
Agricultural Implements	*Mammoties*	99.7	94.4
	Crowbars	77.7	73.2
	Wooden ploughs	0.3	1.1
	Iron ploughs	2.7	7.8
	Sprayers	26.0	43.6
	2 wheeled tractors	3.0	16.2
	4 wheeled tractors	0.3	3.9

Source : ARTI (1994). KOISP Final Evaluation Survey

4.11 Household Expenditure

The household expenditure has been grouped into two categories: expenditure on food and expenditure on non-food items where the latter includes expenditure on house construction as well. Farmers in the old area appeared to enjoy a better intake of food as their expenditure on food items is higher than that of the new area settlers.

4.11.1 Settlers in the New Area

Table 4.41 shows that the expenditure on food as a percentage of household income in the new area decreases along with increasing income. This phenomenon is also observed in the case of non-food items and income from food stamps and *Janasaviya*. Among the lower income groups (those receiving below Rs.1,500/= per month) the monthly expenditure on food is equal to their income or even above it. Even including food stamps into their income, will not make

a significant difference to their expenditure pattern. The monthly expenditure on food and non-food items as a percentage of income in the high income class is low. Also, dependency on food stamps is very low in the high income category.

Table 4.41 Monthly expenditure on food and non-food items by income class in the new area

Monthly Income Class (Rs./Month)	Monthly Expenditure on Food as % of Income	Monthly Expenditure on Non-food Items as % of Income	Monthly Food Stamps (Janasaviya) as % of Income
< 1000	180.2	104.3	23.7
1000 - 1500	92.8	55.7	11.5
1500 - 2000	80.9	47.8	9.7
2000 - 3000	56.0	35.7	6.9
3000 - 4000	53.5	28.7	4.7
> 4000	28.6	21.2	3.0

Source : ARTI (1994). KOISP Final Evaluation Survey

Looking at the expenditure for house construction, it appeared that for the majority of the households the farmers' own savings and government subsidies together covered the expenses incurred. Out of 298 respondents, 181 mentioned this pattern, while 114 used only their savings (ARTI, 1994. KOISP Final Evaluation Survey Data).

Table 4.42 Sources of funds utilized for housing construction after 1986

Sources of Funds	%
Savings in the pre-project period	59.0
Earnings after settling into project	55.3
Formal loans	22.4
Informal loans	8.1
Foreign employment	0.7
Others	6.1

Note : Farmers reported more than one source
Source: ARTI (1994). KOISP Final Evaluation Survey Data

According to Table 4.42, farmers were utilizing more than one source of funds for their house construction.

4.11.2 Farmers in the Old Area

Table 4.43 gives the expenditure pattern of the old area farmers on food and non-food items.

Table 4.43 Monthly expenditure on food and non-food items by income class in the Old Area

Monthly Income Class (Rs./Month)	Monthly Expenditure on Food as % of Income	Monthly Expenditure on Non-food Items as % of Income	Monthly Food Stamps (Janasaviya) as % of Income
< 1000	323.3	206.1	1.4
1000 - 1500	153.3	102.5	0.0
1500 - 2000	131.5	74.9	5.6
2000 - 3000	95.5	58.3	6.0
3000 - 4000	61.1	33.4	1.3
> 4000	29.2	22.4	0.6

Source : ARTI (1994). KOISP Final Evaluation Survey

It can be clearly observed that the expenditure on food as a percentage of household income decreases along with increasing income in the old area as it appeared in the new area. The same trend has been prevailing with regard to expenditure on non-food items. The lower income groups (less than Rs.1,500/month) spend exorbitant amounts on food and non-food items despite food stamps and *Janasaviya* support. The monthly expenses in all income classes are almost double as what was found in the new area.

Further, in contrast to what prevailed in the new area, house construction expenses were mostly met by the farmers themselves. As much as 73 out of 76 respondents reported this in the old area (ARTI, (1994), KOISP Final Evaluation Survey Data). Government subsidies were not utilized by the farmers of the old area to meet the expenses incurred for house construction.

Table 4.44 Sources of funds utilized for housing construction after 1986

Sources of Funds	%
Savings before 1986	5.3
Earnings after 1986	96.1
Formal loans	22.1
Informal loans	2.6
Foreign employment	0.0
Others	3.9

Note : Farmers reported more than one source
Source: ARTI (1994). KOISP Final Evaluation Survey

Here most of the farmers utilized earnings (after 1986 mid-project period) and formal loans.

4.12 Labor Migration

Labor migration can be categorized as inward and outward migration. With regard to internal migration in the KOISP, the majority of the movements "to" and "from" are either due to marriage or to join relatives. During the pre-project period, the number of movements, dictated only by the need for employment, was small, during the final evaluation period, this reason for migration experienced a small increase. Nevertheless, one of the most important reasons for outward migration proved to be seeking employment. Although refined data are not available to study internal migration, the appraisal seemed to support the findings.

If we compare the migration patterns in the old area and the new area, the latter shows a higher percentage of migration, both inward and outward. The old area did not shown any significant percentage of migration at all. Nevertheless, during the recent past, foreign jobs have had an influence among the old area farmers and the new area settlers.

Most of the farmers in the old area and settlers in the new area are agriculture-oriented. Hence inward migration with regard to agricultural activities was found to be higher than other job-related activities. During the harvesting periods, inward migration experiences a considerable increase. The non-availability of water has resulted in outward migration to seek for alternative employment.

Further, due to the proliferation of government and non-government organizations, job opportunities outside the new area increased to a considerable extent in comparison with the pre-project situation. This had also indirectly helped outward migration. However, migration patterns are mostly seen among the new area settlers, rather than among the old area farmers. The reasons for migration can be prioritized as follows:

(a) Marriage
(b) To join relatives
(c) Employment
(d) Miscellaneous

When comparing the appraisal findings with the pre-project situations, migration for employment was found to be increasing. This is a serious development and may threaten the sustainability of KOISP agriculture. There has been migration due to project-related activities, but since the project is now completed, the people who migrated will either find employment in the new area in agricultural activities or they will try to find job opportunities outside the project. Further, unemployment has increased among the new area farmers compared with the mid-project and pre-project periods. However, the rate has declined among the new area settlers. Yet unemployment would have further encouraged migration among the new area settlers. Hence it is difficult to assess these migration patterns accurately in order to arrive at conclusions without evaluating other causative factors.

4.13 The Growth of Private Enterprises

The KOISP is only one of the projects with its main objective of creating new employment in the project area. The appraisal report had formulated the objective to create employment

opportunities for 3,200 workers in the period of construction and in operation and maintenance activities after completion of the project.

However, according to the final assessment survey results only about 4.7 percent of the sample is employed in the state sector. (See Table 4.45).

Table 4.45 *Percentage of employed with main occupation of the head of the household by type of occupation and sex - KOISP Area*

Type of Occupation	Male	Female	Total
Agricultural Operator	89.4	52.6	86.2
Farm helper	1.5	34.2	4.3
Government employment	4.7	5.3	4.7
Private sector employment	0.5	2.6	0.7
Self-employment	0.7	0.0	0.7
Skilled employment	0.7	0.0	0.7
Agricultural laborer	1.2	5.3	1.6
Non-agricultural laborer	1.0	0.0	0.9
Foreign employment	0.2	0.0	0.2

Source: ARTI (1994). KOISP Final Evaluation Survey

Table 4.45 shows that 86 percent of settlers are engaged in agriculture related employment. This situation clearly shows that the creation of employment opportunities as envisaged in project activities has not been achieved successfully. Most NGOs who have actively participated in employment generation activities in the other parts of the island have not focussed their attention to the KOISP area (e.g. Janasakthi Bank. JTF etc). This may indicate that the project has not given full priority to achieve this goal. Efforts have been made only toward the development of the infrastructure in the project area.

The share of income from state sector employment in the total household income consists of 13.2 percent in the old area and 11 percent in the new area respectively. During the baseline survey period income from salaried employment amounted to 28 percent in the old area and 39 percent in the new area respectively. During the mid-project survey period, much income declined to 8 percent in the old area and 7 percent in the new area.

4.14 Private Sector Employment

According to the study on employment generation in the Kirindi Oya area (ARTI, 1987) a small number of settlers were engaged in state and private sector work. It revealed that in both areas only about 1.5 percent of the sample was engaged in state sector work but in the final assessment survey this percentage increased remarkably.

In the new area, the contribution of salaried employment towards the total household income is lower than in the old area. The settlers in the new area appear to have given more emphasis to develop their allotments rather than seek salaried employment. More labor is

needed not only for paddy cultivation but also for other field crops. It is clearly seen from Tables 4.33 and 4.37 that in the new area, the income derived from other field crops represents 8 percent of the total income while it was 3 percent in the old area. However, it must be noted that the production of other field crops has increased only during the final assessment survey period. According to the results of on-going studies the cultivation of other field crops in the KOISP area has failed in the earlier years due to lack of sufficient irrigation facilities. Further, the study of the Socio-Economic Status of Project Beneficiaries Settled under Phase II of the KOISP (W.G. Jayaratne, 1990, unpublished) indicated that at the time the project was initiated about 10 percent of the new area settlers who were earlier employed in the government private sector resigned from their jobs in order to get benefits from the KOISP. This led to adverse effects on the employment pattern in the area.

Educational attainment and employment opportunities have a very close link. However, before the project, facilities for higher education seemed unsatisfactory in the new area. In contrast during the same period educational facilities were very good in the old area. Those who have passed the GCE(OL) among the male and female population in the old area amount to 10 percent and 16 percent respectively. In the new area it adds up to only about 10 percent and 12 percent. Similarly, in the old area 7 percent males and 12 percent females have attained a higher education level, but in the new area the higher education level represents a very low percentage. In this area those who have attained a higher education level, both males and females comprise only about 3 percent and 5 percent of the population respectively. This may be a cause for the prevailing low employment level in the new area.

According to the final evaluation survey results, employment in the private sector was remarkably lower than in the state sector. Private sector employment in the old area and in the new area accounted for nearly 7 percent and 5 percent respectively. Female employment in the private sector is higher than males in the old area (4 percent and 14 percent respectively). In the new area the male population employed in the private sector accounted for 4 percent while 9 percent was female.

During the mid-year evaluation survey period, self-employment in the sample accounted for 4 percent and 3 percent, in the old area and in the new area respectively. The final evaluation survey results showed a drop in the percentage to 2 percent in the new area and 4 percent in the old area.

4.15 Employment and Income Generation

Income generated by the private sector employment is not according to project expectations. The relevant information is given in Tables 4.33 and 4.37. These data revealed that the income derived from private sector employment accounted for 8 percent and 4 percent in the old area and the new area. In the same period the government policy has focussed on the creation of self-employment through its poverty alleviation program. To achieve this objective credit facilities continued to be extended under a loan scheme for income generating activities. Based on observation it seemed that the impact of this strategy has flowed into the old area rather than into the new area.

When generalizing the income pattern prevailing in the area, income from paddy cultivation still occupies a dominant place. It accounts for about 33 percent and 27 percent in the old area and the new area respectively. However compared with the mid-year evaluation survey period there appears to be a decreasing trend. In the mid-year evaluation survey period, it amounted to 74 percent in the old area and 29 percent in the new area. While the income from paddy cultivation declined other variables related to the household income showed an increasing trend during the past few years. Here again the percentage of income from the private sector in the new area is lower than what the mid-year evaluation survey results show. During the mid-year evaluation period, it was 7 percent of the total household income. This clearly shows that the development of the private sector in the new area is not significant.

In contrast, income generated from self-employment is higher than that derived from private sector employment in the old area. In the old area it has increased from 3 percent in the mid-year survey period to 18 percent in the final evaluation survey period. But it has gradually decreased in the new area from 7 percent to 5 percent in the same period. This shows that upon completion of the project the income generated from the private sector employment has increased significantly in the old area while in the new area it has slightly decreased.

4.16 Summary and Conclusions

The major objective of this study was to describe the benchmark socio-economic situation in the KOISP in terms of demography, housing and sanitation, household durables, employment, household income, labor migration, private sector enterprises, employment and income generation.

(a) The study area is comprised of two major irrigated sub-systems of the KOISP. The main sub-systems are new area and old area of the project in terms of their original conditions. The 479 farm household units were randomly selected for the present study and can be divided into two categories namely old and new areas. The distribution of the sample is 14 hamlets in Right Bank and 8 hamlet in Left Bank and five tanks, namely Weerawila, Pannagamuwa, Tissa, Debarawewa and Yodawewa. The old areas have an assured supply of irrigation water during both yala and maha seasons.

(b) The sample represented 6 percent of the total farm households of the KOISP and was randomly selected in each hamlet. Each selected household was interviewed by trained investigators under the supervision of ARTI, IIMI and University of Ruhuna researchers. The information and data gathered from the interviews have been used as a benchmark survey to monitor changes.

(c) The settlers of the KOISP are a relatively homogeneous group as they have come from one region of the country. The region of their origin did not differ ethnically, geographically, agriculturally, environmentally and socio-culturally. The administrative districts where the majority of settlers came from were Galle, Matara and Hambantota. The population of people in the age group of 15-25 comprises of 21 percent of the enumerated population. Children below 14 years account for 34 percent while people over 65 years are 5 percent of the population. The average family size is 5.5. The ethnic composition comprises of 98 Sinhalese and 2 percent of Tamil and Muslim families. The

average literacy rate is 95 percent with a higher proportion of literate people in the old area. The proportion of people with primary education ranges from 25-50 percent while the proportion with education up to G.C.E.(Ordinary Level) ranges from 4-30 percent. The labor force amounts to 60 percent of the total population. The main types of employment in the area are Agriculture Operator (42 percent), Farm Helper (32 percent), Agriculture laborer (2 percent), Government Employment (6 percent) and others (16 percent).

(d) The project area is characterized by the presence of a large proportion of small houses. A large segment of the households has a floor area of between 250-500 square feet (39 percent). 31 percent of the houses are permanent and 69 percent of the houses are semi-permanent.

(e) The water supplies for drinking water in the KOISP developed to a satisfactory level during the period 1981 to 1994. Nearly 80 percent of the households in the KOISP area has obtained drinking water from the their own wells or pipes. 95 percent of the households has toilets facilities.

(f) A large number of durable household items were also observed in the project area and the old area farmers are relatively richer than new area farmers in terms of income.

(g) The income disparity among new area settlers is less than in the old area. The new area shows a lower average household income of Rs. 3,006/month versus Rs. 5,566/month in the old area. Further, it appeared that most of the settlers in the new area belonged to the low income and middle income groups, that is below Rs. 3000/=, and that the majority of farmers in the old area fell in the high income group, that is above Rs. 3000/=. In both the old area and the new area, paddy was found to be the most important source of income, while the other sources of income such as salaried employment, both in government and non-government sectors, were found to have little effect on their income level.

(h) Monthly expenditure on food and non-food items by income class show a disparity between old area farmers and new area settlers. In both areas, low income and middle income class people spent nearly double their monthly income on food and non-food items. Monthly food stamps and *Janasaviya* aid had little influence on the expenditure pattern of old area farmers. However, around 35 percent of the low income group settlers of the new area are still dependent on food stamps and other aid.

(i) The status of employment generation activities outside agriculture such as agro-processing industry, animal husbandry, handicraft industry and carpentry is poor. However, the rice milling industry in the area has shown a considerable improvement. The trend of growth of private enterprises seems to be very low in the project area as only 6.5 percent are active in the private sector.

Annex 4.1 Sampling Frame and Survey Procedure for KOISP Impact Evaluation Study

Periods of Survey	-	June-July 1994
Reference period	-	1992/93 Crop Year 1993 Yala
Basic Unit of Survey	-	Household
Sampling Design	-	Stratified simple random sampling design. The project area was divided into two strata.

(a) Newly Irrigated Area (NIA)
(b) Old Irrigated Area (OIA)

NIA - The 22 hamlets from both right and left banks formed the sub-strata.

OIA - Five tanks of OIA (Tissawewa, Weerawila Wewa, Pannegamuwa, Yodawewa and Debarawewa) were grouped together and this formed one sub-strata.

Sample Size

NIA - Around 10-18 households were selected from each of the 22 hamlets giving a total sample size of 300 households.

OIA - 179 households were selected from the sub-strata comprising of the tank areas of Tissa, Weerawila, Debarawewa, Pannagamuwa and Yodawewa.

In Summary

Area	No.of households in Sample	Total Population of the Sample
NIA	300	4,994
OIA	179	2,985

The survey was intended to provide general and basic information pertaining to the project area. In order to narrow the focus and obtain more in-depth information the sample size was kept around 500 in the survey.

Method of Data Collection	I)	At household level interviews using a structured questionnaire.
	II)	Hamlet level through interviews of key personnel in each hamlet/village, eg.C.O., Village Leader.
	III)	Project level information from several line Ministry Departments and KOISP Project officers through interviews and records.
Type of Data Collected for-Socio-Economic Sector		From household level-population, housing particulars, general household particulars, sanitary conditions, agricultural production livestock farming, employments and income, labor migration and expensive pattern.

Annex 4.2 List of Socio-Economic Indicators

1 The Masculinity ratio: The number of males per 100 females.

2 Age Dependency Ratio

$$= \frac{\text{Age group (0-14) + Age group 65 \& over}}{\text{Age group (15-14)}}$$

3 Employment and unemployment indicators.

I

Activity					
Economically active		Economically Inactive			
(A)	(B)	(C)	(D)	(E)	(F)
Employed (including unpaid family workers)	Unemployed (including those without gainful employment in at least 15 days within 3 months prior to survey	House wives	Students	Discouraged workers (those not looking for employment)	Others (including retired, disabled, those too young or too old to work)

II

1. Crude Activity Rate (%) $= \frac{(a) + (b)}{\text{Total in the sample}} \times 100$

2. Net Activity Rate (%) $= \frac{(a) + (b)}{\text{15-64 years old in the sample}} \times 100$

3. Economic Dependency Ratio (%) $= \frac{(b) + (c) + (d) + (e) + (f)}{\text{Total employed (A)}} \times 100$

4 The following criterion has been used to measure overcrowding on the basis of "a minimum floor area per person".

Floor area (Sq.ft)	If no. of occupants exceed
100	2
100 - 250	4
250 - 500	6
500 - 1000	8

Source: Economic and Social Commission for Asia and the Pacific (*United Nations*)(ESCAP) population of Ceylon. P:295.

5 Other Indicators

1. Literacy Rate.
2 Average family size.
3. No of settlers living in good house.
4. No of settlers with access to good quality and adequate drinking water.
5. No of settlers with adequate sanitation.
6. No of settlers with durables household items.
7. No of school going population and no of children educated.
8. Income trends.
9. Saving amounts and trend.
10. Expenditure patterns.

CHAPTER 5

CROP PRODUCTION

5.1 Introduction

The KOISP objectives granted significant attention to develop the agricultural sector in the area. The main agricultural objectives were:

(a) Development of 8,300 ha. of new land (new area).
(b) Increase the cropping intensity of the new area from 20 percent to 170 percent.
(c) Improvement of the irrigation system for 4,300 ha. of the existing old system (old area).
(d) Increase the cropping intensity in the old area from 140 percent to 170 percent.
(e) Incremental paddy and Other Field Crops (OFCs) production by 44,000 mt. and 11,400 mt., respectively.
(f) Generation of agricultural employment.
(g) Providing agricultural support services such as input supply, extension, training, research, credit, marketing, and processing.

After the completion of the project, this impact evaluation study has been carried out to estimate to what extent the project has achieved its agricultural objectives.

5.2 Methodology

The initial discussions pertaining to the KOISP impact evaluation were held at SLFO-IIMI, Colombo during the latter part of 1993. The team of researchers made indepth discussions on project objectives, evaluation criteria, planning and execution of the investigation, time schedule, etc. Two B.Sc. (Agri) graduates were recruited as field investigators. They participated in a three day workshop organized by the Agrarian Research and Training Institute (ARTI). Further, one day workshop was held at the Weerawila training center. The forum consisted of officials of different institutes such as the Department of Agriculture, Department of Irrigation, IIMI, ARTI, who were involved in the KOISP, and of researchers and investigators. Later, an orientation program was executed for the investigators. This study utilized the ARTI large sample as sampling frame out of which 150 farmers were randomly drawn. After the survey two farmers had to be eliminated due to insufficient data. Hence, the final sample consisted of farmers of the Left Bank (32), the Right Bank (62), and the old system (54). A questionnaire has been developed and prior to the survey pre-testing was done. Based on the information acquired through pre-testing relevant modifications were made. The field investigation has been carried out from June to August 1994 and each investigator was able to complete 3 to 4 questionnaires per day. The researchers monitored the field investigation, brief discussions were held in the field. The research team discussed the progress, problems and further events in monthly intervals.

5.3 Crop Production Prior to the Project

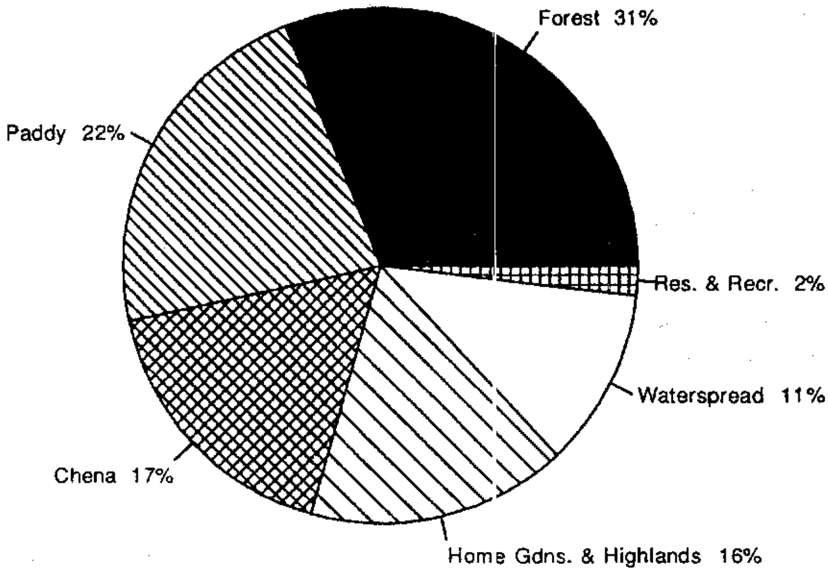
5.3.1 Land Utilization

Historical evidence shows that the project area was regarded as one of the main centers of agricultural production in the island. The agricultural activities were mostly based on irrigated farming. A well established tank irrigation system supplied water to the area. Among the ancient reservoirs, the Tissa wewa, Yoda wewa, Debarawewa, Weerawila wewa and Pannegamuwa wewa were considered to be the major water storages. Many other tanks were abandoned. In fact, the above tanks were resorted during the latter part of the British administration (ADB, 1977). The main water source for these tanks was the Kirindi Oya. The famous Ellegala Anicut constructed by the British in 1876 can be regarded as the water distribution center for the tanks. The Left Bank canal of the anicut supplied water to the Tissa wewa, Yoda wewa, and Debara wewa which have a combined storage capacity of 10,650 acre feet. The Right Bank canal send water to Pannegamuwa wewa and Weerawila wewa which have a combined storage capacity of 12,700 acre feet.

Nearly one-half of the households received a greater part of the family income through farming. The traditional land utilization pattern consisted of five major types: (a) forest and uncultivated land, (b) irrigated rice land, (c) homegardens and highlands, (d) *chena* plots and (e) land for residential, commercial and recreational purposes (Wanasinghe et al., 1984). The land use pattern of the pre-project period is illustrated in Figure 5.1.

Rice was the major crop on irrigated lowlands an estimated 4,000 ha. was confined to this crop. The rice was grown in two seasons: maha (wet) and yala (dry). These two seasons follow the rainfall pattern of the area. Maha falls from October to March (North-East monsoon) and yala from April to September (South-West monsoon). During the maha season almost all *asweddumised* rice lands were cultivated while during yala season cultivation was limited to the irrigation schemes in the area. Cultivation under minor irrigation systems and rainfed conditions often encountered crop failures due to water stress. The cropping intensity for lowland was about 121 percent. The cropping intensity of irrigated and unirrigated areas implied a marked difference, namely 152 percent and 65 percent, respectively (Wanasinghe, et al., 1984). As considerable lowland area was left fallow during the yala season, the total rice production had declined by 50 percent when compared with the production of the maha season. However, the average yield for both seasons have recorded a similar figure of around 2,500 kg/ha. Shifting cultivation (*chena*) was extensively practiced on unirrigable highlands and on a considerable portion of encroached crown lands. 44 percent of the agricultural land was used for rice, 16 percent for *chena*, 14 percent for homesteads and 26 percent were highlands (other than *chena*) (Wanasinghe, et al., 1984). The ADB Appraisal Report (1977) has provided the land utilization pattern within the rice sub-sector of the project area (Table 5.1). This shows that a significant share of the rice cultivation was confined to the major irrigation systems of the project area.

Figure 5.1 *Land utilization pattern in the pre-project period*



Source: Wanasinghe et al, 1984

Table 5.1 *Paddy land distribution pattern in the pre-project period*

Region	Method of Irrigation					
	Major Irrigation		Minor Irrigation and Rainfed		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Project area	4,250	80.7	1,020	19.3	5,270	100
Project area of Hambantota AGA Division	890	75.3	330	26.7	1,220	100
Project area of Kirindi Oya	3,360	95.9	140	4.1	3,500	100
Project area in outer periphery of irrigation region			550	100	550	100

Source: ADB Appraisal Report, 1977

5.3.2 Farming Systems

The farming systems in the area were mainly determined by the types of land and availability of water. Seasonal differences in farming systems were observed due to differences in water availability. Under irrigated conditions, lowland rice cultivation was given priority. Farmers were inclined to cultivate rice lands in both seasons. On the highlands, where irrigation facilities were not available rainfed farming was practised. The rainfed farming can be grouped into two types of farming systems: the first one was a method of shifting cultivation known as *chena* cultivation which concentrated on annual crops. The second one was the cultivation of perennials and annuals on permanent highland plots and homesteads. Table 5.2 shows the variation in farming systems during the pre-project period, maha season 1979-1980. It demonstrates that during the pre-project period 40 percent of the farms were confined to a single-component farm category: highland, whereas only 27 percent of the farmers had two components: lowland and highland.

Table 5.2 Variation in farming systems in the pre-project period, maha 1979-1980

Farm Category	Average Area per Farm (ha.)	Percentage of Farms
Single-component farms		
Confined to lowland	1.23	5.76
Confined to highland	0.59	40.38
Confined to *chena*	1.19	16.07
Two-component farms		
Lowland and highland	1.68	27.06
Lowland and *chena*	2.00	3.21
Three-component farms		
Lowland, highland and *chena*	2.48	7.52

Source: ADB Appraisal Report, 1977

The chena cultivation was confined to the north and north-eastern regions of the project area. Jungle lands suitable for shifting cultivation were available in these areas. The chena cultivation was mostly limited to the maha season. It was observed that chena cultivation was practised by the farmers in the unirrigated area as they could not grow rice due to insufficient water supply. Further, data suggested that limited opportunities for rice cultivation have forced farmers to operate chena. Hence, chena cultivation and rice farming were, in fact, complementing but not competitive. A variety of crops were grown in chenas. Among them, gingerly (*Sesum indicum*), chillies (*Capsicum annum*), ground nut (*Arachis hypogeae*), and other pulses (*Vigna spp.*), kurakkan (*Elucena corocana*), sorghum (*Sorghum vulgari*), cotton (*Gossypium herbaceum*), cassava (*Manihot utilicema*), and vegetables such as pumpkins (*Cucurbita maxima*), snake gourds (*Trichosanthes cucumerina*), bitter gourds (*Momordica charantia*), okra (*Hibiscus esculenta*), tomatoes

(*Lycoposium esculantum*), *brinjals* (*Solanum melongena*), were prominent. Mixed cropping was often a common feature of this farming system. Generally, the cycle of chena cultivation was 4 to 5 years but in some instances, the fallow period was extended to 10 or 15 years to maintain the soil fertility. Though a considerable quantum of food crops were grown under shifting cultivation, farmers often encountered problems pertaining to markets and low prices. There was a glut in the market during the harvesting periods. Frequently, vegetables are subject to this condition as they are perishable. The other chena crops can be stored for a considerable period, therefore farmers used to avoid immediate sale. This situation can only be practised when cash-in-flow to the farm budget was not so important after the harvesting period. Often this was not the case and farmers had to sell their products to repay their debts.

The highland cultivation was practiced in homesteads and other upland plots. A range of crops such as coconuts (*Cocos nucifera*), *jak* (*Artocarpus heterophillus*), mango (*Mangifera indica*), gingerly (*Sesum indicum*), chillies (*Capsicum annum*), pulses (*Vigna spp.*), were cultivated mostly under rainfed conditions. Only 50 percent of the highland area was utilized. Agricultural productivity was very low due to water stress and ineffective management practices. Generally, the highland cultivation satisfied food requirements of the family, a very little quantum of the output was sent to the market.

5.3.3 Technology Adoption

As the project area was basically a rice-growing area, different institutes took initiatives to introduce innovations to the rice culture during the pre-project period. The data suggest that most of the farmers cultivated for a period of 4 to 4½ months High Yielding Varieties (HYVs). Land preparation activities were done by manual labor, buffaloes, two-wheeled tractors or four wheeled tractors. The use of agro-chemicals and fertilizers was below the recommended quantities and transplanting as a method of plant establishment was not popular in the area. Further, water control practices were inadequate as large amounts of water were wasted, especially because rice fields were allowed free-flowing. As a result, water short conditions occurred in the dry spells (ADB, 1977). The farmers' yields ranged between 1,820 kg/ha (35 bu/ac) and 2,860 kg/ha (55 bu/ac) depending on the cultural practices adopted and inputs used. However, irrigated areas have received higher yields. The highland and chena cultivation were practised mostly using traditional methods, external inputs were rarely used. Yet, the majority of the farmers considered chena cultivation as a more dependable farming system over irrigated agriculture.

The data demonstrate that adoption rates of technologies were higher in irrigated areas as compared to the unirrigated areas. Table 5.3 illustrates the adoption rate of selected innovations (Wanasinghe, et al., 1984). It shows that among the improved practices, HYVs, fertilizer, agro-chemicals and tractors for land preparation have captured farmers attention.

Table 5.3 Technology adoption during the pre-project period

Improved Practices	Irrigated Area % of Farmers		Unirrigated Area % of Farmers		Entire Sample % of Farmers	
	Maha	Yala	Maha	Yala	Maha	Yala
Use of high yielding varieties	91	93	56	93	78	93
Land preparation by tractors	89	96	80	86	86	93
Transplanting (random)	22	11	05	02	16	09
Transplanting and sowing in rows	01	01	00	00	01	01
Application of fertilizer	97	96	88	93	94	95
Application of three doses fertilizer	54	66	47	61	51	64
Chemical weed control	84	92	78	82	82	89
Manual weed control	13	04	12	02	12	04
Pest control	85	93	81	89	84	91

Source: Wanasinghe et al., 1984

5.4 Crop Production: The Existing Situation

5.4.1 Rice Cultivation

The command area of the project can be divided into two main segments as Ellegala System (old area) and the new area. The Ellegala System which receives water through the tank irrigation system, diverted from the Ellegala anicut after the implementation of the project. Farmers in this area receive sufficient water for both seasons and most of them grow rice. The new area came into operation with the implementation of the project and efforts were made to provide irrigation facilities through a network of canals. However, farmers in this area often experienced conditions of water shortage for their cultivation, especially for the rice crop.

The study investigated the status of rice production in old and new areas. Table 5.4 demonstrates the total production, average yield and number of rice cultivators during the past three seasons in new and old areas. It is shown that the majority of the farmers in the new area (Right and Left Bank) grew their rice crop only in the maha season. Yala rice cultivation was insignificant. In contrast, farmers in the old area have enjoyed the cultivation of this staple crop in both seasons although the number of paddy growers has declined to 69 percent in yala season. The average yields of old and new areas is estimated to be 3706 kg/ha and 3649 kg/ha, respectively for the maha season 1993-1994. Therefore, there is no evidence of any yield difference pertaining to the two main segments of the project.

The average yields of the yala season cannot be compared as very few farmers cultivated rice in the new area. Farmers in the old area have obtained an average paddy yield over 3000 kg/ha even during the yala season. The major constraint which limits rice cultivation in yala season in the new area is insufficient supply of irrigation water.

Table 5.4 *Status of rice cultivation*

Segment		92/93 Maha Season Production		% of Farmers	93 Yala Season Production		% of Farmers	93/94 Maha Season Production		% of Farmers
		Total (kg)	Average (kg/ha)		Total (kg)	Average (kg/ha)		Total (kg)	Average (kg/ha)	
New Area	Right Bank	203,459	3,839	85	4,620	4,620	2	193,386	3,649	85
	Left Bank	78,567	3,741	66	9,130	4,565	6	15,675	3,135	16
Old Area		196,218	3,847	94	121,440	3,282	69	181,588	3,706	91

The following case illustrates this situation (Vignette 5.1).

Vignette 5.1 : A comment of a group of farmers in the new area

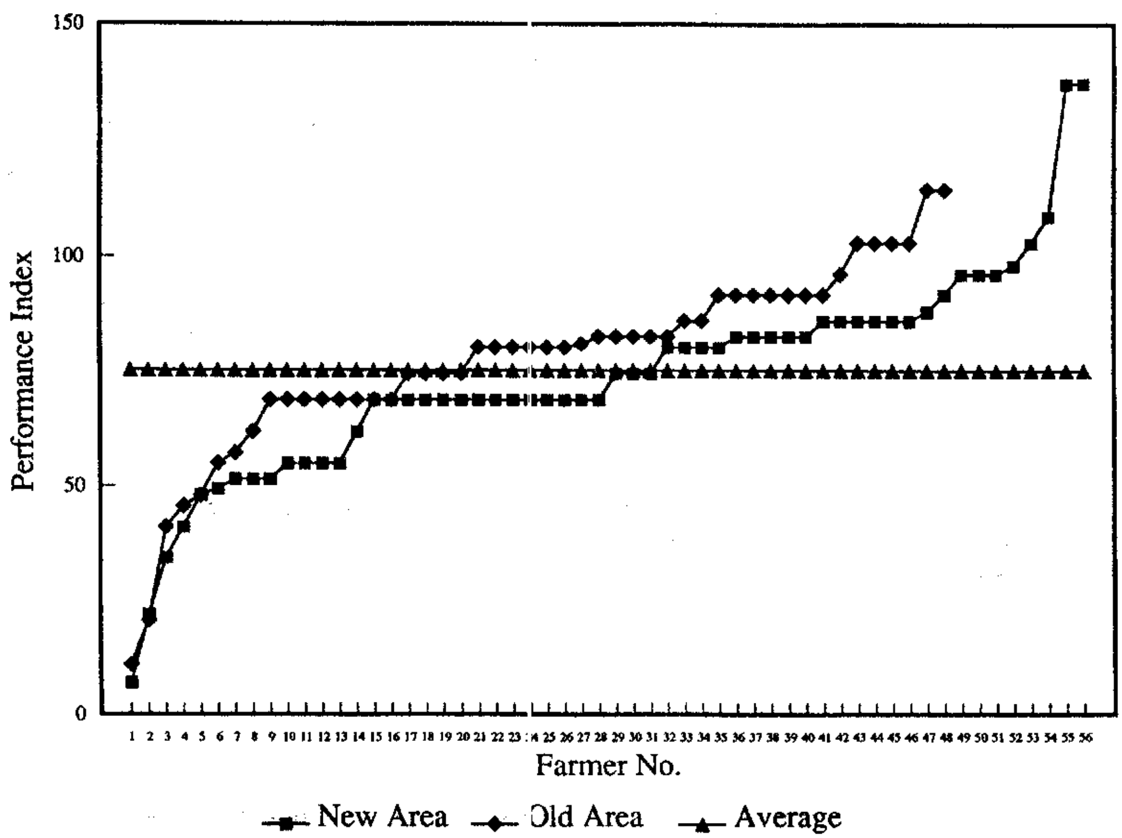
Often we cultivate only one season. Main problem is lack of water. We do not receive sufficient irrigation water and most instances, we suffer from *acute water deficit* condition during yala season. Some farmers used to obtain excess water by unauthorized means, therefore, though water was issued, water distribution is not controlled. During the water issues, disparities were experienced due to location of the field (tail end),location of the field canal, irregularities of the pole, etc. Some farmers inclined to grow OFCs to save water. However, some farmers disinclined to grow OFCs and always request water to grow rice mainly because they could only lease their fields for rice cultivation.Hence, collective decisions can not be taken.We experience frequent elephant and cattle damages during the cultivation season. Further, as elephants used to damage our store ho-uses, we have to sell the products immediately after the harvest though the price is low.Salinity problem is also caused problem,especially in the low-line areas. As a result of all such adverse consequences, we receive a marginal income which is significantly insufficient to sustain our families.We cannot save and in many instances, we live with debts. In all, life in the new area is not attractive.

The study identified the main cropping systems in the lowlands of the old area as (a) maha rice cultivation followed by yala rice cultivation and (b) maha rice cultivation followed by Other Field Crops. However, the second cropping system is not prominent. The major lowland cropping system of the new area is maha rice cultivation followed by a yala fallow period. Further, cropping systems such as maha rice cultivation followed by yala OFCs and maha rice cultivation followed by yala OFCs under shallow wells are also found. The cultivation of OFCs was introduced in 1987/1988 maha season as a remedial measure to overcome the water problem but the sustainability of this solution can not be assessed as yet.

5.4.2 Farmer Performance Index

A farmer performance index was defined as the ratio of farmer yield to the location specific yield potential (Pingali, et al., 1990). This indicates the extent to which the farmer has been able to exploit the yield potential. If the performance index is less than 100 percent, the farmer faces an unexploited yield potential. In fact, the farmer performance index is a measure of the farmer's technical efficiency. It has been reported that potential paddy yields in the area approximate 4,800 kg/ha. The performance index has been calculated separately for farmers in the new and in the old areas. Figure 5.2 illustrates the distribution of farmers' achievements on the performance index. On average farmers have exploited 75.1 percent (average yield is 3,605 kg/ha) of the yield potential. Data suggest that only 7 percent of the farmers in the new area and 13 percent of the farmers in the old area were able to reap the yield potential.

Figure 5.2 Farmer performance index for new and old systems



5.4.3 Cultivation of Other Field Crops

The KOISP has planned to cultivate rice and Other Field Crops. It was envisaged to grow rice in poorly drained soils and OFCs in well and moderately drained soils during the maha season. In the yala season OFCs should be introduced to 50 percent of the lowland area. This cropping pattern was suggested to solve the water shortage in the area. Table 5.5 presents the distribution of OFCs cultivation as well as rice cultivation during the past seasons.

Table 5.5 indicates that although farmers were encouraged to grow OFCs during the yala season, the trend is not encouraging. The maha season 1993/1994 has recorded 1,491 ha. of cultivation of OFCs. In certain maha seasons farmers were inclined to grow OFCs (for example maha 1990/1992) probably due to water deficit conditions experienced in lowland areas. The cultivation extent of OFCs in the project area shows a fluctuated pattern over the last five years. During the last three seasons it shows a more stable situation.

Table 5.5 Cultivation of other field crops and rice (ha.)

Crops	88/89 Maha	89 Yala	89/90 Maha	90 Yala	90/91 Maha	91 Yala	91/92 Maha	92 Yala	92/93 Maha	93 Yala	93/94 Maha
Chili	44.0	15.0	29.0	16.0	42.0	108.0	115.0	17.0	136.0	16.0	73.0
Green Gram	106.0	2.0	18.0	19.0	1,200.0	18.0	742.0	61.0	766.0	763.0	860.0
Cow Pea	75.0		52.0	47.0	360.0	11.0	210.0	7.0	180.0	24.8	33.0
Ground nut	30.0	0.5	87.0	104.0	95.0	42.0	125.0	2.0	191.0	189.0	347.0
Maize	41.0						11.0				
Gingerly	7.0		3.0				12.0	36.0			
Onion		0.2	4.5	1.5	2.0	15.0	11.0	19.0	6.0	9.0	19.0
Vegetables		49.0	16.0	60.0	48.0	44.0	80.0	66.0	116.0	118.0	159.0
Total	303.0	67.4	209.5	247.5	1,747.0	238.0	1,306.0	208.0	1,395.0	1,119.8	1,491.0
Paddy	7,253.0	5,953.0	5,910.0	4,370.0	6,195.0	4,436.0	9,007.0	1,070.0	8,501.0	2,970.0	8,125.0

5.4.4 Crop Diversification in Rice Fields

As farmers encountered the problem of water, the project management introduced OFCs to lowland areas as a remedial measure. Table 5.6 illustrates the cropping system in lowlands with respect to different areas.

Table 5.6 Status of crop diversification in lowlands

Domain	Maha Season 1993/1994			Yala Season 1993		
	Rice	OFC	Rice and OFC	Rice	OFC	Rice and OFC
New Area						
Right Bank	80.6		11.3	1.6	4.8	3.2
Left Bank	50	12.5	15.6	3.1	3.1	
Old Area	90.7			63.0	1.9	3.7

Table 5.6 demonstrates that the majority of the farmers in the old area limited themselves to rice cultivation in both seasons (90.7 percent in maha and 63 percent in yala).

On average, 65 percent of the farmers in the new area (Right Bank 80.6 percent, Left Bank 50 percent) have cultivated rice in the maha season. Some farmers have practiced the combination of rice and OFCs in the same season (Right Bank 11.3 percent, Left Bank 15.6 percent). In the yala season, very few farmers were able to cultivate rice as well as OFCs in the new area.

The above data suggest that crop diversification has occurred only in a marginal form. Case studies indicate that farmers prefer rice cultivation but sometimes are compelled to take the decision to diversify their crops. Further, approximately 92 percent of the farmers in the new area and 31 percent of the farmers in the old area have abandoned their fields altogether during the yala season.

5.4.5 Cropping Intensity

The study calculated the cropping intensity for lowlands and highlands. Table 5.7 demonstrates the results. At the inception of the project, it was expected to increase the cropping intensity from 140 percent to 170 percent in the old area. It is reported that the cropping intensity of the lowlands has increased to 163 percent which is a significant achievement. In contrast, the cropping intensity of the highland area was limited to only 65 percent. This shows that crops introduced to highlands, especially, OFCs were not well incorporated into the farming system.

The cropping intensity of the new area was expected to increase from 70 percent to 170 percent. This objective was not achieved satisfactorily. The lowlands of the Right and Left Banks of the new area have recorded cropping intensities of 98 percent and 48 percent, respectively. Further, the estimated cropping intensity of the highlands of the same domains is rather low: 60 percent and 42 percent. These data too, indicate that highland cultivation has encountered limitations.

Table 5.7 *Cropping intensity of different domains*

Domain	Lowlands (%)	Highlands (%)
New Area		
Right Bank	97.8	60.4
Left Bank	48.0	41.9
Old Area	163.0	65.1

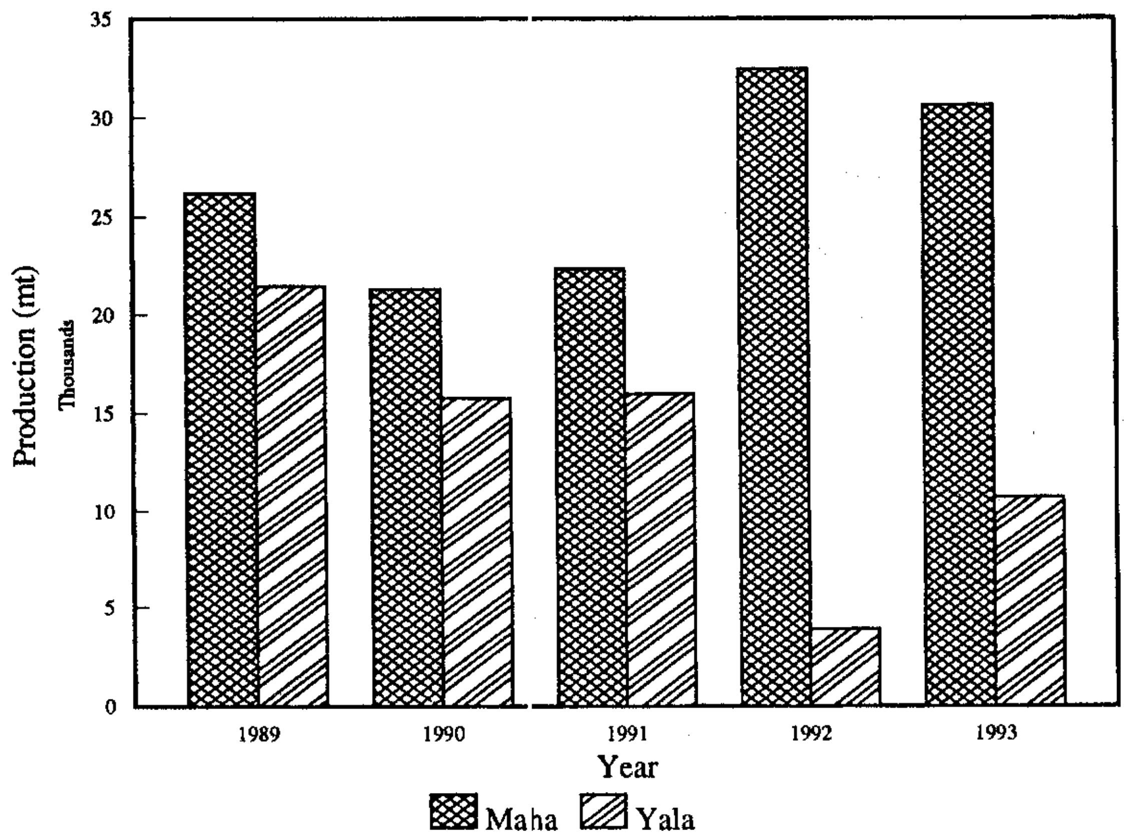
5.4.6 Chena Cultivation

The chena cultivation is practised mostly in crown lands. A variety of crops such as maize, chillies, cowpea, gingerly, kurakkan, green gram, onion and vegetables are grown under rainfed conditions. Approximately, 20 percent of the farmers reported that they practise chena cultivation. the majority of the farmers exploit plots in the category of 0.8 to 2 ha. The fallow period has been reduced to 1 to 2 years. Some farmers now utilize the same plot continuously converting the shifting cultivation into a permanent farming system. Mostly a mixed cropping system is implemented and external inputs such as fertilizers, insecticides and weedicides are only marginally used. Therefore, the cost of production is not very high. A considerable quantum of grains, pulses, and vegetables are produced through this farming system, but often the farmers encounter marketing problems, which causes insufficient farm income. Further, the cultivations are frequently damaged by wild animals. Also it seems that institutional services (credit, extension, research, etc.) have not oriented towards this farming system. Finally, it has to be mentioned that more and more land is encroached by farmers for chena cultivation, especially the reserved land, which has negative consequences for the environment.

5.4.7 Total Production

The investigation reveals a fluctuating pattern for paddy cultivation during the past seasons. Maha production was higher than the yala production in all the years. In certain years yala production has significantly decreased whereas maha production showed a relatively stable situation. The project initially expected an annual incremental paddy production of 44,000 mt. At present the annual paddy production amounts to 41,000 mt (1993). (Figure 5.3). The uneven pattern of the annual total production is mainly due to the fluctuating paddy area in yala seasons. The cultivated area in the old system was generally constant (3,500-3,800 ha.) for both seasons (except 1992 yala). But the extent under paddy cultivation in the new area showed a marked variation ranging from 0 to 1,616 ha. in previous yala seasons. Moreover, even in maha seasons, the paddy area in the new system varied. As an example, in maha 1986/1987 the new area has recorded only 587 ha. of paddy extent while in maha 1991/1992 the paddy extent had increased to 4,562 ha.

Figure 5.3   Paddy production trend 1989-1993



The project expected an annual output of 11,400 mt of OFCs. The cultivation extent of OFCs showed a significant variation from 67 ha. (yala 1989) to 1,747 ha. (maha 1990/1991). Yala OFCs cultivation in the area was comparatively low and most of the farmers totally abandoned their fields in yala mainly due to water shortage. However, during the past three seasons OFCs occupied an extent of over 1,000 ha. (maha 1992/1993 - 1,395 ha.; yala 1993 - 1,120 ha.; maha 1993/1994 - 1,491 ha.). This, can be considered as a relatively stable situation. Nevertheless, the annual OFCs production (maha 1992/1993 and yala 1993) amounted to only 2,800 mt. This satisfies only 25 percent of the projected production target.

5.5 Farm Budget

5.5.1 Cost of Rice Cultivation

The average cost of rice production in the area is estimated as to Rs. 22,823.39 per ha. Table 5.8 provides the cost break down according to the main cost components. Based on the farm gate price of paddy (Rs.7.50 per kg) and the average yields of the sample (3,605 kg/ha) the farm income has been calculated. The net income of rice production comes to only Rs. 4,214.11 per ha. As the farmers receive this net revenue for an approximate spell of six months, their monthly net income is as low as Rs. 702.35 per ha. Hence, it appears that rice production is not very attractive in terms of economic returns and further, it makes only a marginal contribution to the family budget.

Table 5.8 *Cost of production in rice cultivation, maha season, 1993/1994*

Cost Component	Cost		Percentage
Input cost			
Seed paddy	2,365.70		10.4%
Fertilizers	3,863.55		16.9%
Weedicides	1,322.75		5.8%
Pesticides	1,286.78		5.6%
Sub total		8,838.78	38.7%
Labor cost	367.83		1.6%
Ploughing	2,105.43		9.2%
Preparing bunds	1,358.53		6.0%
Sowing/replanting	397.87		1.7%
Fertilizing	241.86		1.1%
Weeding	385.89		1.7%
Refilling	310.08		1.4%
Controlling pests and diseases	2,712.02		11.9%
Harvesting	2,155.04		9.4%
Threshing			
		10,034.55	44.0%
Sub total			
Cost of machinery and fuel			
Ploughing	3,537.11		15.5%
Controlling pests and diseases	59.15		0.3%
Transporting	353.80		1.6%
Sub total		3,950.06	17.3%
Total cost			
Yield (kg/ha)	3,605.00		
Price (Rs./kg)	7.50		
Income		27,037.50	
Net Profit		4,214.11	

As the net income rests on costs and returns, it is worthwhile to analyze the cost structure. Table 5.8 demonstrates that 44 percent of the cost of production was spent on labor wages. Harvesting and land preparation activities have claimed 21 percent and 26 percent of the cost of production, respectively. Further, 39 percent of the total cost was spent on inputs out of which approximately 17 percent is claimed by fertilizers. The above data indicate that rising costs of production are mainly due to labor and input costs.

The average yield is 3,605 kg/ha, which can be regarded as a satisfactory achievement. However, farm gate prices received (Rs. 7.50 per kg) at the harvesting season are not reasonable since during the off season the price is increased even up to Rs. 11.00 per kg. Therefore, it is worthwhile to launch strategies to reduce the cost of production and also to stabilize farm gate prices at a reasonable level.

5.5.2 Cost of OFC Cultivation

The study reveals that among the OFCs grown in the area, three crops namely, green gram, cowpea and ground nut are the most important. The study demonstrates that few farmers confined themselves to mono cropping of OFCs. Table 5.9 presents the cost break down of the three OFCs separately. The average yields of these crops in the area were below the potential yields. Cowpea and ground nut cultivation indicate net losses. However, green gram cultivation has produced a profit of Rs. 24,381.25 per ha. As the majority of OFCs cultivators practised mixed cropping, the cost of production has been calculated on the basis of a typical farm with three crops. Table 5.10 illustrates the cost break-down of the mixed cropping system. It has to be mentioned that farmers have applied inputs to the entire plot, hence it is difficult to obtain the fractions of inputs used for each crop. The data suggest that in the mixed cropping system OFCs have yielded a net profit of Rs. 5,987.62 per ha. It can be concluded that mixed cropping systems have given better results than the mono cropping systems of OFCs. It is evident that many factors have resulted in the low yields and the low income from OFCs. Table 5.11 illustrates the major constraints encountered by OFCs farmers.

Table 5.9 *Cost of production of green gram, cowpea and groundnut cultivation*

Cost Component	Greengram	Cowpea	Groundnut
Input cost			
Seeds	750.00	1,500.00	1,500.00
Fertilizers			
Weedicides			
Pesticides		1,000.00	1,200.00
Labor cost			
Land preparation	125.00	5,000.00	6,000.00
Sowing and replanting	2,500.00	2,000.00	3,000.00
Fertilizer			
Weeding		2,000.00	3,000.00
Pest and disease control	450.00	400.00	125.00
Harvesting	2,125.00	6,000.00	3,600.00
Drying and packing	2,000.00	3,000.00	600.00
Machinery and fuel cost			
Land preparation	3,500.0	100.00	
Pest and disease control	150.00		
Transport			
Total cost	*11,600.00*	*21,000.00*	*19,025.00*
Yield (kg/ha)	1,439.25	1,145.50	773.30
Price (Rs./kg)	25.00	18.00	22.00
Income	*35,981.00*	*20,619.00*	*17,012.00*
Net Income	*24,381.25*	*-381.00*	*-2,012.40*

Table 5.10 *Cost of production and revenue of OFCs cultivation in the mixed cropping system*

Component	Cost (Rs.)
Input cost	982.50
Seeds	554.72
Fertilizers	69.44
Weedicides	2,202.50
Pesticides	
Labor cost	3,619.44
Land preparation	1,854.86
Sowing and replanting	170.14
Fertilizer	2,020.14
Weeding	331.94
Pest and disease control	4,313.89
Harvesting	1,798.61
Drying and packing	
Machinery and fuel cost	555.56
Land preparation	38.89
Pest and disease control	37.50
Transport	
Total cost	*18,550.13*
Yield (kg)	479.75
Greengram	381.00
Cowpea	257.80
Groundnut	
Price (Rs./kg)	25.00
Greengram	18.00
Cowpea	22.00
Groundnut	
Income (Rs./ha.)	*24,537.75*
Net profit (Rs./kg)	*5,987.62*

Table 5.11 Major constraints encountered by OFC farmers

Constraint	New Area		Old Area	
	Maha	Yala	Maha	Yala
No water	29.0	80.5	33.3	30.8
Inadequate water	20.4	60.1	10.4	18.2
Salinity	26.7	55.6	66.7	64.6
Cattle damage	60.0	58.4	34.9	44.0
Pests and diseases	44.2	59.2	22.3	34.5
Low prices	60.0	70.4	49.0	60.4
Lack of buyers	54.0	53.4	33.0	41.4

Case studies reveal that in addition to the above constraints certain other factors such as water logging, degradation of soil fertility due to removal of the top soil, high rainfall, damage caused by wild animals and lack of knowledge are also responsible for the poor yields of OFCs. As there is a price fluctuation farmers used to store their outputs in order to receive higher prices after the harvesting season. However, farmers could not keep the harvest for a long period of time as most of them require income to settle their debts. Further, as storage facilities are inadequate or not well established, often a considerable part of the output is wasted (pest attacks).

Four types of grain collectors operate at the local level: buyers at the Pannegamuwa local market, collecting centers run by traders, individual collectors who come to the field and large scale collectors. These buyers control the prices and the farmers pose little countervailing power.

5.6 Technology Adoption

Efforts were made to introduce technologies such as HYVs, fertilizers, agro-chemicals, transplanting, multiple cropping, processing and storage with the implementation of the project. The study investigated the degree of adoption of the innovations.

HYVs have gained great popularity in the area. Almost all the rice farmers cultivate HYVs such as BG 350, BG 300, BG 76/02, AT 62/02, etc. Transplanting has been introduced as a plant establishment method, bit it seems that farmers are still inclined to practise broadcasting. The main reason for this situation is the high labor involvement in transplanting and also timing of water issues.

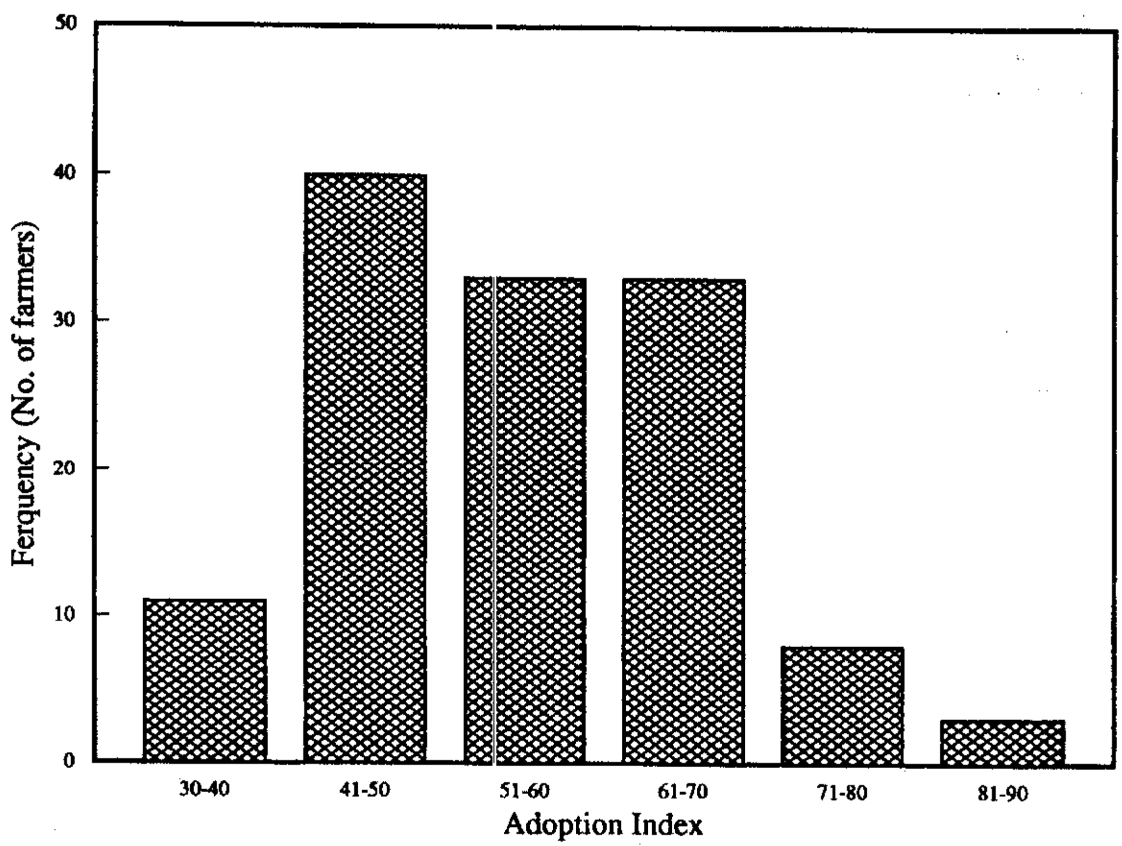
Nearly 70 percent of the farmers have applied fertilizers to their rice fields. Farmers in the new area show relatively lower adoption rates. The main reason for this situation is the risk associated with the conditions of water shortage. Although the majority of the farmers have applied fertilizers, it is reported that the recommendations were not followed with respect to frequency and dosage. Among the farmers who applied fertilizers to rice crops only 65 percent of the farmers implemented the recommendations correctly.

Nearly 75 percent of the farmers have controlled pests and diseases only by chemicals. It is noted that farmers have used a wide range of chemicals recommended by different agencies. But the selection of the correct chemicals, the application of the proper dose, time and frequency are questionable. It seems that the majority of the farmers has deviated from the standard recommendations, and in many instances, applications were made irrespective of economic threshold. Recent introduction of the Integrated Pest Management (IPM) technique is gaining popularity as nearly 25 percent of the farmers have practised it during the last season (1993/1994 maha). In fact, farmers have realized the cost saving and environmentally friendly nature associated with the IPM concept.

Weed control too, was mostly (65 percent) done with agro-chemicals. Approximately 30 percent of the farmers still weeded manually. Four-wheeled and two-wheeled tractors were utilized for land preparation and threshing operations but still a part of the land preparation and the entire harvesting operations were done with manual labor.

The commonly introduced technological packages to the project area have been investigated and stress elements pertaining to each package have been identified in order to construct the Adoption Index. The Adoption Index implies the degree of adoption of given technologies by the clients in a given domain. Figure 5.4 illustrates the status of technology adoption. It reveals that only 12 farmers (9 percent) belonged to the category of high technology adopters (71-90). 66 farmers (51 percent) belong to the category of middle adopters (51-70) whereas 51 farmers (40 percent) are low adopters (30-50). The above data reveal that technology utilization in the project area is still not satisfactory.

Figure 5.4 Status of technology adoption



5.7 Institutional Support

5.7.1 Fertilizers and Agro-Chemicals

The study reveals that fertilizers and agro-chemicals are widely available in the project area. The Agrarian Service Centers (ASCs), co-operatives, agents of private companies and retail dealers operate as distributors of fertilizers at the local level. Up to the recent past fertilizers were available in a mixed form and farmers used to purchase ready-made fertilizer input. However, with the introduction of straight fertilizers some farmers purchased fertilizer components, N,P,K, separately and mixed them according to the recommendations. But since the straight fertilizer recommendations were introduced only recently, only a small percentage of farmers have been able to adopt it.

Agro-chemicals such as pesticides, weedicides, fungicides, etc. are also widely available at the farm level. A number of agro-chemical companies have established very effective distribution networks in the area. The retail outlets functioning at the local level fulfil the agro-chemical requirements of the farmers. In addition to supply of the inputs, the agro-chemical companies have also launched demonstrations and advisory services. But, as many agro-chemical agencies are operating in the area, in some instances farmers were confused about the correct selection of the chemicals. Further, farmers' knowledge about standard recommendations pertaining to time of application, frequency, mixing ratio, threshold value and also precautionary techniques is still not satisfactory. The following constraints were reported by farmers in the area with respect to fertilizers and agro-chemicals (Table 5.12).

Table 5.12 Constraints pertaining to fertilizers and agro-chemicals

Constraint	Percentage of Farmers
No problem	24%
High price	53%
Low quality	36%
Unavailability of inputs	12%
Lack of advisory service	32%

Data reveal that the majority of the farmers considered the prices of fertilizers and agro-chemicals as too high. As a result, farmers are inclined to apply lower quantities of fertilizer than recommended or totally avoided using this input. It seems that the removal of fertilizer subsidy schemes has an adverse effect on fertilizer use. The low quality was very much associated to mixed fertilizers but as mentioned above recent introduction of straight fertilizers will be a remedial measure to this problem. The fact that farmers mention lack of advisory service as a major constraint could have been anticipated since the extension-farmer contacts were reduced due to the removal of the Village Extension Workers.

5.7.2 Agricultural Extension and Training

As the project identified agricultural extension as one of the key elements responsible for the increase of agricultural production, and because this service input was required for the crop diversification program, efforts were made to establish an extension network under supervision of the Department of Agriculture (DOA). In fact, the Department of Agriculture was given the sole responsibility for the extension component. The Assistant Director of Agriculture (ADA), Hambantota, attached to the Division of Agricultural Extension was responsible for the planning, implementation and supervision of extension programs in the project area. Within the district, extension units were organized through the network of Agrarian Service Centers (ASCs). The extension framework implied a single line of command introduced by the Training and Visit (T&V) system of Agricultural Extension, as Agricultural Officers (AOs), Agricultural Instructors (AIs), Village Extension Workers (VEWs), Contact Farmers (CFs) and Follower Farmers (FFs). The Subject Matter Officers (SMOs) were supposed to make the institutional link between research and extension and they performed this function mainly at the district level.

The Hambantota District is divided into three segments and the KOISP area is confined to segment III. This segment is headed by an AO stationed at Weerawila. Three SMOs, four AIs and seven VEWs are allocated to the project area. According to the concept of the T&V system, bi-weekly training programs were scheduled for AIs and VEWs, separately during two seasons. The knowledge transfer process and backward flow of information were expected to occur through the visits made to CFs by VEWs on a pre-arranged visit schedule and further, through frequent contacts made to the FFs by the respective CFs. However, at present, the above mentioned bi-weekly training courses and farm visits are not implemented as the VEWs are not attached to the Department of Agriculture any more. The removal of grass-root level extension workers, the VEWs from the extension framework with the introduction of the Provincial Council (PC) System has disturbed the extension efforts launched by the Department of Agriculture. The extension coverage has been investigated utilizing the frequencies of visits. Results demonstrate that only 4 percent of the farmers have received a visit per month whereas 45 percent of the farmers had only one visit per season. The rest, (51 percent) has not had any extension contact during the last season. Therefore, the extension network has to be reoriented in order to facilitate the knowledge transfer process.

The agricultural training component too was handled by the Division of the Agricultural Education and Training Division of the Department of Agriculture. Training for SMOs, AIs, VEWs and farmers was mainly conducted at District Training Centers (DTCs). The Regional Training Center at Agunukolapelessa and DTC at Weerawila facilitated most of the training programs with the help of trainers of the Department of Agriculture and personnel from other institutes.

5.7.3 Agricultural Research

The Department of Agriculture executed the research programs through one of its Regional Research Centers (RRCs), Angunakolapelessa. The RRC was responsible for planning, implementing and monitoring of the research programs. A separate Adaptive Research Station has been established at Weerawila. This station facilitated adaptive research, on-farm trails, demonstration plots water management, input use, etc. The rice sub-station located at Ambalantota provided research facilities for paddy. The RRC is responsible for the co-ordination

of research, extension and training activities. The Regional Technical Working Groups were formal bodies established to provide links between these components. Apart from the research activities of the Department of Agriculture, the IIMI too, conducted research programs with special attention to water management, salinity, and farmer organizations. The study reveals that approximately 80 percent of the farmers were aware that research programs were undertaken. Moreover, 16 percent of the farmers reported that research programs were launched on salinity problems (salinity control, salinity resistant varieties) and another 7 percent reported that research programs on drought resistant varieties were carried out. It was evident that farmers are very much concerned about the salinity problems and therefore they are looking forward to the research output.

5.7.4 Institutional Credit and Insurance

Sources of agricultural credit in the KOISP area are the Peoples' Bank, the Bank of Ceylon and the Regional Rural Development Bank. The study reveals that in principle 76 percent of the farmers has access to institutional credit. But generally, farmers feel that non-institutional credit can be obtained more easily. Private money lenders have established informal loan facilities well at the local level and these sources were effectively used for the release and recovery of credit. Although the private money lenders' interest rates were high, farmers inclined towards non-institutional credit as they can thus avoid the formal application submission, approvals and also the delays.

Institutional credit facilities were granted for short-term crops at an interest rate of 9.5 percent per annum and farmers have to repay the full amount at the end of the cropping season. Medium-term loans were granted for purchasing tractors and other farm equipment. Such loans were granted at 12.5 percent interest per annum and the repayment period was 3-5 years. Long-term loans were given for livestock farmers at the rate of 12.5 percent interest for six years.

The study disclosed that the implementation of the project facilitated lending opportunities especially to the new area. In general, loan recovery rates were satisfactory. However, during the adverse seasons farmers were unable to settle their loans and in such situations, the banks often extended the repayment period. As farmers experienced many adverse seasons in a series, they were unable to settle their institutional credit, therefore, non-institutional borrowings increased during the past period. The data demonstrate that, at present, approximately 42 percent of the farmers were not eligible for institutional credit. The study further reveals that nearly 90 percent of the farmers reported that they were unable to repay their loans due to low farm income in adverse seasons.

The crop insurance scheme was introduced by the Agricultural Insurance Board. Agricultural insurance was compulsory in the credit schemes and often the cost of insurance was included in the loan. The insurance payments were pre-determined by the extent of damage with a ceiling of Rs. 5,412 per ha. for irrigated paddy and Rs. 1,476 per ha. for rainfed crops. The OFCs, such as maize, cowpea,greengram, groundnut, and chillies were granted a maximum of Rs. 2,964, Rs. 2,914, Rs. 4,940, Rs. 4,940 and Rs. 9,880, respectively for crop failures. The crop insurance scheme has encouraged farmers to adopt new crops, new cultural techniques and cropping patterns with greater confidence. The present study indicates that only 55 percent of the farmers in the project area have contributed to the crop insurance scheme. Factors for non-participation were investigated. Data reveal that 15 percent of the farmers did not join to the

scheme because their income was too low; 29 percent of the farmers had no confidence in the scheme; 38 percent of the farmers had not received enough benefits during past seasons; and 18 percent of the farmers had not obtained adequate information.

As far as the OFCs are concerned the Agricultural Insurance Board has accounted heavy losses. The main reason for this were crop failures of OFCs.

5.7.5 Agricultural Marketing

At the inception of the project, the Paddy Marketing Board and co-operatives were the main buyers of paddy and OFCs through a Guaranteed Price Scheme for paddy and a Floor Price Scheme for OFCs. However, as the government oriented its policy towards private sector marketing activities, the above institutes and the price stabilizing schemes are not effectively operating at the local level. In fact, it seems that marketing systems for paddy and OFCs are completely controlled by the private sector dealers. The marketing channels for paddy in the area are well established by the local collectors, traders, and millers. It appeared that this area produced high quality rice and therefore collectors from outside regions often came to the project area during the harvesting season. Local collectors and large scale traders mostly pre-arranged to purchase paddy at the farm-gate.

Marketing channels for OFCs are also well established by private dealers. Most of the farmers are able to sell their OFCs at the farm-gate but fairs like Pannegamuwa, Lunugamvehera, Tissamaharama are also attractive market places for OFCs.

Prices of paddy as well as OFCs decreased considerably during the harvesting periods and this was particular problematic for OFCs. The absence of floor prices for OFCs caused significant price fluctuations. Further, very few farmers had access to market information. These limitations have had adverse effects on the crop diversification programs as introduced by the project. In fact, farmers were reluctant to invest in OFCs as there is a great risk of not obtaining a reasonable farm income due to the low prices.

The study investigated the constraints pertaining to marketing of agricultural products. Data reveal that 69 percent of the rice farmers were not satisfied with the farm-gate price they received whereas 80 percent of the OFC farmers reported the same. Only a few farmers mentioned the problems of market places or buyers.

In sum it can be stated that there is a well established marketing system by the private sector collectors and further the problems presented by the farmers focused mainly on the low farm-gate price.

5.8 Conclusions

(a) The majority of the farmers in the old system cultivate rice in both seasons but the number of rice farmers in the yala season has declined to 63 percent. In contrast, farmers in the new area have confined their rice cultivation only to the maha season.

(b) The **average paddy yield** of the old and the new areas is estimated at 3,706 kg/ha and 3,649 kg/ha, respectively for the maha season. Hence, there is no significant yield difference in the two domains during the maha season. The average paddy yield of the entire area is 3,605 kg/ha and this can be regarded as a reasonable achievement.

(c) The **total annual paddy production** in the project area is estimated to as 41,000 mt. As one of the original objectives of the KOISP was to produce an incremental output of 44,000 mt of paddy. This achievement can be regarded as a significant development effort. However, due to high production costs and low farm-gate prices farmers receive a low farm income.

(d) **Crop diversification** in the rice fields has occurred only marginally. Approximately 31 percent of the farmers in the old area and 92 percent of the farmers in the new area had abandoned their rice fields during the yala season. Cultivation of Other Field Crops was limited to the maha season. Nearly 80 percent of the farmers in the new area have encountered conditions of water shortage in the yala season. In general, farmers were not inclined to grow OFCs due to many limitations.

(e) The **annual total production of OFCs** amounted 2,800 mt. As the original expectation was to produce 11,400 mt of OFCs, this situation cannot be considered as a reasonable achievement.

(f) The **farmer performance index** indicates that on average, farmers have exploited 75 percent of the potential rice yield. The majority of the farmers was unable to exploit the full yield potential in the area.

(g) The **cropping intensity** of lowlands in the new area was limited to 98 percent for the Right Bank , 48 percent for the Left Bank. Lowlands of the old area have reached a cropping intensity of 163 percent. The cropping intensity of the highland area (both old and new system) is well below 65 percent. The KOISP expected to increase the cropping intensity of the old system and the new area to 170 percent. Only the lowland area of the existing system has approximated the target.

(h) The degree of technology adoption was investigated by employing an **adoption index**. It demonstrates that technology utilization in the project area is still not satisfactory as 40 percent of the farmers can be considered as low adopters.

(i) The KOISP has made efforts to improve **institutional facilities** such as supply of agro-chemicals, extension and training, research, credit and insurance and marketing. It appears that private sector involvement has increased, but still farmers encounter certain limitations which should be addressed.

CHAPTER 6

LIVESTOCK PRODUCTION

6.1 Introduction

In the past the project area, like other areas in the Hambantota District, was considered as one of the important cattle and buffalo raising areas of Sri Lanka. Only in the second phase of the project the livestock component was introduced into the mainstream of the development activities of the KOISP. The major objectives of the livestock component were:

(a) Development of 1,000 ha. for livestock (and agro-forestry) enterprises;

(b) Incremental production of 4.1 million liters of milk annually and saving foreign exchange by import substitution;

(c) Improved living conditions and sustained economic growth of the beneficiaries.

The present study aimed to find out to what extent these project objectives have been achieved. The results of distributing improved stock among settler and non-settler herdsmen, and the adoption of improved practices have been assessed. Therefore, the study attempts to estimate levels of production and value of livestock produce, to examine the livestock extension activities, the credit, veterinary, artificial insemination and marketing services provided under the project and also to assess the role of herdsmen societies in increasing livestock production and reducing stray cattle problems.

6.2 Methodology

A close scrutiny of the project objectives in terms of livestock and the various activities planned to reach these objectives reveal that the major concern in the livestock development component has been the cattle and buffalo raising activity. Various indicators enumerated in the draft terms of reference too point to cattle and buffalo raising as the principal livestock production activity to be investigated. A recent study conducted by the ARTI (1994) revealed that only a meagre 3 percent of the farmers in the KOISP area shows any preference for animals other than cattle or buffaloes. Therefore, only the cattle and buffalo raising activity in the project area is studied, as it is the most important livestock husbandry practice in the traditional and modern Kirindi Oya area.

The study on the livestock component was carried out in three stages. In the first stage a close scrutiny of the project proposal and secondary data available on the pre-project situation, was conducted to find out the factors that led to the formulation of the KOISP, the objectives of the project, pre-project livestock husbandry practices, etc. This stage of the study revealed that no attention has been paid by the project proponents on any livestock development activity in the KOISP area during the project formulation stage, although this formed the principal

economic activity for the Kirindi Oya folk. Moreover, documentary evidence on the pre-project status of livestock husbandry was very scarce. Therefore the study had to depend heavily on information elicited in the second stage of the study.

The major objectives of the second stage of the study were:

(a) To find out the pattern of livestock production today.

(b) The various costs and returns associated with these livestock production practices.

(c) The present institutional set up providing livestock services.

In the third stage of the study an attempt was made to find out the overall impact of the project on livestock production activities in the KOISP area with respect to the major objectives of the livestock component.

Field studies were carried out in the second stage, which consisted of several basic data collection methods. Case studies were done to elicit information on specific issues such as daily milk collection by a particular milk collecting center over a period of one year. Rapid appraisals were conducted in order to understand the key issues associated with a particular component or a problem before structured questionnaires were administered to samples of herdsmen. A small sample survey was also carried out with a random sample of herdsmen in order to elicit specific answers to specific questions.

6.2.1 The Population and the Sample

Since the objectives of the livestock development component of the project envisaged the expansion of the milk production, the target population of the study consisted of all herdsmen in the project area. However, a population frame of herdsmen does not exist. The ARTI study could provide a population frame of only settler-herdsmen. Therefore, it was decided to resort to the lists of member-herdsmen of the three Cattle Owners Associations (Magampura, Beralihela and Ruhunu) in the KOISP area, which include both settler and non-settler herdsmen. Yet, as indicated by the office bearers of these associations, only about 80 percent of the herdsmen in the area have obtained membership in these associations. In the absence of a proper population frame this was taken as the population frame of the herdsmen in the project area.

Most of the traditional herdsmen were located in the old area and livestock management practices too varied according to location. The command area of the Beralihela Cattle Owners Association covered mainly the Left Bank of the new area. The Ruhunu Cattle Owners Association covered to a great extent the Right Bank and the command area of the Magampura Cattle Owners Association falls under the old area.

A random sample of herdsmen was then drawn separately from each of the cattle owners associations as indicated in Table 6.1.

Table 6.1 *Population and sample*

Cattle Owners Association	Population Size (Membership)	Sample Size
Magampura	149	40
Ruhunu	225	30
Beralihela	82	30

Since the three cattle owners associations had different command areas representing the Left Bank and the Right Bank of the new area and the old area, the sample drawn was close to a stratified random sample, the strata representing locational differences.

In the large sample survey of the ARTI, 14 households out of a sample of 179 (2 percent) in the old area and 30 households out of 300 (10 percent) in the new area were found keeping livestock. Eight of these settlers keeping buffalo and cattle on a small-scale were subject to further study. They represented the settler-herdsmen in the new area.

6.2.2 Herdsman-settlers and Settler-herdsmen

A distinction should be made between the herdsman-settlers and settler-herdsmen in the KOISP area. The former category consists of the traditional herdsmen in the area who have been traditionally involved in cattle and buffalo raising. They are mainly concentrated in the old area, while some of them were given land in the new area under the KOISP. The settler-herdsmen are those settler-cultivators in the new area who have adopted cattle and buffalo raising after they were allocated with land in the KOISP, all of whom are concentrated in the new area. While all the settler-herdsmen are part-time livestock farmers, only some of the herdsman-settlers fall in this category. The rest of the herdsman-settlers are full-time herdsmen. In fact, these herdsmen in the old area of the project have been engaged in livestock raising for generations. The above distinction is maintained throughout the analysis.

A structured questionnaire was administered to the sample herdsmen, with a view to collecting detailed quantitative data on, herd characteristics, feeding practices, animal health, costs of production, incomes, use of extension and other supporting services.

The questionnaire was pre-tested, revised and finalized. The survey was conducted by four graduates of the Faculty of Agriculture of the University of Ruhunu.

Data coding, tabulation and computerizing was carried out by a research assistant, a graduate of the Faculty of Agriculture, University of Ruhunu at the Economic Research Unit of the Department of Agricultural Economics and Extension.

6.2.3 Limitations of the Study

The study experienced severe constraints due to the lack of background information and published data on the pre-project situation and any progress evaluation studies. Therefore, it was hard to compare the present milk production data with those in the past to assess the net benefits. Animal numbers presented another problem. Very often herdsmen were reluctant to give actual animal numbers as they were hesitant to reveal their wealth position. The most important factor was the tradition of not counting the number of animals owned, which is supposed to be a socially despised practice. It was felt that the numbers as reported by herdsmen are heavily underestimated. Data collection through observation was constrained by difficult access to jungles, where some farmers keep their herds. This was especially true with the Jungle-Based System of cattle and buffalo raising.

6.3 Cattle and Buffalo Husbandry in the Pre-KOISP Period

Cattle and buffalo husbandry in the Kirindi Oya area dates back to the establishment of the Ruhuna Kingdom by King Mahanaga who pioneered the building of a network of irrigation systems. He is the one who used the Kirindi Oya to build up the Tissa Wewa, the Yoda Wewa and the Debara Wewa and transformed the surrounding area into fertile paddy fields (Uluwishewa & Jayasuriya 1991). A number of kings who followed Mahanaga, such as Dutugemunu (161 - 37 B.C.), Walagambahu (103-89 B.C.), Vasabha (76-111 A.D.), Gajabahu (114-36 A.D.) and Parakramabahu 1 (1153-86 A.D.) also contributed to the expansion of this network of irrigation systems. However, with the decline of Ruhuna by the end of the 12th century caused by foreign invasions and internal instabilities, the irrigation systems were neglected and started to disintegrate(ibid.). Hundreds of irrigation tanks which were being ruined in the jungles were used by people for both animal husbandry and crop production, especially cattle and buffalo raising and chena cultivation. As Uluwishewa and Jayasuriya (ibid.) have noted the pioneers who migrated into these areas could have been those who left the Wet Zone due to the increasing population pressure on grazing lands there. Probably they found the ruined irrigation tanks attractive sites providing drinking water and wallowing sites for animals. Chena cultivation too became a part-time activity for these herdsmen. Cattle and buffaloes reared by them provided them with milk and draught for land based activities. Animals were also hired out to cultivators of paddy. Since there were a large number of irrigation tanks, the herdsmen moved from one area to the other in times of water shortage which led to the infiltration of settlements into distant jungles. A large number of villages in this area have been founded by these herdsmen.

The traditional system of cattle and buffalo husbandry in the Kirindi Oya area has been a low technology, low input and extensive system. In this system of management, the non-lactating cows and adult male animals were allowed to stay in the jungles adjacent to the village Only lactating cows and calves were kept in the neighborhood. During the night the calves were kept in cow pens which were maintained close to the village irrigation tank. In the evenings lactating animals were released into the jungle. Milking was done once every morning after the cows returned to their calves. Non-lactating cows and adult males remained in the jungle and they returned to the village only at the end of the cropping season to feed on paddy residues. At the commencement of the next cultivation season, the animals were used for land preparation work and then again released to the jungle till the end of that cropping season. (Uluwishewa and

Jayasuriya ibid.).In this system purchased inputs formed a negligible part of the variable costs, the major input was manual labor. The major outputs of the system were milk and draught. While sale of animals for meat was not a prevalent practice in the distant past, it has commenced to bring in considerable cash income to herdsmen with the increase in demand for beef in the expanding urban centers.

The traditional system of cattle and buffalo husbandry in the Kirindi Oya area can be regarded as an environmentally friendly system. In fact, it was a crop-stock integrated system because the cropping system benefitted from draught power and organic fertilizer provided by the animals, while the animals fed on stubble left behind in the paddy fields after the cultivation season. While most of the farmers were both herdsmen and cultivators, there was social harmony between the two categories of farmers. The survey reveals that at each *Kanne* Meeting, the dates for the erection of fences were decided (to protect fields from cattle, buffalo and wild animals) and that these were strictly enforced by the Village Leaders (*Vel Vidane*).

Large herds of animals (even exceeding 1,000) have been maintained by some herdsmen, who enjoyed a high social status in the traditional Kirindi Oya area (*Gambaras*).

One of the major turning points that affected the pre-KOISP livestock industry was the introduction of tractors in the mid-twentieth century, which reduced the importance of male animals used for animal draught power. With this change in technology the sale of male animals for beef to various brokers started. The brokers acted as middlemen for the butchers in the cities, who strengthened their activities in the rural areas. Therefore, in most of the animal herds today, the number of adult animals is quite low because they are sold by the herdsmen at the age of 2 to 3 years.

6.4 The KOISP and Livestock Raising

While the KOISP area is considered to be a traditional buffalo and cattle raising area, also other kinds of livestock are present. Therefore, information was sought from the large-scale sample survey carried out by the ARTI on various forms of livestock kept by the settlers.

Out of a total sample of 479 households (300 in the new area and 179 in the old area), only 44 kept livestock.

Table 6.2 provides information on different types of livestock kept by sample households who raised livestock in both new and old areas. It is evident that cattle and buffalo raising is the most important livestock enterprise, while poultry assumes a secondary importance. Poultry appeared to have gained popularity in the new area where more than half of the households raising livestock kept poultry. From the size of the flock per household, it is evident that poultry is mainly kept for home consumption. Pigs and goats are not raised in the KOISP area although the latter are supposed to be good dry-zone animals.

Table 6.2   Livestock raising by households in the KOISP area

Area	Type of Animals	No. of Settlers Reporting	Percentage of Settlers Reporting*	Total No. of Animals	Number of Animals per Settler
New Area	Cattle	12	40.0	165	13.8
	Buffaloes	4	13.3	74	18.5
	Goats	0	0.0	0	0.0
	Poultry	17	56.7	272	16.0
	Pigs	1	3.3	9	9.0
	Total	30	113.3**	520	17.3
Old Area	Cattle	9	64.3	155	17.2
	Buffaloes	3	21.4	100	33.3
	Goats	1	7.1	15	15.0
	Poultry	5	35.7	124	24.8
	Pigs	0	0.0	0	0.0
	Total	14	128.5**	394	28.1

* *of those having livestock*
** *total exceeds 100 because some settlers keep more than one kind of livestock*

Cattle and buffalo raising appeared to be very popular in the old area where animals are kept by about 86 percent of the sample households who keep livestock. The corresponding figure for the settlers in the new area is 53 percent.

6.4.1 Cattle and Buffalo Raising in the KOISP Today

Although the Kirindi Oya area is an important cattle and buffalo raising area, this was not recognized by the proponents of the KOISP. Neither the appraisal of the KOISP in 1977 nor the appraisal of the reformulated KOISP in 1982 mention the cattle and buffalo industry in the area. Since the emphasis of the project was on settler-based crop production under irrigation, about 1,800 ha. of scrub jungles used by herdsmen as grazing lands were cleared and a large number of irrigation tanks that provided drinking water and wallowing sites for cattle and buffalo were levelled and developed.

These activities had an adverse impact on the cattle and buffalo husbandry practised by herdsmen in the old area. These herdsmen, who used to graze their animals in the scrub jungles which were located in the new area, lost their traditional grazing grounds. Moreover, irrigation facilities provided by the project enabled the farmers to engage themselves in double cropping

(both yala and maha cultivation) reducing the duration of the fallow periods. This prevented the herdsmen from keeping their animals in the fallow fields for long periods. Although this has created a pervasive cattle problem in the area no thoughts have been given to these impacts on livestock raising at the planning stages of the KOISP.

The loss of grazing land to herdsmen in the area with the advent of the KOISP led to a change in the traditional cattle and buffalo raising system. Today, about five types of management systems have been adopted by the herdsmen in the Kirindi Oya area.

(a) The Village Based System
(b) The Migration System
(c) The Traditional System
(d) The Jungle Based System
(e) The Tethered Grazing System

(a) The Village Based System

The Village Based System of cattle and buffalo raising is mainly practised by part-time farmers (or settler herdsmen) whose herds are dominated by cattle. Using mostly family labor these herdsmen keep their herds in the village itself. During the cultivation season the animals are fed on road sides, canal sides and reserves which form the village or hamlet food resources. During the fallow period the animals are fed on stubble left in the paddy fields. Animals are kept in pens during the night. Close supervision of animals is of paramount importance during the cultivation period and therefore both women and child labor are extensively used in this system.

(b) The Migration System

Due to the loss of traditional grazing land herdsmen in the new area are forced to take their herds to jungle areas during the cultivation period. Many herdsmen at the Right Bank take their herds to the Western part of the Lunugamvehera Upper Catchment Area, while those at the Left Bank take their herds usually to the Eastern part of it (to Amarawewa and Bembawa grazing grounds). During the non-cultivation or fallow period, the animals are brought back to the village and then feed on stubble left in the paddy fields. The Migration System depends both on hired and family labor.

(c) The Traditional System

The Traditional System is a modification of the traditional cattle and buffalo raising system practised by the herdsmen in the Kirindi Oya area. With the loss of grazing land in the new area where they used to feed their herds in the pre-KOISP era, the herdsmen in the old area had to find alternative grazing land. Moreover, the KOISP facilitated double cropping in the old area which drastically reduced the duration of the fallow period. Therefore, the herdsmen moved to jungles adjacent to their villages which often had ruined tanks. Unlike the traditional pre-KOISP system the herdsmen in this system bring the calves and lactating cows to cow pens in the evening. They keep a closer watch on animals than the pre-KOISP system in which some animals returned to the herdsmen only after a few seasons. Since most of the jungle-based lands

are situated close to the villages, there is also the danger of animals damaging crops grown in fields adjacent to the jungle. Animals are brought back to the fallow paddy fields whenever possible.

(d) The Jungle Based System

Some herdsmen, in the old area, have taken their herds to far away jungle areas in search of food and drinking water. These herdsmen mainly operate in the Upper Catchment Area of the reservoir (Kadawarawewa, Bundala and Yala). The herdsmen have put up temporary huts for labor (*wadiya*). Cow pens (*gala*) are maintained near the wadiya. The herds are kept in the jungles over long periods. However, when sufficient food is available in the village paddy fields the animals are brought back to the village, which makes this system also a type of migration system. Therefore, it was difficult to correctly distinguish between the Jungle Based and Migration Systems when analyzing information obtained from the sample survey. Therefore, some of the herdsmen practising the Jungle Based System could have been categorized under the Migration System as well.

(e) The Tethered Grazing System

The Tethered Grazing System of livestock raising is adopted by settlers (settler-herdsmen) in the new area. The herd size in this system is small and mainly cattle is raised. The purpose of production is principally to meet household consumption needs. The animals are kept in cattle yards and sheds and are fed mainly with cut grass and straw. The system depends totally on family labor.

Table 6.3 Distribution of herdsmen under different management systems

Type of Herdsmen	Type of Management System	Herdsmen in the New Area (%)	Herdsmen in the Old Area (%)
Herdsman-settlers	Village Based	43.75	26.47
	Jungle Based	0.0	2.94
	Migration	43.75	48.53
	Traditional	12.50	22.06
	Total	100.00	100.00
Settler-herdsmen	Tethered Grazing	57.00	
	All other	43.00	
	Total	100.00	

Table 6.3 gives the distribution of herdsmen in the different management systems in the new and old areas of the KOISP. It is clear that 85 percent of all herdsmen in the new area are

engaged in the raising of cattle and buffalo under Village Based and Migration systems. On the other hand, approximately a half of the herdsmen in the old area practise the Migration System while the Village Based and Traditional System of cattle and buffalo raising are practised by the rest. The latter system is more important in the old area than in the new area. The reason for increased importance of the Village Based System in the new area could be attributed to the fact that many herdsmen in the new area are part-time herdsmen, who cannot afford to practise Jungle Based or Migration Systems which require spending a considerable amount of time in distant areas, away from cultivated plots of land.

Of the settlers in the new area who raise buffalo and cattle, about 57 percent practised the Tethered grazing method while the rest raised their animals under other systems. Not a single herdsman in the old area raised animals under the Tethered grazing system.

It has become evident that the KOISP has had a considerable influence on animal raising in the Kirindi Oya area. The system of cattle and buffalo management that has emerged today is on one hand closely related to the availability of resources at present and on the other hand to the type of animals raised.

6.4.2 Buffalo and Cattle Populations

One of the most difficult tasks in the study was the collection of information on animal populations. No accurate estimates or attempts to estimate the buffalo and cattle populations in the KOISP area are at hand. Although data on buffalo and cattle populations are available in the Hambantota AGA and Tissamaharama AGA divisional secretariats, reliable estimations for the KOISP area can not be made based on this information. Uluwishewa and Jayasuriya (ibid.) reported from the records of the revenue officers of the Hambantota AGA division 75,000 cattle and 82,000 buffaloes in Hambantota district. The records of the Hambantota *Kachcheri* show a total of approximately 14,965 buffaloes and 13,188 cattle in the KOISP area. Information obtained from the Tissamaharama AGA division reveal the presence of 8,141 cattle and 5,297 buffaloes in the Tissamaharama area. Consequently, the population of buffaloes and cattle in the KOISP area would be around 20,262 buffaloes and 21,329 cattle (a total of 41,591 animals). However, since part of the animal population in the KOISP area is also reared in lands falling under the Lunugamvehera AGA division where records indicate the presence of 6,070 buffaloes and 6,583 cattle, the total animal population in the KOISP are works out to be 54,244 animals; 26,332 buffaloes and 27,912 cattle. But according to many knowledgeable and experienced herdsmen in the area, these figures are heavy underestimations.

Information was obtained from the herdsmen about the changes in the number of animals in their herds over the past 8 years. This information would help to find out whether the animal population has declined after the implementation of the KOISP, as popular belief suggests. (See Table 6.4)

Table 6.4 *Changes in buffalo/cattle populations in the KOISP area: 1985-1994 (Information obtained from herdsmen in the sample)*

Type of Animal	Year	Old Area (Total No.)	New Area (Total No.)	Project (Total No.)
Buffalo	1985	2,835	329	3,164
	1990	1412	179	1,591
	1994	1997	352	2,349
Cattle	1985	2,686	420	3,106
	1990	2173	599	2,772
	1994	3,387	1,317	4,704

According to the information provided by herdsmen, soon after the implementation of the KOISP, the population of both cattle and buffaloes decreased, but then increased again gradually. Today, the total population of animals seems to remain at a level slightly above its 1985 level. These findings are contrary to the popular belief that animal populations have decreased since the implementation of the KOISP.

6.4.3 Herd Characteristics

Herd sizes by type of management system and area for settler-herdsmen and herdsman-settlers are given in Table 6.5.

Table 6.5 *Herd size - by area and type of management system (no. of animals)*

Management System	Herd Size	
	New Area	Old Area
Village Based	50.1	65.5
Jungle Based		166.0
Migration	61.4	104.7
Traditional	75.5	89.5
Tethered Grazing	7.4	

It is evident that the largest herds are maintained by herdsman-settlers in the old area and under Jungle Based and Migration Systems. Even under the Village Based System, the average herd size appears to be quite high: 50 in the new area and 65 in the old area. However, our results show that there is a pressure on herdsmen to keep their animals in the village due to the insufficient availability of forest land to provide sufficient drinking water and food for animals. Moreover, live fences have been erected along the Yala sanctuary border. As it will be shown later, the tendency of herdsmen to raise their animals on village resources has led to increased crop damages.

Unlike the traditional herdsmen, the majority settler-herdsmen maintain small herds - with an average herd size of 7.4. These smaller herd sizes can be attributed to the fact that the major objective of livestock rearing for these herdsmen is meeting their household consumption needs. Moreover, constraints are imposed by unavailability of land, inability to attend full-time for livestock rearing, insufficient availability of grazing land, etc.

Herd composition by type of management system and area for both categories of herdsmen is given in Table 6.6. It is well evident that cattle dominate the herds in all systems. Buffaloes are found in larger numbers in the Jungle Based System. This can be attributed to the fact that buffaloes graze during the night while they wallow during the day time, where as the opposite is true with cattle. Therefore, in systems where animals have to be watched closely, herdsmen prefer cattle to buffalo. Moreover, unlike cattle, buffaloes have the habit of moving together without dispersing, which facilitates rearing of animals in Jungle Based Systems where supervision is difficult. The dominance of cattle in herds maintained by settler-herdsmen too, is well evident. This can be attributed to the fact that settler-herdsmen keep animals mainly for consumption of cow milk.

Table 6.6 Distribution of buffalo and cattle - by area and type of management system (%)

Management System	New Area		Total	Old Area		Total
	Buffalo	Cattle		Buffalo	Cattle	
Village Based	47.65	52.35	100	36.39	63.61	100
Migration	29.22	70.78	100	41.48	58.32	100
Jungle Based				10.15	19.84	100
Traditional	28.48	71.52	100	31.45	68.55	100
Tethered Grazing	18.6	81.36	100			

Breed composition of female calves and cows are presented in Table 6.7.

Table 6.7 Breed composition (% of improved animals) of herds by area and type of management system

Area	Management System	Buffalo Calves (%)	Buffalo Cows (%)	Cattle Calves (%)	Cattle Cows (%)
Old area	Village Based	51.4	5.64	31.00	8.87
	Jungle Based	57.0	8.30	0.0	14.00
	Migration	23.7	9.40	31.2	27.8
	Traditional	4.90	86.9	21.55	58.8
Average old area		21.90	18.05	28.69	28.20
New area	Village Based	18.00	22.46	28.69	28.2
	Migration	80.77	24.11	38.10	49.37
	Traditional	50.00	0.00	0.00	27.3
Average new area		39.30	20.97	21.23	28.64
New area	Tethered Grazing	50.00	100.00	33.33	7.00

Table 6.7 shows that more than 25 percent of the animals in both new and old areas are of the improved type (pure breeds and cross breeds). In the Jungle Based system, improved animals are mostly found among the buffalo population indicating that the aim of this system is mostly buffalo milk production for curd making. In most of the management systems, calf population consist of more improved animals than the cow population indicating the increasing interest among herdsmen in improving their herds.

Information on **calving percentage** by type of management system and area are given in Table 6.8. Information was also obtained from respondents concerning changes in the calving percentage over the past 6 years.

Table 6.8 Calving percentage of buffaloes/cattle by area and by type of management system

Area	Management System	Before 1988		Now	
		Buffalo	Cattle	Buffalo	Cattle
New area	Village Based	90.0	60.0	31.0	47.0
	Migration	35.0	54.0	50.0	52.5
	Traditional	45.0	45.0	50.2	56.8
Mean for new area		35.8	38.3	38.1	51.0
New Area	Tethered Grazing	40.0	50.0	68.0	58.0
Old area	Village Based	49.0	49.4	50.2	56.8
	Jungle Based	80.0	90.0	66.0	50.0
	Migration	67.5	52.5	57.7	54.4
	Traditional	67.0	74.4	63.7	68.3
Mean for old area		48.9	54.4	59.4	57.4

According to information furnished by the respondents, calving percentage has increased slightly for both buffaloes and cattle in the project area as a whole. It remains at 38 percent for buffaloes and 51 percent for cattle in the new area and 59.4 percent and 57.4 percent for buffaloes and cattle respectively in the old area. It is also evident that the calving percentage is higher in the old area than in the new area. However, calving percentage in the Tethered Grazing System in the new area has increased during the past few years indicating the positive net benefits reaped by the settler herdsmen. While the same trend is evident in most of the management systems, the Village Based System in the new area shows a declining trend in respect of calving percentage. The same trend is also observed in the Jungle Based System.

As evident from Table 6.9, **calf mortality** remains at a level of 20 percent for buffaloes and 22 percent for cattle in the KOISP area as a whole. Information provided in Table 6.9 also reveals that calf mortality has increased with the implementation of the KOISP. With the increased veterinary services provided under the project this situation should not arise. There could be a high degree of misreporting by herdsmen who are biased against the KOISP.

Table 6.9 Calf mortality by area and type of management system

Area	Management System	Before 1988		Now	
		Buffalo	Cattle	Buffalo	Cattle
New Area	Village Based	12.1	10.7	14.3	26.4
	Migration	14.3	19.4	19.4	24.6
	Traditional	16.3	12.5	12.5	20.0
Mean for new area		14.2	14.2	15.4	23.7
New Area	Tethered Grazing			2.3	6.3
Old area	Village Based	14.7	18.3	18.4	16.4
	Jungle Based	22.5	7.5	42.5	25.0
	Migration	21.8	15.0	22.0	14.0
	Traditional	9.5	10.0	15.0	24.0
Mean for old area		17.7	12.7	24.6	19.8
Mean for project		15.7	13.5	20.0	22.0

With respect to the areas of study, calf mortality of cattle appears to be high in the new area, while that of buffalo calves appears to be high in the old area. With regard to the systems of management, mortality of buffalo calves is highest in the Jungle Based system and lowest in the Tethered Grazing System. In the old area too buffalo calf mortality is lowest in the traditional system while for cattle, it is lowest in the migration system, for both types of animals. Lack of close supervision of animals and poor attention paid in the Jungle Based System and the closer attention paid to animals in the Tethered Grazing System could partly explain the observed variations.

Milk productivity of animals. The average milk yield of a cow was obtained for two levels of feed availability: when food is available and, when food is scarce. Moreover, in order to understand as to whether there has been any change in the average milk yields, the respondents were also asked to indicate the average milk yields obtained prior to the year 1988. Information obtained from the respondents is summarized in Table 6.10.

Table 6.10 Average milk yield of a cow, by type of animal and area

Area	Type of Animal	Average Milk Yield (lt/day)			
		Food Available		**Food Scarce**	
		1988	**Now**	**1988**	**Now**
Old area	Buffalo	1.91	1.41	0.41	0.51
	Cattle	2.41	2.87	0.72	0.57
New area	Buffalo	1.50	0.86	0.37	0.27
	Cattle	1.48	0.87	0.78	0.37
New area (Settler-herdsmen)	Buffalo	1.80	2.50	1.50	1.50
	Cattle	2.67	2.24	1.38	1.43
Project	All animals		1.50		0.43

The average milk yield of an animal in the new area is approximately half that of the animals in the old area which can be attributed to the acute shortage of food for animals in the new area. From information furnished by the respondents, it is evident that the average milk yield has shown a downward trend since the implementation of the KOISP. Declining milk yields along with increasing animal populations point also to the fact that animals are mainly raised by the herdsmen for meat rather than milk (except the settler-herdsmen).

Table 6.11 gives information on the milking percentage of the herds by area and by type of animal.

Table 6.11 Milking percentage

Type of Animal	**Milking Percentage (%)**		
	Old Area (%)	**New Area (%)**	**New Area (%) Tethered Grazing**
Buffalo	39.0	23.0	0.0
Cattle	33.0	40.0	42.5

A larger proportion of cattle rather than buffaloes are milked in the new area while the opposite is true for the old area. This is an indication that curd production (from buffalo milk) is more concentrated in the old than in the new area.

Major reasons given by respondent herdsmen for not milking their animals are given in Table 6.12.

Table 6.12 Major reasons for not milking cows (percentage of respondents reporting)

Type of Animal	Reasons for Not Milking	Old Area (%)	New Area (%)	Project (%)
Buffalo	Drought	82.14	68.75	77.27
	Poor animal health	0.0	0.0	0.0
	Feeding calf	21.43	18.75	9.10
	Other	3.57	18.75	20.45
	Total	100.00	100.00	100.00
Cattle	Drought	71.43	58.82	66.67
	Poor animal health	7.14	5.88	6.67
	Feeding Calf	32.14	11.76	24.44
	Other	0.0	29.41	11.11
	Total	100.00	100.00	100.00

The major reason for not milking the cows appeared to be drought in both old and new areas.

Lactation yield. Information obtained from sample herdsmen in both the new and the old area on the lactation yield of animals is summarized in Table 6.13.

Table 6.13 Lactation yield of cows

Management System	Old Area		New Area	
	Buffalo (Lt.)	Cattle (Lt.)	Buffalo (Lt.)	Cattle (Lt.)
Village Based	313.5	307.5	226.0	169.0
Jungle Based	122.5	45.0		
Migration	258.0	237.0	161.6	170.0
Traditional	233.0	200.0	142.0	137.6
Tethered Grazing				242.5

The lactation yield is low in the new area, probably due to insufficient availability of grazing land. The highest lactation yield is reported by herdsmen raising animals under the Village Based System in the old area which could be due to the fact that more feed is available and animals are raised under closer supervision. The lactation yield of animals reared under the Jungle Based System appeared to be extremely low. The results hint that animals in this system are reared mainly for meat rather than for milk.

6.4.4 Profitability Criteria of Buffalo and Cattle Raising in the KOISP area

The profitability of raising buffalo and cattle under different management systems was studied. The results are presented in Annex Tables A-6.1, A-6.2 and A-6.3. A summary of the findings are presented in Table 6.14. The fixed costs of cattle and buffalo raising include the value of animals, those of instruments and investments on animal sheds and huts for cattle keepers. The variable costs on the other hand are those incurred on transport, motorcycle maintenance and repair, fuel, ropes, feed, veterinary services and labor (both hired and family labor). The cost of family labor was imputed using going wage rates. Payments to cultivators for damages to crops caused by buffalo and cattle have also been included in the computation of variable costs. Information on variable costs was obtained for operations during the year 1993. Variable costs were estimated with family labor (VC1) and without (VC2). Annual gross value of output for 1993 was obtained by adding up income from sale of milk, yoghurt, curd and sale of animals for meat, which formed the gross income.

Using the above information, gross profits were calculated for each management system. Positive gross profits indicate short term viability of an enterprise, which is calculated by subtracting variable costs from the gross income. The Village Based System and the tethered-grazing system in the new area are not viable in the short run indicating the risk of disappearance of these systems of animal raising within a short time span. Yet, it should be noted that the imputed cost of family labor takes a great share of the total labor cost in these systems. If the opportunity cost of family labor is assumed to be zero, then both these management systems become viable in the short run.

Net profits were calculated by subtracting imputed interest payments on capital and annual depreciation value of equipment from gross profits. An interest rate of 14 percent (which is the current rate of interest on savings deposits) was used. Here again net profits were estimated at two levels (with VC1 and with VC2). The long term viability of a productive activity is indicated by positive net profits and it is evident from Annexes 1,2,3 and Table 6.14, that even assuming zero opportunity cost of family labor, the Village Based System of management in the new area is not viable in the long run.

Table 6.14 Profitability of buffalo/cattle raising

Area	Management System	Gross Income (Rs.) 10^3	Variable Cost		Gross Profit		Net Profit	
			(1) (Rs.) 10^3	(2) (Rs.) 10^3	(1) (Rs.) 10^3	(2) (Rs.) 10^3	(1) (Rs.) 10^3	(2) (Rs.) 10^3
New area	Village Based	334.6	460.5	166.02	-125.9	168.58	-365	-90.9
	Migration	665.5	407.6	150.6	257.9	514.9	23.72	280.7
	Traditional	418.5	141.7	51.70	276.80	366.80	190.1	280.1
	Tethered Grazing	56.84	105.44	12.54	-48.60	44.31	-69	23.88
Old area	Village Based	1,169.	633.75	281.5	731.65	1083.9	278.3	630.5
	Jungle Based	328.0	164.8	128.8	225.2	261.2	-8.5	27.48
	Migration	3,735	1,340.3	711.35	2,046.1	2675.1	907.7	1,536.7
	Traditional	1,294	833.45	490.45	460.93	803.93	66.43	409.4

Note should also be made of the importance of family labor; especially women and child labor (of the herdsman's household) which form a large component of the labor time spent on animals reared under the Tethered Grazing System. Such labor is usually considered as 'non-marketable' or 'not easily marketable' labor. Under such conditions, by adopting the Tethered Grazing System, the herdsman is able to use resources whose opportunity cost is zero or low.

Table 6.15 gives the cost, gross income and net profits per livestock unit. In calculating the number of livestock units in a herd a cow in milk was considered as one livestock unit, non-lactating cows and bulls as 0.8 unit, heifers 0.6 unit, steers 0.4 unit and calves 0.25 unit (following Uluwishewa & Jayasuriya op.cit.).

Table 6.15 Profitability of cattle/buffalo raising (per livestock unit)

Area	Management System	Cost per Livestock Unit (Rs.)	Gross Income per Livestock Unit (Rs.)	Net profits per Livestock Unit (Rs.)
New Area	Village Based	948.74	689.33	-752.80
	Migration	729.16	1,190.54	42.42
	Traditional	648.36	1,914.89	870.21
	Tethered Grazing	2,516.35 (299.16)	1,356.56	-2667.39 (570.00)
Old Area	Village Based	863.65	1,593.62	112.2
	Jungle Based	873.80	1,739.13	-373.9
	Migration	469.11	1,307.39	439.80
	Traditional	983.42	1,527.28	78.38
Project		788.04	1,423.17	59.47

The cost of raising animals (variable cost) is lowest in the Migration System in the old area and highest in the Tethered Grazing System in the new area. However, if opportunity cost of family labor is considered to be close to zero, then the cost of raising animals in the Tethered Grazing System would be Rs. 299.16 per livestock unit the method incurring the least costs. For the project as a whole, the average cost of raising one livestock unit (a cow in milk, for example) is around Rs. 788/= per year.

The gross income (returns or value of output) per livestock unit ranges from Rs. 1,100/= to Rs. 1,900/= per year in all systems except the Village Based System in the new area, where returns per livestock unit are Rs. 689.33 - the lowest reported. For the project as a whole, returns per livestock unit are Rs. 1,423.17. The net profit per livestock unit appeared to be negative for the Village Based System and the Tethered Grazing System in the new area as well as for the Jungle Based System in the old area showing the risk of disappearance of these management systems. Yet, if imputed cost of family labor is considered to be zero, which is the case especially in the Tethered Grazing System, then the latter system too becomes viable in the long-run. For the project as a whole, positive net profits of Rs. 59/= per livestock unit per year reveal the long-term viability of the cattle and buffalo raising activity.

6.4.5 Institutional Aspects

Livestock support facilities extended by the KOISP

The institutional ability and experience of the Mahaweli Draft Animal and Dairy Development Program (MDADDP) was used to implement the KOISP livestock component, The Mahaweli Farm (as it is popularly known) was established under phase II of the project, at the

end of 1986 at Jambugaswewa in the Left Bank of the project area, bordering the Tissa-Kataragama road. Initially it was intended to provide the following facilities to the settler and non-settler herdsmen in the area:

- To develop a 80 ha. Service Center
- To import 25 purebred *Sahiwal* and 5 milking buffalo sires
- To establish a specialized Extension Service
- To purchase and supply to settlers some 2,800 local female cows and 400 local buffalo heifers
- To establish a milk collection, processing and sales system

The extent of the Service Center is around 174 ha., about 94 ha. above the planned area, which was mainly due to the fact that around half the extent of the Service Center consisted of unfertile land characterized by rocks and pebbles. Development activities of the land acquired for the Service Center commenced in mid 1987. Due to the scarcity of water only about 10 ha. of land could be irrigated and in maha 1989/1990 about 10 ha. of pasture was established with *brachiaria brizantha, brachiaria decumbens, Pannicum maximum* etc. However, during the dry months very few pasture stands could withstand the drought. Uluwishewa & Jayasuriya (*op.cit*) indicate that water was sprayed on pasture stands during the dry months at the rate of 12-15 bowsers/ha in 5 day intervals. Some of the grasses (such as *B.ruziziensis*) and legumes (*stylosanthes, centrosema*) originally planned to be established were never planted.

Upgrading the animals in the project area was another activity planned by the MDADDP. It was intended to use improved sires; purebred and 75 percent upgraded, to improve the herd in the area. It was planned initially to import 25 purebred *Sahiwal* cattle and 5 *Murrah* buffaloes from Pakistan and then to procure 30 more stud bulls of improved tropical breed locally. The second activity planned under the upgrading program was the purchase and distribution to farmers of 2,800 heifers (700 annually) and 400 three year old local buffaloes (100 annually). These heifers were to be purchased locally, quarantined in the Service Center for one month, tested for Brucellosis, vaccinated, mated and then supplied to selected herdsmen.

However, due to civil disturbances in the country, the livestock development program of the MDADDP could not be carried out according to the schedule and some of the services planned by the service center could not be rendered.

Extension services were also to be provided by the five high school graduate Livestock Officers employed by the farm. The planned activities included creation of demonstration homestead lots of integrated farming methods, whereby crop residues could be utilized to raise animals. The livestock officers were also expected to provide vaccination services to needy herdsmen. It was also planned to organize educational trips to various livestock farms for groups of selected livestock farmers.

Collection, processing and marketing of milk are three other activities in which the MDADDP planned to get involved. Milk Collecting Centers were to be established in various parts of the area with the help of livestock officers. The project anticipated an average daily collection of 1,000 liters of milk from the area. A mini dairy was also to be established with the intention of producing 3,300 cups (112 grams each) of yoghurt, 153 pots of curd and 75 kg. of butter per day to serve the consumers in the area.

Assessment of services rendered by the MDADDP (Mahaweli farm)

- The Cattle and Buffalo Upgrading Program

Various activities planned by the livestock center (MDADDP) could not be carried out as planned, mainly due to civil disturbances in the country that prevailed during the years 1988 and 1989. The purebred stud bulls expected to be imported at the commencement of the development activities arrived only in 1990. It appeared that the response of the herdsmen for the 'board and lodging' system was poor. The system failed due to two reasons. The first, was the feed problem that existed within the farm and the second, was the problem of transporting the animals encountered by the herdsmen. Most of the beneficiaries of this system has been the herdsmen in the Left Bank of the KOISP.

Table 6.16 *Services rendered by the Mahaweli Draught and Dairy Development Project*

Service Rendered	1990	1991	1992	1993	1994
Vaccinations (No.)	1,845	5,975	10,830	12,602	
Cattle Purchases from farmers (No.)	272	110	341	200	
Animals Culled and Resold (No.)		71	240	151	118
Milk Societies (No.)	4	4	4	4	4
Membership of Milk Societies (No.)	74	101	141	160	200
Milk Collection (Lt.)	39,852	71,981	75,770	69,412	39,200
Yoghurt Production (Cups)	48,627	190,344	102,857	97,240	43,240
Curd Production (Pots)	780	1,805	1,985	1,144	2,297
Ghee Production (Bottle)	24	193	201	210	89
Stud Bulls Issued to Farmers					
(a) Free					
(b) Sold	10	18	16	20	20
(c) Lending	8	7	10	10	8
Field Trips (No.)			1	1	
No. of Participants			28	25	
Heifers Distributed (No.)					
(a) *Sahival*		92	124	100	60
(b) *Murrah x Niliravi*		42	34	46	30

Due to the failure of the 'board and lodging' system, stud bulls were also stationed at 5 stud bull centers in the Left Bank. These stud bulls were reared for free by selected herdsmen. This produced better results than the 'board and lodging' system.

It has been noted that the farmers' "poor knowledge in heat detection and non-castration of local males in their herds had reduced the possibility of getting hybrid offspring" (Uluwishewa & Jayasuriya op.cit. : 72).

Stud bulls were also sold to the needy farmers through bank loans arranged by the farm. The number of stud bulls sold to farmers reached its maximum of 20 animals during the year 1993 (Table 6.16). This number appears to be quite low showing the unpopularity of this activity among the herdsmen.

Herdsmen could also borrow stud bulls from the farm for mating the females in their herds. The number of animals provided to farmers under this program was 10, both in 1992 and 1993 (Table 6.16), showing that the system is not popular among herdsmen. Many herdsmen are reluctant to obtain stud bulls under this system because of the likelihood of theft of animals, in which case the borrower has to pay the full cost of the animal to the farm. This is especially true with herdsmen adopting extensive systems of buffalo and cattle raising.

The upgrading program also included the activity of procurement and distribution of purebred Sahival cattle heifers and cross-bred *Murrah* x *Niliravi* buffalo heifers to needy herdsmen. This program was implemented in 1991, 376 Sahival heifers and 152 *Murrah* x *Niliravi* heifers have been distributed to herdsmen. Some of these purchases have been arranged through loans provided by State Banks. But, as Table 6.16 indicates, the number of animals distributed under this system generally shows a declining trend since 1992.

Purchasing and distribution of 2,800 two year old Sinhala heifers (700 annually) and 400 three year old local buffaloes was another activity planned by the livestock center over a four year period. The intention was to reduce the existing herds of free ranging, low productive animals by replacing them with selected good breeding animals. Table 6.16 shows that, starting in 1990, the farm has been engaged in purchasing of cattle from herdsmen and reselling back to them after culling, vaccination and mating. However, only cattle have been distributed under this system and the numbers distributed have been low (maximum of 240 in 1992) compared to the expected annual distribution of 700. A total of 580 animals have been distributed under this system as against the planned distribution of 2,800 animals. The same program for buffaloes that was planned initially was never implemented.

The failure of the above program can be attributed to several reasons as indicated below:

(a) Herdsmen were reluctant to obtain breeding cows from the farm because they were uncertain whether they would get a hybrid calf sometime later.

(b) Complaints were reported that some cows had problems delivering hybrid calves of large body sizes.

(c) Since pregnancy tests were not conducted in the farm, some herdsmen stated that these breeding cows had already conceived when they were purchased by the farm. Therefore, there was a high risk of obtaining local calves from the purchased breeding animals.

(d) The 'feed problem' too imposed limits on the number of breeding animals that could be kept on the farm.

- Milk Collection and Marketing

With the help of four livestock officers recruited by the MDADDP, four milk collecting centers were established. Groups of producer herdsmen were formed under the canopy of a cooperative around these centers. These societies were provided with capital costs for the building, milk testing equipment, bulk cans, tables, record books, etc. During the first year of operation, the cost of keeping a secretary was also borne by the project.

Table 6.16 shows that although the membership in milk societies has grown from 74 in 1990 to 200 in 1994 (up to September), annual milk collection was highest in 1992 and has declined since then. It is evident that the MDADDP has not been able to compete with the private dealers of milk such as Milco and Nestle, to whom most of the herdsmen sell their milk today. When herdsmen sell their milk to the MDADDP, they have to take their milk to one of the collecting centers whereas the private milk dealers such as the MILCO and NESTLE have their own local suppliers who operate as small-scale collectors in villages. They traverse the villages in their two wheel tractors collecting milk from producers. Obviously, the latter system is much more convenient to the herdsmen

- Extension

After 1991, few demonstration trials (straw treatment demonstrations) have been carried out by the livestock officers. The vaccination program implemented with the help of the livestock officers appeared to be one of the most efficient services rendered by the MDADDP. Vaccinations, which numbered 1,845 in 1990, increased to 12,602 by the year 1993 (see Table 6.16). Apart from this, two field trips had been organized by the MDADDP; one in 1992 and the other in 1993, with the participation of 23 and 25 herdsmen respectively. Compared to the training resources possessed by the farm and the needs of the herdsmen in the area, the services rendered under the extension activities can hardly be called adequate.

The production of the mini-dairy of the MDADDP also shows a declining trend since 1992 (Table 6.16) indicating the declining output of products such as yoghurt, curd and ghee. This can be attributed to the decreasing amount of milk collected by MDADDP.

Table 6.17 gives a summary of information obtained from herdsmen on services they have obtained from the Mahaweli Farm (MDADDP).

Table 6.17 Receipt of services rendered by the Mahaweli Farm

Service Received	Percentage of Herdsmen Reporting (Old Area) n = 68	Percentage of Herdsmen Reporting (New Area) n = 32
Milk marketing facilities	8.82	25.00
Stud bulls	17.65	21.86
'Board & lodging system'	0.00	6.25
Improved animals (cows and calves)	0.00	15.63
Veterinary services	11.76	25.00
Training programs and field trips	10.29	12.50

The major beneficiaries of the services rendered by the MDADDP, the major beneficiaries have been the herdsmen in the New Area. Milk marketing facilities, stud bulls and veterinary services have been obtained by approximately a quarter of the sample herdsmen in this area. In the old area, such services have been obtained by only a tenth of the sample herdsmen except the receipt of stud bulls which has been reported by nearly a fifth of the sample herdsmen.

Veterinary Surgeon's Office at Tissamaharama

This office consists of a veterinary surgeon and 3 livestock development instructors who are engaged in the provision of veterinary services to the people in the Tissamaharama AGA division. The present program of activity includes - vaccinations for HS & FM, training classes for cattle farmers, artificial insemination, castration, supply of stud bulls, etc. With the cessation of an array of activities of the MDADDP in 1994, including the vaccination services, the veterinary surgeon has commenced to shoulder a heavy burden of vaccinating animals in the KOISP area. Table 6.18 gives the number of visits by and to the veterinary surgeon as reported by the sample herdsmen in both new and old areas.

Table 6.18 Number of contacts of veterinary surgeon

Number of Contacts in 1993	Percentage of Herdsmen Reporting (Old Area)	Percentage of Herdsmen Reporting (New Area)
1	30.88	9.37
2	22.06	28.13
3	10.29	18.75
4 and above	16.18	34.38
no contact	20.59	9.37
Total	100.00	100.00

It is evident that the veterinary services provided by the veterinary surgeon's office have been utilized by nearly 90 percent of the herdsmen in the new area and 80 percent of them in the old area. Moreover, information furnished in Table 6.18 also reveals that more than 80 percent of the herdsmen in the new area have met the veterinary surgeon twice a year or more while the corresponding figure for the old area is 50 percent. Most of the veterinary services obtained by herdsmen are vaccinations for HS and FM.

Institutional credit for livestock development

With the establishment of the MDADDP livestock center at Jambugaswewa, loan schemes were designed to help the needy herdsmen to purchase stud bulls or improved heifers from the farm. While the center acted as the mediator, the state banks provided the loans. However, field studies revealed that only 3 herdsmen out of a sample of 68 (4 percent) in the old area and 1 herdsman out of a sample of 32 (3 percent) in the new area have obtained loans from state banks for the purchase of stud bulls while none has borrowed to purchase heifers. The total amount of all money borrowed from state banks by the sample respondents amounted to Rs. 74,000.00 of which Rs. 33,000/= have already been repaid. Since buffalo and cattle are raised on open land without any protection, there is a high risk of good animals being stolen by cattle thieves. On the other hand, as was already pointed out the herdsmen did not have much faith in the improved animals provided by the Mahaweli Farm. Therefore, the low demand for loanable funds does not necessarily indicate that institutional credit is not important for livestock development in the area. The problem was associated with the nature of the livestock rearing system which did not induce herdsmen to acquire good valuable animals to the herd.

Hambantota Milk Producers' Cooperative Society

This society was established under the Integrated Rural Development Project of Hambantota. This society too collects about 75,000 liters of milk annually from the herdsmen in the KOISP area, that is from Mattala and Addala. However, compared to the total quantities

handled by other private collectors such as Milco and Nestle, the quantities are small. It should be noted that the efficiency of services rendered by this society depends heavily on the activities of this society in terms of collecting and marketing of milk of the herdsmen in the Hambantota District rather than those in the KOISP area.

Cattle Owners' Associations

The pervasive problem of crop damages by cattle, the rising conflict between herdsmen and cultivators and the strongly felt need for grazing land to feed their large herds was recognized by most of the herdsmen in the KOISP area. During the latter part of 1991 and the early 1992, these herdsmen formed three Cattle Owners Associations (COAs): the Beralihela, Magampura and Ruhunu. While the major command area of the Beralihela COA is the new area, that of the Magampura is the old area, while the Ruhunu COA consists of herdsmen belonging to both new and old areas.

Information obtained from sample herdsmen with respect to the services rendered by these associations are summarized in Table 6.19.

Table 6.19 Services rendered by Cattle Owners' Associations

Service	Percentage of Herdsmen Reporting (Old Area) n = 68	Percentage of Herdsmen Reporting (New Area) n = 32	Percentage of Herdsmen Reporting (Project) n = 100
Milk collection	45.6	50.0	47.0
Solving conflicts with cultivators	47.1	75.0	56.0
Obtaining grasslands	35.3	62.5	44.0
Education and training	4.4	15.6	8.0
Other	7.4	9.4	8.0

Table 6.19 reveals that the major functions performed by the Cattle Owners Associations at present are the collection of milk, intervening in the problem of crop damages by animals which usually gives rise to conflicts with cultivators and working towards obtaining suitable grazing land for cattle and buffalo populations from the government.

The Magampura COA is directly engaged in milk collection while other COAs are indirectly providing this facility. Today, COAs have given strength to herdsmen in the KOISP area in solving conflicts with cultivators which often results in herdsmen paying crop damages to cultivators. Before the COAs were formed, many herdsmen said that their bargaining power against the cultivators was low and, with the major emphasis on crop production under

irrigation, the farmers enjoyed a privileged position. Today, the office bearers of the COAs directly intervene in solving 'Cattle Problems'.

It is said by many herdsmen that the major push for the formation of COAs came from the urgent need to find suitable grassland for the large herds. All the COAs have identified suitable grazing land to feed their large herds and discussions have been carried out at various levels of authority to obtain these lands. The Magampura COA has already received the Amarawewa grazing land which is 1,000 ha. in extent. Yet, this grazing land cannot be made full use of due to insufficient availability of water and land encroachment by chena cultivators. Cultivated plots of crown land can be seen in the Amarawewa grassland today.

When asked as to whether the herdsmen are satisfied with the services rendered by the COAs, 46 percent herdsmen members said they are satisfied, while 23 percent of them were not satisfied with the services. About another 30 percent did not respond to the question.

6.4.6 Problems of Livestock Rearing in the KOISP Area

Cattle and buffalo raising

In Table 6.20, a summary of all major problems indicated by sample herdsmen in raising buffalo and cattle in the KOISP area is presented.

Table 6.20 Problems of buffalo/cattle raising in the KOISP area

Major Problems	Percentage of Sample Herdsmen (Old Area) n=68	Percentage of Sample Herdsmen (New Area) n=32	Percentage of Sample Herdsmen (Project) n=100
Insufficient availability of grazing land	94.1	93.8	94.0
Low milk prices	1.5	6.3	3.0
Inadequate veterinary services	42.6	28.1	38.0
Milk marketing problems	33.8	65.7	44.0
Cattle thieves	66.2	31.3	55.0

It is evident from Table 6.20 that the major problems encountered by the herdsmen today are associated with insufficient availability of grazing land, inadequate veterinary services, milk marketing and animal stealing problems. The problem of stealing animals by thieves is a problem that has arisen recently with the higher rate of animal sale for meat. It appeared that mobs of thieves have emerged who steal animals and sell them to cattle merchants who operate in the area.

Insufficient availability of grazing land

- Destruction of Traditional Grazing Land

Large extents of forest land were cleared and hundreds of small tanks found in these lands were levelled to develop land for cultivation under the KOISP. The proponents, at the initial stages of the project, had really underestimated the significance of these forest land and small irrigation tanks in the sustenance of the traditional livestock raising system in the area, the Ruhunu dairy industry. As Uluwishewa & Jayasuriya (op. cit) note "the project's concern was only the timber value of these jungles and scrublands". Whatever tanks and scrublands remain, they still provide grazing grounds for the cattle and buffalo herds in the area. Among the more important small-scale irrigation tanks that were sources of drinking water and wallowing sites for animals, which were destroyed to make room for the large-scale irrigation development work of the KOISP, were Lassanawewa, Asarappliwewa, Galwewa, Tammanawewa, Kodigahawewa, Beralihelawewa, Bogahawewa, Punch Appuduwewa and Julmullawewa.

- Chena Cultivation

Apart from the project activities, land encroachment at a rapid pace by chena cultivators and their land clearing activities have resulted in siltation of tanks. The water holding capacity of most of the tanks has declined and they dry out rapidly during the dry season. The animals have to walk long distances to find water and, along with poor feeding, animals lose weight and their milk yield drops. Under these conditions of stress most herdsmen do not milk their animals. Those who milk report very low milk yields of less than half a liter per animal per day.

- Short Fallow Period

Another problem that emerged with the implementation of the KOISP resulted from the possibility of cultivation during the yala season. Irrigation water is issued to the old area during the yala season and settlers in the new area are requested to cultivate Other Field Crops (OFC) during this season when water is insufficiently available. These two activities had serious adverse effects on the dairy industry. Yala cultivation drastically reduced the fallow period during which time the animals used to feed on stubble left in the fields. OFC cultivation was done in unprotected pockets dispersed in tracts. Therefore, crop damage by grazing animals became a serious problem. In order to avoid this, the herdsmen were forced to move their herds away from the fallow paddy fields where OFC are cultivated. It is clear that the present cropping pattern has imposed restrictions on cattle and buffaloes to feed on fallow paddy lands during yala, which in the traditional Kirindi Oya was an important source of food for animals.

The most immediate consequence of the insufficient availability of drinking water and wallowing sites for animals is the drop in average milk yield of animals during the dry season. It was evident that milk collection during the dry season is roughly half of that during the wet season.

- Conflict between Herdsmen and Cultivators

With the loss of traditional grazing land, animals were often raised close to the cultivated plots of land. This increased the risk of crop damage by buffaloes and cattle. Some animals still have the tendency to use their age-old (traditional) 'cattle corridors' to move in search of food. But even main irrigation channels have been built across these corridors by the project. Today, a considerable damage to crops is caused by cattle and buffaloes which is considered to be the major cattle problem. It should be noted that fencing of cultivated plots was done even by the traditional Kirindi Oya folk to keep animals away from their plots. In fact, the herdsman and the cultivator happened to be the same person in many occasions. At present, cultivators and herdsmen are often two categories of people who are in conflict with each other. Although cultivators are expected to erect fences around their plots, this is not properly done by cultivators. On the contrary, they expect the herdsmen to keep their animals away from the cultivated plots of land.

Today, costs incurred by herdsmen for crop damages caused by their animals form a considerable portion of the variable cash costs of cattle and buffalo raising. Some herdsmen, in the Migration System in the new area pay crop damages equal to almost 38 percent of the variable cash costs of production (see Annex 1). Obviously, crop damages do not form an important cost item in the Jungle Based System of management.

The cattle problem is largely a problem that emerged and continued after the initiation of the KOISP due to greater concern for crop production rather than livestock raising at the initial stages. This is the reason why many cultivators neglect putting up proper fences, thinking that it is the responsibility of the herdsmen to keep their animals away. Yet, the project had a scheme where settlers were provided with barbed wire to erect fences around their plots, but proper monitoring has not been carried out.

Problems Associated with Milk Marketing

Most of the problems that are associated with milk marketing are problems of transportation and price fluctuations during the year. Table 6.21 provides a summary of information obtained from sample herdsmen on the problems associated with milk marketing.

Table 6.21 Milk marketing problems

Problem	Percentage of Herdsmen Reporting (Old Area) n=68	Percentage of Herdsmen Reporting (New Area) n=32	Percentage of Herdsmen Reporting (Project) n=100
Transportation	36.8	25.0	33.0
Low price	16.2	9.4	14.0
Price fluctuation	25.0	12.5	21.0
Quality deterioration during transportation	1.5	3.1	2.0

- Milk Collection

Today, cow milk in the KOISP area is collected by two large private companies Milco and Nestle, the Hambantota Milk Producers Cooperative Society and the Milk Collecting Centers of the MDADDP. The latter is now selling all its excess collected milk to the above mentioned private collectors. Buffalo milk, on the other hand, is mainly sold through a large number of small-scale private collectors for the production of curd. Milk collection by major collectors in the KOISP area for the first 6 months of the year 1994 and the share of each collector in the total collection by all major collectors are given in Table 6.22.

Table 6.22 Collection of milk in the KOISP area

Major Collector of Milk	Total Collection (Jan - July 1994) (Lt.)	Share of the Total Collection (Lt.)
Nestle	304,073	50.6
Milco	219,050	36.4
Hambantota Milk Producers' Cooperative	38,898	6.5
MDADDP (Mahaweli Farm)	39,200	6.5
Total	601,221	100.0

It is clear that Nestle and Milco together handle about 87 percent of all milk collected by major producers in the KOISP area indicating that prices and services offered by these channels have a large influence on the dairy industry of the area.

It should be noted that the market for buffalo milk is more competitive than for cow milk. A large number of private collectors are involved in collecting buffalo milk and the price paid for this milk is considerably higher than cow milk (Table 6.23).

Table 6.23 *Milk prices*

Type of Milk	Average Prices reported by Sample herdsmen (Old Area) (Rs./Lt.)	Average Prices reported by Sample Herdsmen (New Area) (Rs./Lt.)
Buffalo Milk	16.10	17.10
Cow Milk	9.50	9.60

It is evident from Table 6.23 that buffalo milk receives a price which is about 70 percent higher than what is received for cow milk. There does not exist a perfect market for cow milk since the two major collectors handle more than 80 percent of the milk collected by major producers. Although the price paid for cow milk by these collectors depends on the fat and SNF content, about a fifth of the sample herdsmen reported that they are not paid according to fat quantity. This may happen in remote areas where milk is collected by collecting agents of Milco and Nestle who probably pay a flat rate to producers.

As indicated earlier, due to loss of grazing land with the implementation of the KOISP, many herdsmen took their herds to remote jungle areas in search of food and water for the animals. One of the major problems that arose with this movement is the problem of transportation of milk to the collecting centers. Very often the herdsmen use motorcycles for daily transporting milk from the producing areas to the collecting centers. Two related problems of this routine are firstly the quality deterioration of milk during transportation over long distances and secondly the high cost of transportation, which is especially felt during the dry months when the average milk yield of animals drops by about half.

Due to quality deterioration during transportation, a good number of herdsmen seemed to mix their milk with H_2O_2 although the practice is prohibited. Accurate information on this practice was not available for further confirmation.

Due to the above problems, many herdsmen say that they do not milk their animals during the lean months. This is also done not to exhaust animals who do not find sufficient water and food during these months.

Inadequate Veterinary Services

With the termination of most of the livestock development activities of the MDADDP by the end of 1993, the herdsmen no longer received services such as vaccinations, provided by the livestock officers of the Mahaweli Farm. Today, only one livestock officer is attached to the farm whose major responsibilities lie in milk collection. Compared to 12,602 vaccinations performed

by livestock officers in 1993, the number of vaccinations performed in 1994 by the Mahaweli farm has fallen to zero. Naturally, the veterinary surgeon can not handle all the veterinary needs of the herdsmen. It appears that insufficient veterinary services would be a serious constraint to the development of the livestock industry in the KOISP area .

6.5 Concluding Remarks and Recommendations

6.5.1 Achievements Compared to Objectives

It is evident that the project, at its initial stages, failed to recognize the Kirindi Oya area as an important cattle and buffalo raising area. The significance of the scrub jungles and the countless number of small irrigation tanks in the sustenance of this livestock rearing system was not realized. Most of the problems confronted by herdsmen today are the result of this negligence.

Although it was envisaged to develop 1,000 ha. for livestock development and agro-forestry, this reforestation project failed to contribute any notable impetus to the development of the livestock industry. Hardly any management system based on these reforested land was found in the present study.

While the project planned an incremental production of 4.1 million liters of milk annually, it appeared that even the total collection of milk from the area today is less than this figure. Information obtained from the two largest milk collectors Nestle and Milco reveal that they together handle approximately 50 percent of all cow milk produced in the KOISP area. With a total collection of 601,221 litres of milk during the first 7 months of the year 1994 and assuming a half of that quantity for the last five months of the year (which is usually the case in the dry months starting in June/July), the total quantity collected would amount to 900,000 litres. Therefore, the total production of cow milk in the KOISP area would be around 1.8 million litres a year. Since the buffalo population and the average milk yield per cow are not much different from that of cattle, one may assume the same quantity of milk produced by buffaloes. Therefore, the total quantity of milk produced in the KOISP area would be roughly around 2.6 m litres, which is far below even the incremental milk yield envisaged in the project proposal.

With respect to the objective of improving living conditions of the settlers, the project has been able to help a few settlers (about 5 percent in the new area and 3 percent in the old area) to take up livestock raising on a small scale. Yet less than half of these herdsmen used improved breeds of cattle and buffalo and it appeared that they are only concerned with meeting home consumption needs of milk. Therefore, they are not much interested in purchasing expensive animals which can produce high average milk yields but need closer attention and more purchased production inputs. Most of these herdsmen (under the Tethered Grazing System) obtained their animals from fellow herdsmen. More herdsman-settlers than settler-herdsmen have obtained improved animals as provided by the MDADDP.

Poultry appeared to be a livestock enterprise gaining popularity among settlers. Settlers rear poultry mainly for egg production to meet domestic consumption needs rather than for the market. Various costs and returns associated with this activity could not be obtained from settlers because the activity depends purely on family labor and household resources. Settlers

who raised poultry complained of the lack of extension education facilities for this activity. In view of the nutritional status of households, this is an activity that should receive attention of those concerned about the development of the Kirindi Oya area.

Goat farming is not a popular practice in the Kirindi Oya area (only one farmer in the old area reportedly kept goats), although it is an animal which is well adapted to dry zone scrublands as found in the KOISP area. Research work carried out by Dr. W.W.D.A. Gunawardena of the Faculty of Agriculture of the University of Ruhuna reveals that this animal can be very profitably raised by the people in this area. As in the case of poultry, when asked about raising these animals on a small-scale many settlers said that they are reluctant to undertake this lacking the knowledge. What is therefore required is a well formulated extension program with incentives for innovators and early adopters.

It can generally be said that the project has failed to achieve its objectives with respect to the dairy industry, but some progress is seen in the raising of other livestock such as poultry which can contribute significantly to improve the level of nutrition of the population. Even with regard to dairy industry some progress has been achieved in bringing down calf mortalities and in improving and upgrading herds. Systems like the Tethered Grazing System which makes use of 'non-marketable' resources appeared to help settlers to raise livestock at the least possible costs to meet domestic consumption needs.

6.5.2 Present and Future of the Livestock Industry

Of the different types of large scale cattle and buffalo raising systems, the Village Based and Jungle Based Systems of management would disappear in the long run for these systems enjoy negative net profits. Migration and Traditional Systems would remain but their sustenance depends on the rate of deforestation for other development activities and the rate of encroachment of jungle land by chena cultivators. One of the most important strategies in helping the livestock industry in the KOISP area is to allocate grazing land for the herdsmen in the three Cattle Owners Associations. These associations should be helped by way of technical support required for reconstruction of tanks which are in a ruined status and, to dig wells. Not only grazing lands should be allocated but they should be properly protected by enforcing laws against encroachment by chena cultivators and erecting fences around the lands to protect herds from wild animals. The herd sizes would then be stabilized in the long run after getting adjusted to the available resources.

The other important aspect of intervention is to impose strict rules and regulations on cultivators to put up proper fences around their cultivated plots. The bias against the herdsmen in paying crop damages caused by animals can not be justified at all occasions.

It is of paramount importance to strengthen the veterinary service and the herd improvement program. It is quite clear that the staff at the veterinary surgeons office at Tissamaharama can not cater to all needs of herdsmen in the area. Although the herd improvement program could not achieve much in terms of targets, it has been able to improve the herd composition by upgrading the herds with improved animals to some extent. One should make note of the fact that the clientele included herdsmen who used to rear animals in the open scrublands using traditional techniques. As fundamentals of extension education have

taught us, changes in the attitudes of these traditional herdsmen towards new techniques of livestock development would take place over a much longer period of time than what the project proposal envisaged. In this respect, is the function performed by the 'agent of change' - the extension officer is more important. Therefore, a good herd improvement program should be supported by a strong extension service that encompasses farmer training classes, focussed not only on a particular practice but on the livestock production activity as a whole. At the initial stages of such a program, the number of improved animals distributed among herdsmen can be kept small with more funds to build up an extension program.

Milk marketing has been pointed out as a major problem in the area, but it is not very significant compared to other problems enumerated above. There is enough competition for buffalo milk and the market can be considered as 'near perfect'. There are no complaints about marketing of buffalo milk. The problem is more acute with cow milk where collecting centers are located away from producing areas and where there exist an oligopsony rather than a perfect market. One solution is to help herdsmen establish more collecting centers under the leadership of Cattle Owners Associations. These associations should be helped to set up milk societies by way of providing milk marketing equipment, soft loans, other technical help, etc. This decentralization of collection points would also keep herdsmen from adding H_2O_2 to arrest deterioration of milk quality. Herdsmen did not complain about milk prices, other than fluctuation of prices, which is largely a matter of supply which varies due to natural factors.

The livestock center of the MDADDP farm at Jambugaswewa could still serve as the Livestock Center for the area. The services of this center should be extended to include herdsmen in the old area. As noted earlier, attention should be focussed on strengthening the extension base of it rather than expanding and increasing technical input packages. One should make note that awareness, interest, experiment, all precede actual adoption of an innovation.

Annex 6.1 ***Profitability of cattle and buffalo raising***

Table A-6.1 *Profitability of cattle and buffalo raising - new area*

Profitability	New Area		
	Management System		
	Village-Based Total (Rs.)	Migrating Total (Rs.)	Traditional Total (Rs.)
Capital Costs			
Sheds for Cattle and Labour	0	1000	0
Total Value of Herd	1449000	1620700	612800
Value of Instruments	19455	36430	4110
Total	1468455	1658130	616910
Variable Costs (1993)			
Motor Cycle/Maintenance/Repair	12700	29400	7000
Consumables	2700	1000	0
Ropes	7400	10600	4000
Food	6500	1000	0
Veterinary Services	15800	18100	500
Fuel	58350	20000	19000
Labour			
Hired Labour	29500	13600	12000
Family (Owner)	277500	240000	90000
Family (Wife)	0	0	0
Family (Children)	17000	17000	0
Crop Damages	27570	56900	9200
Other Costs	5500	0	0
Total VC 1 (with Family Labour)	460520	407600	141700
Total VC 2 (without Family Labour)	166020	150600	51700
Annual Value of Output (1993)			
Sale of Milk			
Buffalo	149000	52000	65000
Cattle	65900	387000	92500
Curd	37200	0	0
Hiring Out Animals	5000	0	0
Sale of Animals for Meat	77500	226500	261000
Gross Income	334600	665500	418500
Crop Damages as a % of VC 1	5.9867106749	13.959764475	6.4925899788
Crop Damages as a % of VC 2	16.60643296	37.782204515	17.794970986
Contribution of Sale of Animals to Gross Income	23.161984459	34.034560481	62.365591398
Imputed Interest on Capital	255599	226898	85792
Annual Depreciation	3891	7286	822
Gross Profit 1	-125920	257900	276800
Net Profits 1	-365410	23716	190186
Return to Capital 1	-24.883976697	1.4302859245	30.828808092
Return to Labour 1	-84.585648148	6.5731707317	139.84264706
Cost per Livestock Unit	948.74	729.16	648.36
Net Profit per Livestock Unit	-752.8	42.42	870.21
Cost of Hired Labour	29500	13600	12000
Cost of Family Labour	294500	257000	90000
Total Labour Cost	324000	270600	102000
Total Man Days	4320	3608	1360
Gross Profits 2	168580	514900	366800
Net Profits 2	-90190	280716	280186

Table A-6.2 Profitability of cattle and buffalo raising - old area

Profitability	Old Area			
	Management System			
	Village-Based Total (Rs.)	Jungle-Based Total (Rs.)	Migrating Total (Rs.)	Traditional Total (Rs.)
Capital Costs				
Sheds for Cattle and Labour	1000	0	5500	6000
Total Value of Herd	3184400	1658000	7999550	2717900
Value of Instruments	37520	8000	92440	69970
Total	3222920	1666000	8097490	2793870
Variable Costs (1993)				
Motor Cycle/Maintenance/Repair	19900	10800	88900	39400
Consumables	15000	0	11200	28000
Ropes	18750	4400	40700	29600
Food	0	1000	9300	0
Veterinary Services	10500	2600	52900	10000
Fuel	58000	41000	151300	139250
Labour				
Hired Labour	94250	48000	176400	118400
Family (Owner)	340250	36000	531000	321000
Family (Wife)	12000	0	12000	5000
Family (Children)	0	0	86000	17000
Crop Damages	65100	21000	169650	120800
Other Costs	0	0	11000	5000
Total VC 1 (with Family Labour)	633750	164800	1340350	833450
Total VC 2 (without Family Labour)	281500	128800	711350	490450
Annual Value of Output (1993)				
Sale of Milk				
Buffalo	240000	200000	1633375	253375
Cattle	335400	20000	738500	486000
Curd	432000	0	241100	216000
Hiring Out Animals	0	90000	0	0
Sale of Animals for Meat	162000	18000	1122500	339000
Gross Income	1169400	328000	3735475	1294375
Crop Damages as a % of VC 1	10.2721893491	12.7427184466	12.657141791	14.4939708441
Crop Damages as a % of VC 2	23.126110124	16.304347826	23.84901947	24.630441431
Contribution of Sale of Animals to Gross Income	13.8532580811	5.487804878	30.049725938	26.190246258
Imputed Interest on Capital	445816	232120	1119937	380506
Annual Depreciation	7504	1600	18488	13994
Gross Profit 1	731650	225200	2046125	134350
Net Profits 1	278330	-8520	907700	-260150
Return to Capital 1	8.6359574547	-0.5114045618	11.209646446	-9.3114568681
Return to Labour 1	46.751985863	-7.6071428571	84.526374799	-10.497877423
Cost per Livestock Unit	20007.52	1601.25	21660.47	15292.4
Net Profit per Livestock Unit	-4194.5	774.12	14212.6	-2300.07
Cost of Hired Labour	94250	48000	176400	14400
Cost of Family Labour	352250	36000	629000	516500
Total Labour Cost	446500	84000	805400	582900
Total Man Days	5953.33	1120	10738.66	24781.2
Gross Profits 2	1083900	261200	2675125	634950
Net Profits 2	630580	27480	1536700	520691

Table A-6.3 Profitability of cattle and buffalo raising by settler-herdsmen

Profitability	New Area Settler-Hersmen Tethered-Grazing System Total (Rs.)
Capital Costs	
Sheds for Cattle and Labour	4250
Total Value of Herd	142350
Value of Instruments	2500
Total	149100
Variable Costs (1993)	
Motor Cycle/Maintenance/Repair	0
Consumables	0
Ropes	3450
Food	535
Veterinary Services	8550
Fuel	0
Labour	
Hired Labour	0
Family (Owner)	18000
Family (Wife)	40900
Family (Children)	34000
Crop Damages	0
Other Costs	0
Total VC 1 (with Family Labour)	105435
Total VC 2 (without Family Labour)	12535
Annual Value of Output (1993)	
Sale of Milk	
Buffalo	0
Cattle	51840
Curd	0
Hiring Out Animals	0
Sale of Animals for Meat	5000
Gross Income	56840
Crop Damages as a % of VC 1	0
Crop Damages as a % of VC 2	0
Contribution of Sale of Animals to Gross Income	8.7966220971
Imputed Interest on Capital	19929
Annual Depreciation	500
Gross Profit 1	-48595
Net Profits 1	-69024
Return to Capital 1	-46.293762575
Return to Labour 1	-55.724734794
Cost per Livestock Unit	2516.35
Net Profit per Livestock Unit	-2667.39
Cost of Hired Labour	0
Cost of Family Labour	92900
Total Labour Cost	92900
Total Man Days	1238.66
Gross Profits 2	44305
Net Profits 2	23876

CHAPTER 7

FORESTRY

7.1 Selection of the Project Site and Project Activities

The "Preparation report - Kirindi Oya Irrigation and Settlement Project (Phase II)" produced by the ADB, in its Appendix 7 spells out the area selection and activities with regard to community forestry and environmental issues. This chapter is based on the proposals and targets given in this document for the following components.

(a) Nursery development
(b) Woodlot development
(b) Homelot development
(d) Live fencing
(e) Extension services
(f) Fuel efficient cook stoves
(g) Forests in the project
(h) Elephant relocation

The social forestry component of the KOISP was launched by the Land Commissioner's Department, with the Forest Department as the executing agency. Social forestry operations commenced in 1986.

Of the above 8 components, the dissemination of fuel efficient cooking stoves has not been implemented in the project area.

For the development of woodlots, the project document had identified about 300 ha.of land within the Phase I command area and another 300 ha.of land in the Phase II area.

The lands in Phase I (new area) are located in the tracts 1, 2 and 5 of the Right Bank and tracts 1 and 2 of the Left Bank. Lands in Phase II (new area) are located in the tracts 3, 4, 6 and 7 of the Right Bank and tracts 3 and 4 of the Left Bank.

However, the lands selected for the woodlot program are confined to the RB tracts 1, 2 and 5 and LB tract 2 only. Though the target given was 1000 acres, only 687 acres were allocated for woodlot development. The Forest Department has selected the areas preferred by the farmers from the available lands. There have been no takers beyond this acreage.

The Forest Department nursery at Tanamalwila was identified to produce all planting material for the project. But this nursery has supplied plants only during the first year of operations, that is 1986. Thereafter the Forest Department has opened up a new central nursery at Lunugamvehera, within the project area. This was a good move which reduced the cost of transport. The Lunugamvehera nursery continues to supply plants to farmers in the project area.

The nursery has produced about 1,100,936 plants during the project period. But only 606,180 plants have been established in the woodlots, homelots, medicinal herb gardens and road

side avenues. Another 100,000 plants has been issued as extension material. This shows that over 35 percent of the stock has been utilized for filling up (vacancy planting) in all the programs. This heavy beating up can be due to the unexpected droughts, poor quality of plants produced, poor coördination of supplies during the planting period and the indifference of some farmers.

Homelot development is the most important and interesting intervention carried out by the Forest Department. The Forest Department has experience with a community forestry project in 1982. They have substantial practical experience in forestry extension work. This experience has been very useful in the homelot development. About 4,180 households were identified by the foresters in the command area, in the tracts 1, 2, 5, 6 and 7 at the Right Bank and tracts 1, 2 and 3 at the Left Bank, a total of 24 hamlets.

Women and children have been involved in the development of homelots. Foresters had discussions with the families, especially the lady of the house to find out what type of tree is preferred by them. They had opted for varieties such as pomegranates, lime, *cadju, divul, siyambala, margosa, jak* and *halmilla* for timber and *ehela* for ornamental planting. Medicinal tree species and *vativer* grass also were planted.

The communal disturbance in 1988/1989 and inclement weather conditions led to repeated beating up. The homelot tree species produce very little fuel wood. Fuel is obtained from the woodlots, and agricultural residues. Few coconut seedlings have been distributed by the Coconut Development Authority, but no records are available. See Annex 7.2, Map 7.1.

The establishment of medicinal herb gardens was not indicated in the original document. But the Forest Department has been very thoughtful in introducing this component. The village farmers depend heavily on *Ayurvedic* treatment for common diseases such as influenza, colds, cough, rheumatism, cuts, wounds and snake bites. They require a variety of medicinal herbs for treatment. The medicinal herb gardens, each 1 acre in extent, have been located close to the dwelling places of *Ayurvedic* physicians, community centers and schools. The herb gardens though well established in certain locations, are generally not maintained.

Planting of roadside avenues is also not indicated in the original document. But a good job has been done by the farmers who have planted over 30 km. of roadside avenues. These avenues have ameliorated the climatic conditions of the area. They also serve as wind breaks and as a source of seed material. Most of the roadside avenues are available on the Left Bank. See Annex 7.2, Map 7.2.

7.1.1 Nursery Development

The target set by the Forest Department was to raise 500,000 seedlings annually. According to the planning six maha seasons were identified for plant production from the year 1986/1987 to 1992/1993. Three million plants were to be produced in the Forest Department nurseries.

According to the Forest Department figures the number of plants raised in the nurseries was 1,042,549, while the number of plants supplied to the farmers amounted to 1,100,936. The number of plants supplied from the Tanamalwila nursery has not been recorded, therefore the

excess may be due to the plants supplied in 1986 from the Tanamalwila nursery and the plants purchased from outside. Plants from outside amounts to 58,387. This means that the number of plants produced is far below the projected 3 million. Leaving aside the failures in 1988 and 1989 (period of unrest in the country) the production is still very low. This may be due to the reduced extent of wood lots, homelots and plant distribution during the project period. There are no records of plant production during the year 1986 at the Tanamalwila nursery. Subsequently plants have been produced in the Lunugamvehera project nursery which was well managed and well maintained.

The plant species raised during the project period are as follows:

(a)	*Albizzia lebbek*	-	*Suriya Mara*
(b)	*Acacia aurieculiformis*	-	*Acacia*
(c)	*Leucaena leucocephala*	-	*Ipil-Ipil*
(d)	*Eucalyptus camalduleusis*	-	*Gum*
(e)	*Terminalia bellerica*	-	*Bulu*
(f)	*Pterocarpus marsupium*	-	*Gammalu*
(g)	*Tectona grandis*	-	Teak
(h)	*Anacardium occidetale*	-	*Cadju*
(i)	*Berrya cordifolia*	-	*Halmilla*
(j)	*Parkinsonia aceuliata*	-	--
(k)	*Delonix regia*	-	Flame of the forest
(l)	*Casuarina equisetifolia*	-	*Casuarina*
(m)	*Sterculia foedica*	-	*Thelambu*
(n)	*Tamarindus indica*	-	*Siyambala*
(o)	*Artocarpu integra*	-	*Jak*
(p)	*Cassia fistula*	-	*Ehela*
(q)	*Terminalia catappa*	-	*Kottamba*
(r)	*Feronia limonia*	-	*Divul*
(s)	*Sesbenia grandiflora*	-	*Katurumurunga*
(t)	*Azadiracta indica*	-	*Kohomba*
(u)	*Cassia auriculata*	-	*Ranawara*
(v)	*Terminalia arjuna*	-	*Kumbak*
(w)	*Chloroxylon swietenia*	-	Satin wood
(x)	Bougainvillea *spectabilis*	-	Bougainvillea
(y)	*Vativeria zezanoides*	-	*Sevendara* grass

Some farmers who were supplied with plants for infilling (vacancy planting) in the woodlots have not planted all the seedlings. Some perished in the polytene bags and some green plants lying under trees in polybags were observed even in April 1994. The reason for this disregard was found to be indifference on the part of a few farmers. They were not motivated to carry out planting for several reasons. Firstly, no usufruct right has been granted to them. The farmers have been promised lease agreements for long periods (up to 25 years). To date not a single lease agreement has been issued, although the project document had suggested this procedure. This has to be regarded as a failure on the part of the Land Commissioner's Department who is the custodian of the land. The Forest Department has not monitored this process.

Secondly, poor co-ordination of plant distribution has led to failures. Some farmers complained that plants were supplied to them after the rainy season. The Forest Department has failed to supply plants well in time due to transport difficulties.

During the years 1988 and 1989 many plants have perished in the nurseries and at the planting sites due to unrest in the country. Details of nursery plant production appear in Annex 7.1, Table A-7.1.

7.1.2 Woodlot Development

It was aimed to establish a woodlot area of 400 ha. This extent was to be distributed among 540 families, at the rate of 1.85 acres per family. The objective was to raise tree crops together with agricultural crops in a *Taungya* system. Out of the 400 ha, a portion of 200 ha. was to be in the buffer zone between the Bundala bird sanctuary and tracts 3 and 4 of the Right Bank. Farmers would be selected from families with 4 or more dependents and with a relatively high income level. The land to be allocated had to be at a distance of less than one mile from the residing land.

The woodlot had to be initially given on a 5-year lease which would be extended to 25 years, with usufruct rights. In this way, the farmer would obtain small woods for his needs and fuel wood for his daily consumption.

Starting from the year 1986 the Land Commissioner's Department together with the Forest Department has allocated lands in the project area for the development of farmers' woodlots. Only 687 acres have been allocated against a target of 1,000 acres to 441 farmer families. The area finally planted remained at 611 acres.

Where the success is over 70 percent, the farmer families had worked hard and protected the area. Details of farmers wood lots appear in Annex 7.1, Table A-7.2.

In the 1988 block of 48 acres (RB Hamlets 5 and 6) all 58 acres have been successfully established. But, the 1990 block (RB Hamlets 6 and 8), out of the 100 acres only 25 acres have been established. These failures are due to the negligence of farmers who have concentrated on their cultivation only, ignoring the tree planting component in the agro-forestry system.

Some farmers have carried out agricultural practices in the woodlots up to 3 years. Others have tried further cultivation by lopping branches of growing trees. The extreme condition is the removal of trees and non-planting of vacancies. See Annex 7.2, Map 7.1.

Observations

Hamlets 6 & 7 - RB Tract 2 (1990)

100 acres of scrub land with sporadic growth of natural tree species have been allocated to this hamlet. 86 acres have been distributed as follows:

(1) 2 acres each for 32 farmers
(2) 1 acre each for 22 farmers

During the 1st year all 86 farmers cleared the land, prepared the ground for cultivation in maha 1990.

Plants have been distributed to plant the blocks at a spacing of 3 m x 3 m. Only 22 farmers have carried out the planting. Others concentrated on the cultivation of arable crops only.

According to the Forest Officers and farmers in the field this situation arose as a result of:

(1) Lack of incentives.
(2) Failures in the supply of plants (not given at the proper time).
(3) Anticipating the shade during the second and third year which would prevent cultivation of arable crops.

About 25 acres are well established with a survival rate of 60 percent. No attempt has been made to rehabilitate the abandoned area.

Another reason for the poor interest shown by the farmers is that they have not been granted long term agreements. The project report had a provision for this.

Hamlets 5 & 6 - RB Tract 2 (1988)

58 acres have been allocated among 29 farmers, at a rate of 2 acres per farmer. All farmers have carried out cultivation of arable crops together with the planting of trees. These farmers have done hard work and maintained the planted blocks even after the third year, when cultivation is not possible due to the shade thrown by the timber species.

The tree species planted are:

Acacia, Margosa, Eucalyptus, Cadju, Ipil-Ipil, Suriyamara, Bulu, Thelambu, Halmilla.

Jak was not successful.

Success rate: 75 percent.

The farmers here too have requested the Forest Department to issue them long term agreements for usufruct rights, but this has not been done.

Hamlet 3 - RB Tract 2, Muwanwewa - (1987)

24 acres were allocated to 24 farmers. The woodlots were well established and the success was over 75 percent. Farmers here too are requesting usufruct rights. Some thinning can be carried out in this and other older blocks where the plant percentage is over 75. This operation will provide space for the balance trees to grow for the production of timber and also provide some fuel wood to the farmers.

Hamlet 3 - RB Tract 2, Weerawila - (1987)

Land was allocated to 26 farmers. The woodlots were well established. Success rate over 75 percent. No usufruct rights granted. Some thinning could be carried out.

Hamlet 2 - RB Tract 1, 33 Acres - (1988)

2 acres and 1 acre blocks have been allocated. Mr. Heenbabun who was cultivating a patch has recently used vacancy planting and reported that he carried out *Taungya* cultivation for 2 years obtaining a good crop of vegetables. *Kohamba, Halmilla*, Teak, *Caaju, Gammalu* and Acacia has been planted and are well established. Natural tree species such as Satin, *Kohamba* and *Ehela* are also observed in woodlots. Success is over 75 percent.

Hamlets 2 & 4 - RB Tract 1, 60 Acres - (1987)

30 farmers have been allocated 2 acres each. Good work have been done and the success is over 70 percent. The species planted are:

> *Eucalyptus, Acacia, Kohomba, Ipil-Ipil, Dalbergia Sissoo, Bulu, Gammalu, Halmilla*

The farmers continue to look after the planted trees in all the blocks.

There is a block of 50 acres close to this area planted by the Forest Department on tender basis. In this area maintenance work and opening of fire lines has been carried out. The latter operations have cost over Rs. 25,000/= to the project as there was no *Taungya* cultivation practised like in the farmers woodlots.

Hamlet 5 - LB Tract 2, Beralihela, 33 Acres - (1991)

33 farmers have been allocated 1 acre each. Vacancy planting has been carried out in 1992. Success rate of the plantation is over 75 percent. Naturally occurring trees such as *Burutha, Palu, Weera* and *Ingini* have not been felled. This is a very good practice, seen in most of the woodlots.

Hamlet 5 - LB Tract 2, Beralihela, 126 Acres - (1991)

63 farmers have been allocated 2 acres each. This block is poorly done. No vacancy planting has been carried out although the Forest Department had supplied the plants. Some plants are still observed in polybags lying under trees. These have been supplied in 1993.

In this block the farmers have concentrated only on their agriculture. They have insisted on incentives for tree planting. Lack of motivation appears to be the cause for failure.

The success is about 25 percent.

Hamlet 5 - LB Tract 2 - 150 Acres - (1991)

150 farmers have been allocated 1 acre each. Some blocks are 90 to 100 percent successful. The average success rate is about 65 percent. The location of this block is in a valley between the Tissamaharama hills and Kataragama hills . The main tree species planted are Acacia and Eucalyptus.

Between the years 1986 and 1991 the Forest Department has allocated 13 blocks of farmers woodlots amounting to 68 acres.

No woodlots have been established in the buffer zone between the Bundala bird sanctuary and the tracts 3 and 4 of the Right Bank. Apparently there has been no adopters in that region.

Although the target has been reduced, the planted woodlots except those in hamlets 6 and 8 RB, hamlet 2 LB show over 70 percent success for which the farmers and the Forest Officers have to be commended. It is observed that during the last decade, hill slopes in the Beralihela area have been subject to a slow process of deforestation. This may be due to the collection of small woods for house construction, fencing and also collection of fire wood. This process threatens the stability of the environment. Therefore, more woodlots and fuel wood plantations have to be raised in and around the project area. The project has given the lead to continue this process. Therefore, before the settlers lose interest in tree planting the process has to be continued by providing more incentives to the settlers. More nurseries have to be established to provide a variety of seedlings to be distributed among the settlers. The tree planting habit has to be sustained and the extension arm of the Forest Department strengthened.

7.1.3 Homelot Development

For the homelot development, the following households have been identified:

RB tracts - 1, 2, 5, 6, 7
LB tracts - 1, 2, 3
Hamlets in RB - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 18, 19, 20
Hamlets in the LB - 1, 2, 3, 4, 5, 6, 7, 8, 9

The total number of households was 4,924 but about 15 percent of these households were either absent or not interested. Many of the households in this 15 per cent group were not living in their allotments. As a result about 4,180 households were identified and discussions were held with them. The foresters had supplied them with the plant species they required.

The plants supplied are of the following species: *Eucalyptus Camaldulensis, E. Tereticornis, Ipil-Ipil, Margosa,* Teak, Jak, Tamarind, Lime, Pomegranate and *Vativer* grass.

Observations made after random checks in the field between June and July, 1994

<u>Location: RB Hamlet 2</u>
Name of the homelot owner: Mr. E.L. Heenbabun, Lot 271

Land has been allocated in 1982. Up to 1986 clearing of land and building the dwelling took place. After 1986, KOISP has provided the following plants, through the CO 20 coconut, 5 each of Mango, Lime, Orange and Pomegranate. Forest plants: *Margosa,* Tamarind, Teak, *Halmilla.* A few cashew plants have been supplied by the Cashew Corporation.

Present status: coconuts, lime and orange are bearing. Other trees provide fuel wood and poles. In addition to these plants, the Forest Department has supplied five each of the following plants: Margosa, Acacia, Tamarind, Eucalyptus and Halmilla.

There is no damage by wild elephants but damage is caused by stray cattle. About 30 trees are available at present, providing fruits and fuel wood. Forest trees will yield timber at rotation.

Location: RB hamlet 4
Name of the owner: Mr. W.A. Somasiri, Lot 400

Land has been allocated in 1983. From 1985 onwards he has planted coconut and fruit plants provided by the project staff. Number of plants planted : 20 coconut, 5-7 orange, lime and mango. Timber and fuel wood have been provided amounting to 30 plants.

The coconut and fruit trees are now bearing and provide an income. The forest trees are supplying fuel wood and poles. About 40 trees are now available in the homelot. Following are the timber species supplied by the Forest Department: *Kohomba*, Acacia, *Ipil-Ipil*, Tamarind, Teak.

There is no damage by elephants.

Location: RB hamlet 5
Name of the owner: Mr. A.A. Gunadasa, Lot 216

Land allocated in 1983. The following fruit trees have been planted in 1986, five plants of each species: Lime, Mango and Pomegranate. Also ten coconut plants have been supplied and the following timber species: *Kohomba*, Teak, *Ipil-Ipil*, Eucalyptus, Acacia. *Gliricidia* sticks have also been provided for fencing.

Today the coconut and fruit trees are bearing and are providing income to the settler. The timber species provide poles and fuel wood. About 30 trees are available in the home garden today.
Occasional damage by elephants experienced.

Location: RB hamlet 10
Name of the owner: Mr. S. Jayawickrema, Lot 409

Lands were allocated in 1983. There have been forest trees species such as *Palu, Buruta, Weera* when the land was allocated. In 1986 the land has been cleared and the following trees planted: Orange, Pomegranate, Lime, Mango and Coconut. Five to ten plants of the above species have been supplied by the project staff. The forest species planted are *Kohomba, Ipil-Ipil*, Acacia, Eucalyptus. Up to ten plants each of the above species have been supplied by the Forest Department.

Today about 20 trees are available in the homelot. The land owner is now reaping the harvest of coconut, fruit trees and fuel wood.

Damages by elephants are reported.

Location: RB hamlet 11
Name of the owner: Mr. D. Dahanayake

Land allocated in 1985. In addition to scrub, there have been Palu, Weera and Satin trees after 1986. The following trees have been planted: Coconut 10 plants, Cashew, Mango, Orange and Lime 5 plants each. The following forest species have been supplied by the Forest Department: *Margosa*, Acacia, Tamarind, Eucalyptus.

7.1.4 Medicinal Herb Gardens

Under the Kirindi Oya Irrigation and Settlement Project, a program of establishing medicinal herb gardens was undertaken by the Forest Department in addition to woodlot and homelot development.

15 medicinal herb gardens have been established comprising of 1 acre blocks, as shown in Annex 7.1, Table A-7.4.

Settlers depend heavily on *Ayurvedic* treatment for small and day to day ailments such as fever, indigestion, general debility, wounds and cuts. Snake bites are common and many settlers seek *Ayurvedic* treatment for it. The herb gardens are located close to schools, government buildings, community centers and residences of *Ayurvedic* medical men. Planting has been carried out from 1986-1987. After care is minimal and as a result most herb lots are overgrown with weeds. However, the emergent tree species survive. Some infilling has to be carried out. These lots have been established under the cooperative reforestation system where farmers have been allowed to intercultivate for 3 years. Barbed wire have been provided to protect the block from animals. These 15 blocks have to be weeded, vacancy planted and maintained as they serve an important and a useful purpose for the settlers. They have to be made use of to collect seeds for propagation. See Annex 7.2, Map 7.1.

Following trees and herbs are available.

(a) *Terminalia beleria (Bulu)*
Fruit used for fever and bowel ailment

(b) *Azadiracta indica (Kohomba)*
All parts used for treatment of fever and for disinfection. Seed oil is an insect repellant and a disinfectant.

(c) *Citrus auruntfolia* (Lime)
For seasoning of food, relieve congestion, in sinuses (boiled leaf and bark).

(d) *Citrus aurantium* (Sour orange)
For relief from cough and phlegm.

(e) *Punica granatum* (Pomegranate)
Used as a cooling drink rich in vitamins; for eye sore treatment and tender dried fruit for diarrhea.

(f) *Cassia auriculata (Ranawara)*
Dried flowers used as a beverage for kidney treatment; leaves for kidney diseases and a good source of leaf *kanjee.*

(g) *Pterocarpus marsupium (Gammalu)*
Latex used to treat diabetes.

(h) *Gamelina arborea* (Roots)
Used to treat fever.

(i) *Cassia fistula (Ehela)*
Tender leaves - a good laxative. Seeds used in decoctions.

(j) *Adenanthera pavonia (Madatiya)*
Seeds used to weigh *Ayurvedic* herbs for treatment. Bark used in decoctions.

(k) *Phaseolus adenonthus (Welmi)*
Used to control phlegm. Improves voice.

Settlers collect leaves and bark of these trees when required. These herb gardens have become a source of readily available material for *Ayurvedic* treatment. This project has to be continued to provide more benefits.

7.1.5 Roadside Avenue Planting

The Forest Department's target for planting roadside avenues was 36 km. The project has planted about 44 km., thus exceeding the target.

At the beginning of the project the road network established to service the project area remained dry and insolate. Shade is very essential in the Kirindi Oya climate. The planting of roadsides by the Forest Department has ameliorated the climatic conditions to a great extent. The trees planted from 1986 to 1991 have provided the much needed shade to the roads, homesteads and birds. The lower branches serve as fodder for the livestock, and the dried and dead branches provide fuel wood.

Roadside planting has been carried out on a self-help basis by those farmers living at the roadside. Tree species planted are *Margosa*, Tamarind, *Ipil-Ipil*, Acacia spp.

More roads in the project area need shelter. Therefore, this is an operation to be continued. Details of roadside planting appear in Annex 7.1, Table A-7.5.

7.1.6 Live Fencing

The target for establishing live fences was as follows:

(a) 350 cuttings of *Gliricidia* sticks to each homelot on the Left Bank tracts 3 and 4.

(b) 250 cuttings of *Gliricidia* sticks to each homelot on the Right Bank tracts 1 and 2.

(c) 400 cuttings for each woodlot area.

The objective of planting live fences was to provide a fence to the homelot, provide fodder for the live stock and also to provide fuel wood from the prunings. The species used were *Gliricidia Sepium* (*Makulatha* or *Laadappa*) and *Thespesia Populnea* (*Gan Sooriya*). Both these species provide very good fodder and sticks, and when planted during the monsoon period they established quite well.

The estimated number of stem cuttings for the total program was 450,000. Only 95,300 sticks have been supplied from 1990 to 1993.

The success of this program is even less than 25 percent as far as the supply is concerned. Failures in the field are still heavy. It is estimated that about 60 percent of the cuttings supplied did survive. This situation is due to the bad time planning in the supply of sticks. Some sticks have been supplied during the dry period. Other sticks have perished as a result of long delays in transport and supply.

The best method would have been to establish a *Gliricidia* bank in the first year and to supply cuttings from the third year. A nursery site with a good supply of water is the best method to establish a bank.

7.1.7 Extension Services

The project has supplied funds to sustain the Forestry Program for about 7 years. The following constructions have been provided to the Forest Department:

(a)	Forest Ranger's Quarters, Lunugamvehera	-	1 No.
(b)	Beat Forest Officers Quarters, Lunugamvehera Nursery	-	1 No.
(c)	Beat Forest Officers Quarters, Weerawila	-	1 No.
(d)	Nursery Watchers Quarters	-	1 No.
(e)	Pump House for the Lunugamvehera Nursery	-	1 No.

The following items have been provided under the awareness and extension program:

(a) 1 No. Television Set
(b) 1 No. Video Deck
(c) 1 No. Slide Projector
(d) 1 No. Overhead Projector
(e) 1 No. Mini Radio Cassette

Also the following equipment has been supplied:

(a) Typewriter
(b) Tables
(c) Chairs
(d) Cupboards
(e) Refrigerator

The following vehicles had been supplied for the Forest Project staff.

(a)	Double Cab	1 No.
(b)	Honda CG125 Motor Cycle	1 No.
(c)	Push Bicycles	2 Nos.

The awareness and extension program of the Hambantota Forest Division is still going one. Funds are provided by the Forest Department to continue these programs after the termination of the Forestry (KOISP) Project.

The reduction of illicit cutting of the dwindling forest resources in the KOISP area can be attributed to the awareness program carried out by the project staff. Settlers have realized the value of tree planting as well. Planting techniques and the choice of species are taught to the participants and school children for whom many video shows and lectures have been delivered on conservation, protection and planting of trees.

The establishment of a rest named Thurusevena in the project area at the 158th km.post on the Hambantota - Wellawaya road served as an excellent spot for awareness education. Pilgrims to Kataragama and other visitors to the area stop at this point to rest. Earlier there had been a plant sales center at this location. Brochures and pamphlets on forests, trees, flora and fauna and other related subjects have been issued free of charge from this center to visitors. These activities are not implemented any more, but it is suggested here to reintroduce them. The Thurusevena which is maintained by the Forest Department, a building to conduct seminars and classes is available. These days the building is used only as a facility for visitors. It is suggested to reorganize the place. A permanent officer would be able to carry out more extension work and to develop awareness raising programs.

At the 160th km. post the Air Force has started another Thurusevena in about a ¼ acre of land. This is an arboretum with a variety of dry zone plants, provided by the project staff. This arboretum is useful for botanical studies of the local school children.

At the Thurusevena which is maintained by the Forest Department, a building to conduct seminars and classes is available. These days this building is used only as a facility for visitors. It is suggested to reorganize the place, a permanent Officer would be able to carry out more extension work and to develop awareness raising programs.

7.1.8 Forests in the Project Area

The forests in the project area are of the Dry Mixed Evergreen type (7 c). There are strips of riparian lowland forests (7 B2) close to waterways and coastal forests (7k). Most of the area has been logged and partially cleared for chena cultivation. As a result scrub vegetation dominates with a few emergents such as *Palu, Kolon, Satin, Thelambu, Veralu* and *Ingini.*

In the thorny shrub, trees such as *Divul, Ehela, Hema, Kukuruman* and *Andara* are available. In a good stand a maximum of about $5m^3$/ha could be obtained as timber. These forest types are located in the following areas (estimated):

(a)	LB : Between the district boundary and Tissa-Kataragama road	-	570 ha.
(b)	LB : Between the LB boundary and District boundary	-	325 ha.
(c)	Near hamlet 17 RB	-	50 ha.
(d)	Close to Bundala Bird Sanctuary	-	200 ha.
(e)	Close to Niyadagala and Mahapelessa Wewa RB	-	500 ha.
			1645 ha.

The people living in the project area continue to extract fuel wood from these forests. Some chena cultivation is still practised in the RB Mahapelessa forest blocks, but as a result of the irrigation settlements, chena cultivation is reduced. Illicit felling of timber is not carried out in the KOISP area and the buffer zones.

Some enrichment planting has to be carried out in the degraded patches of forests to improve the tree density and the value of the forest blocks. The locations of the Dry mixed forest blocks is shown in Annex 7.2, map 7.2.

The Forest Department has carried out some reforestation close to hamlet 5 of the RB tract 2 with an extent of 100 acres. The species planted is *Kohomba*. In addition a further extent of 46 acres of cooperative reforestation has been carried out close to hamlets 5 and 6 of RB tract 2. The species planted are Eucalyptus, *Kohomba* and Acacia in a mixture. Another 10 acres have been planted close to the Lunugamvehera nursery comprising of Acacia and *Kohomba*.

The 100 acres block mentioned above has been damaged by elephants and cattle. Therefore the success of this block is about 50 percent. It is interesting to note that during the drought period cattle browse on *Kohomba* which is not palatable.

The following blocks of natural forests, wood lots, medicinal herb gardens and Forest Department Plantations in and around the project area may be recognized as lands covered with trees:

(a) Natural forest blocks	-	1645 ha.
(b) Wood lots under KOISP	-	275 ha.
(c) FD plantations	-	62 ha.
(d) Medicinal herb gardens	-	6 ha.
Total		1988 ha.

7.1.9 Elephant Relocation

The Lunugamwehera National Park (which is still not gazetted) has the following boundaries:

North - A line drawn from Kitulkote to Kahahena and a horizontal line drawn from Kahakema to Sellangala

South - Lunugamvehera Dam, extended up to Kataragama

East - A vertical line from Sellangala to Kirindi Oya, from Kitulkote to Lunugamvehera (see Annex 7.2, Map 7.3)

Before the commencement of the KOISP in 1986 there had been free movement of elephants within the project area. With the opening of the Lunugamvehera National Park an attempt has been made to drive the herds from the command area and enclose them within the National Park. To a large extent this has been successful, but the lone elephants and families of three (*tumpath rela*) continue to raid crops and home gardens in the settlements.

The boundary survey of the National Park is not yet complete. After the completion of the survey, maps will have to be drawn and the area gazetted. Only then the laws pertaining to the National Park can be effective. This process may take at least another six months.

Villagers are continuing to practise chena cultivation within the proposed National Park. The wildlife officers are unable to evict them until the laws come into force. About 300 chena cultivators are still active.

There are a few private lands within the proposed boundaries. These will have to be acquired.

The wildlife officers have observed an estimated number of 10,000 privately owned buffaloes and 2,000 neat cattle within the National Park boundaries. These animals threaten the limited stocks of fodder grass within the National Park, creating a problem for elephants and other ruminants. Unless this cattle population is provided with alternative lands, the wild animals will continue to visit the village farm lots. These private cattle also compete with the wild animals for the limited amount of drinking water during drought periods.

The electric fence put up by the Department of Wildlife appears to be very effective in containing the elephants within the Park area. 10 km. of fencing is completed on the western boundary. Another 5 km. are to be erected. On the eastern boundary another electric fence as been put up. Crop damage has been reduced after the fences were erected.

The elephant relocation program of the Department of Wildlife also has contributed to the reduction of crop damage. In 1991/1992 the drive aimed at pushing the KOISP area elephants into the National Park has been successful in chasing away about 200 elephants. According to the Wildlife officers about 100 animals are still left in the KOISP area.

The Department of Wildlife is constructing another electric fence between Weli area and Banduwewa. 15 km. of this fence are completed. They hope to complete 20 km. within the year.

The other component of the relocation program undertaken by the Department of Wildlife is the tranquilizing of dangerous elephants. In 1991 the number tranquilized and transported away from the area amounted to 9.

The settlers support the electric fencing program. They report if damages occur. There has been instances where the cattle owners have damaged the fencing themselves to introduce cattle to the park area. Therefore it is urgent to identify grazing lands outside the National Park and the KOISP area for the large private cattle population.

7.1.10 Bundala National Park

The Bundala National Park has the following boundaries:

North -	Boundary of tract 3 and 4 of the RB, starting from Kirindi Oya, up to Koholankola Levaya.
South -	Indian Ocean
East -	Kirindi Oya
West -	Koholankola Lewaya (see Annex 7.2, Map 7.4)

As the forest blocks of this National Park lie below tracts 3 and 4 of the RB, elephants visit these tracts which are not yet under settlement, and invade tracts 5, 6, and 7 of the RB and surrounding areas. There are about 50 elephants in this National Park. An electric fence has to be put up to protect the KOISP area above this National Park. Bundala has been declared a national Park at 04.01.1992.

The other protected area is the Weerawila - Tissa sanctuary. Very few human-elephants conflicts are reported from this area. Most of the lands are under paddy cultivation.

From January 1991 to March 1994 damage to crops and properties by elephants has been reported from the following areas in and around the KOISP: Weerawila, Senapura, Badagiriya, Pallemalala, Bundala, Tissa, Bodagama, Angunakola Wewa, Lunugamvehera, Elalla, Mihindupura, Veheragala, Ranawarnawa and Berilahela.

7.2 Benefits of the Project

7.2.1 Nursery Program

Tree planting and growing of forests begin with the nursery program. During the 7 years (1987 to 1993) of the project the Lunugamvehera nursery has supplied 1,100,936 plants. In the year 1986, the nursery at Tanamalwila has supplied about 58,000 plants. Though this quantity is below the targeted 3 million plants, the number of trees established in woodlots, homelots and road side avenues bear witness for a good attempt at planting. The nurseries which were established with project funds continue to supply plants to the settlers free of charge for various

tree planting campaigns. They also supply plants for other projects of the Forest Department; and also sell plants to the public.

The settlers continue to get the benefits of the Lunugamvehera nursery.

7.2.2 Woodlot Program

Although the target for woodlot development was 1,000 acres, only 687 acres have been allocated. The success at the planted lots amounts to approximately 70 percent. This is a very good average compared with other plantations raised by the Forest Department in the past. The success is mainly due to the participation of the farmers. Better results and more areas would have been achieved if the promised long leases were given to the farmers.

The stocking of trees in the planted area (611 acres) amounts to about 244,000. These trees if allowed to grow for 30 years will produce very valuable timber. Between now and the thirtieth year about 25 percent of the stocking will be removed as small timber, poles and fuel wood. The value of these intermediate products could be estimated at Rs. 1 million.

The balance trees which could be estimated at 180,000 will carry a value of about Rs. 2,000/= per tree on average. Then the value of the tree crops planted will amount to Rs. 360 million. These trees can be harvested on a selective basis from the thirtieth year to the fiftieth year to provide valuable building material for the settlers. Sale of timber will also generate finances for various development activities in the project area.

The benefit provided by the woodlots in ameliorating the climatic conditions cannot be quantified in financial terms. The effects are a healthy environment for people and animals to live in and shelter from wind and dust storms. The soil will be improved by addition of organic matter and the soil moisture will be retained.

Wood will provide raw material for the carpentry industry. All the lops and tops of the felled trees will provide fuel wood for the households. As most of the trees are good flowering species, bee keeping can be started as a subsidiary business.

Table A-7.1 *KOISP Nursery Program 1987-1993 Lunugamvehera Nursery*

Year	Species		Species		Total Number of Plants	Remarks
1987	Kohamba	19,035	Ipil Ipil	1,180	100,270	No. of plants raised = 1,100,936
	Eucalyptus	29,850	Parkinsonia	5,000		
	Acacia	13,810	Jak	1,000		
	Bulu	900	Flambouyant	2,400		
	Gammalu	1,050	Pinus	15		
	Kohamba	200	Telambu	750		
	Teak	17,600	Tamarind	450		Target = 3,000,000
	Cadju	5,290	Ehela	50		
	Halmilla	3,690				
1988	Kohamba	584	Casuarina	1,307	41,124	No. of sprigs of vativer grass supplied = 15,000
	Eucalyptus	14,208	Thelambu	679		
	Acacia	7,948	Ranawara	40		
	Gammalu	5	Siyambala	1,300		
	Cadju	1,298	Jak	242		
	Halmilla	2,856	Ehela	155		
	Teak	2,720	Kottamba	173		
	Ipil Ipil	240	Divul	74		
	Flambouyant	3,363	Bula	40		
	Parkinsonia	3,892				
1989	Eucalyptus	11,960	Jak	22,975	139,779	
	Halmilla	11,410	Kottamba	4,045		
	Cadju	10,390	Suriyamara	5,440		
	Jak	3,525	Bulu	6,300		
	Siyambala	1,860	Divul	2,055		
	Kohamba	51,989	Ipil Ipil	50		
	Teak	9,800				
1990	Acacia	35,865	Gammalu	500	182,620	
	Divul	125	Suriyamara	4,270		
	Halmilla	17,450	Jak	4,960		
	Kohamba	75,450	Satin	600		
	Casuarina	15	Teak	1,275		
	Cadju	4,445	Ipil Ipil	1,700		
	Eucalyptus	53,025				
1992	Suriyamara	1,390	Casuarina	460	240,100	
	Bulu	100	Kottamba	33,343		
	Acacia	46,245	Jak	75		
	Sesbenia	260	Eucalyptus	170,750		
	Flambouyant	500	Halmilla	200		
	Divul	1,702	Satin	75		
	Teak	1,975				
1992	Suriyamara	160	Divul	1,707	199,175	
	Halmilla	2,625	Ehela	10		
	Flambouyant	515	Casuarina	11		
	Eucalyptus	1,300	Satin	40		
	Cadju	9,785	Kohamba	29,390		
	Acacia	137,830	Siyambala	12,622		
	Jak	2,535	Kottan	332		
	Kumbuk	2,003	Bouganvillea	109		
1993	Suriyamara	1,545	Jak	67,970	197,868	
	Acacia	79,435	Divul	3,475		
	Halmilla	3,305	Siyambala	9,172		
	Jak	2,487	Cadju	2,960		
	Satin	5,190	Ehela	1,158		
	Mara	465	Kottan	520		
	Kumbuk	355	Bouganvillea	626		

Table A-7.2 Farmers' Woodlots

Year of Planting	RB/LB	Tract	No. of Hamlet	No. of Farmers	Extent Allocated (Acres)	Extent Planted (Acres)	Species Planted	Survival Rate (%)	Reason for Failure (if any)
1986	RB	1	2, 4	50	50	50	Mixed species	70	
1987	RB	1	2, 4	30	60	60	Mixed species	70	
1987	RB	1	3 Weeravila Area	13	26	26	Mixed species	80	
1987	RB	2	5 Muwan Wewa	12	24	24	Mixed species	75	
1987	RB	1	2	5	10	10	Mixed species	20	Neg;lect by farmers
1988	RB	2	5, 6	29	58	58	Mixed species	75	
1988	RB	1	2	17	34	33	Mixed species	75	
1988	RB	5	8, 9	2	4	4	Mixed species	90	
1989	RB	5	8, 9	12	12	12	Mixed species	70	
1990	RB	2, 5	6, 8	100	100	25	Mixed species	20	Neglect by farmers
1990	LB	2	5 Beralihela	75	150	150	Mixed species	30	Neglect by farmers
1991	LB	2	5 Beralihela	63	126	126	Mixed species	30	Neglect by farmers
1991	LB	2	5 Beralihela	33	33	33	Mixed species		

Table A-7.3 Distribution of Plants for Homelot Planting - 1993

	RB/ LB	Hamlet Number	Number of Farmers	Extent (Acres)	Species Planted	Success Rate (%)	Remarks
1993	RB	1	85	44	*Cadju, Divul, Acacia, Margosa, Ehela, Jak, Halmilla*	45	4,000 plants supplied
1993	RB	5	80	40	*Cadju, Divul, Acacia, Margosa, Ehela, Jak, Halmilla*	40	5,924 plants supplied
1993	RB	11	117	58	*Cadju, Divul, Acacia, Margosa, Ehela, Jak, Halmilla*	30	7,920 plants supplied

Table A-7.4 Medical Herb Gardens

Year	RB/LB	Tract	Hamlet No.	Location	Extent (Acres)	Plant Species	Present Status
1986/87	LB	1	1	Close to school	1	Bulu Margosa Lime Orange Pomegranate	Distributed among farmers
1986/87	LB	2	3	Near CO's office	1	Bulu Margosa Lime Orange Pomegranate Cadju Ranawara Gammalu	T.W. Dayapala has planted banana in this lot
1986	LB	2	4	Near CO's office	1	No planting	Dharmadasa is cultivating
1986	LB	2	5	Opposite school	1	Kohomba	Farmers cultivate during maha season
1986	LB	2	6	Near CO's office	1	Kohomba Bulu Gammalu	This block is being cared for by the village medical practitioner
1986	RB	1	1	Adjoining CO's quarters	1	Bulu Kohomba Ehela Pathangi	Overgrown
1986	RB	1	2	Near school	1	Bulu Ehela Margosa	Not maintained
1986	RB	1	3	Near community centre	1		
1986	RB	2	4	Near school	1		
1986	RB	2	5	Near temple	1		
1986	RB	2	6	Near cemetery	1		
1986	RB	2	7	Near community centre	1		
1986	RB	2	8	Near school	1		
1986	RB	5	10	Near community centre	1		
1986	RB	4	11	Near temple	1		

Table A-7.5 Roadside Planting

Year	RB/LB	Location Road	Number of Plants (Approx.)	36 km. Length to be planted	Success Rate (%)
1986/87	LB	Roads within Hamlet 1	900	5 km	70
1986/87	LB	Roads within Hamlet 2	1,200	6 km	65
1986/87	LB	Roads within Hamlet 3	1,200	6 km	70
1986/87	LB	Roads within Hamlet 4	1,200 (Some trees cut for power lines)	5 km	80
1986/87	LB	Roads within Hamlet 5	750	4 km	75
1986/87	LB	Roads within Hamlet 6	450	3 km	60
1986/87	LB	Roads within Hamlet 7	750	4 km	60
1990/91	LB	Roads within Hamlet 8	1,100	6 km	65
1990/91	LB	Roads within Hamlet 9	900	5 km	60

Table A-7.6 Supply of Gliricidia Cuttings for Live Fencing

Year	Location	Number of Cuttings Targeted	Number of Cuttings Supplied
1990	R/B Tracts 1, 2 L/B Tracts 3, 4	100,000	36,400
1991	R/B Tracts 1, 2 L/B Tracts 3, 4	100,000	3,050
1992	R/B Tracts 1, 2 L/B Tracts 3, 4	100,000	50,000
1993	R/B Tracts 1, 2 L/B Tracts 3, 4	150,000	6,850
Total		450,000	95,300

Year 1993: Number of plants supplied 17,844
Number of farmers 282

Table A-7.7 Record of the Deaths of Elephants reported to the Department of Wildlife from within and around the KOISP Area - 1992-1993

Record of the deaths of elephants reported to the Department of Wild Life from within and around the KOISP area - 1992 - 1993						
Reported date	Approx date of death	Approx age of the elephant in years	Cause of death	Male/ Female	Tusker/ Non tusker	Place of death
03.05.92	03.04.92	--	Gun shot injuries	F	Non T	Lunugamwehera
25.01.92	18.01.92	--	- do -	M	Non T	- do -
20.06.92	11.06.92	10	- do -	M	Non T	Bundala
25.06.92	17.06.92	40	- do -	M	Tusker	Weligaththa
14.10.92	23.09.92	40-50	- do -	M	Non T	Pahala Mattala
29.11.92	18.10.92	65	- do -	M	Non T	Lunugamwehera
03.02.93	30.01.93	25 - 30	Not-known	F	Non T	Mattala
19.06.93	04.05.93	--	--	--	--	Bogahawewa
03.08.93	20.07.93	35	Gun shot injuries	F	Non T	- do -
25.09.93	19.09.93	35	- do -	F	Non T	Tanamalwila
16.10.93	12.10.93	--	- do -	F	Non T	Balaharuwa
12.11.93	06.11.93	45	- do -	M	Tusker	- do -
26.03.93	00.01.93	40	--	M	Non T	Tanamalwila

(Source : Department of Wild Life Conservation)

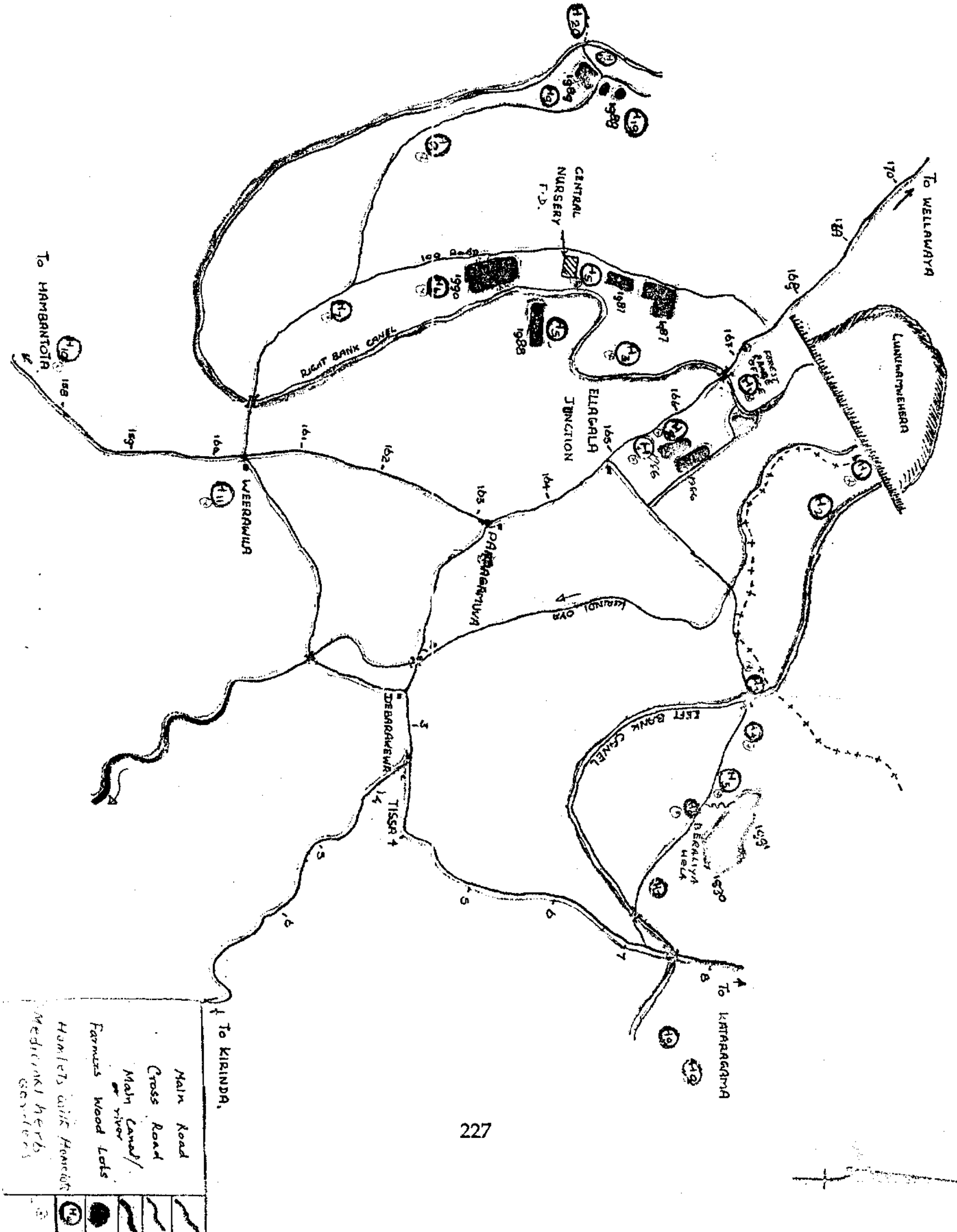
Table A-7.8 Complaints of Damage by Elephants in the KOISP Area - 1991-1994

Complaints of damage by elephants in the KOISP area - 1991 - 1994		
Date of Complaint	**Area**	**Complanent**
18.03.91	Weerawila	Dputy Director, field operations - W L
03.04.91	Bandagiriya	Divisional Secretray, Hambantota
03.04.91	Bundala	- do -
11.09.91	Tissa	Additional G A, Tissa
14.10.91	Bodagama	G A, Hambantota
20.05.91	Angunakola wewa	Villagers
12.02.92	Bundala	Divisional Secretray, Hambantota
08.01.92	Lunugamvehera	Forest Ranger, Lunugamvehera
14.03.92	Elalla	G A, Hambantota
10.06.92	Mattala	Divisional Secretary, Lunugamvehera
17.07.92	Kirindi Oya - LB	Additional G A, Tissa
23.11.92	Mihindupura - H 6	Divisional Secretary, Lunugamvehera
03.12.92	Veheragala	Additional G A, Lunugamvehera
17.12.92	Mattala	Divisional Secretary, Lunugamvehera
13.12.92	Balaharuwa	Elephant Control Unit
03.01.93	Kitulkote	Divisional Secretary, Wellawaya
04.02.93	Udamattala	Divisional Secretary, Lunugamvehera
04.01.93	Ranawarnawa	- do -
28.01.93	Jandura	Forest Ranger, Kitulkote
15.11.93	Weerawila - Malala	Divisional Secretary, Tissa
15.09.93	Lunugamwehera	Divisional Secretary, Lunugamvehera
04.01.93	Uda Mattala	- do -
26.01.93	Ranawarnawa	Gramodaya, Tanamalwila
25.02.93	Mattala	Divisional Secretary, Lunugamvehera
02.06.93	All G N Divisions - L'vehera	- do -
29.01.94	Mattala - Weerawila	- do -
25.01.94	Uda Mattala	Elephant Control Unit
03.02.94	Mattala	Additional G A, Lunugamvehera
14.02.94	Kirindi Oya - 19 col	Forest Ranger, Weerawila
01.03.94	Mattala	Additional G A, Lunugamvehera
24.01.94	Lunugamvehera	- do -
08.02.94	Kitulkote	Forest Ranger, Kitulkote

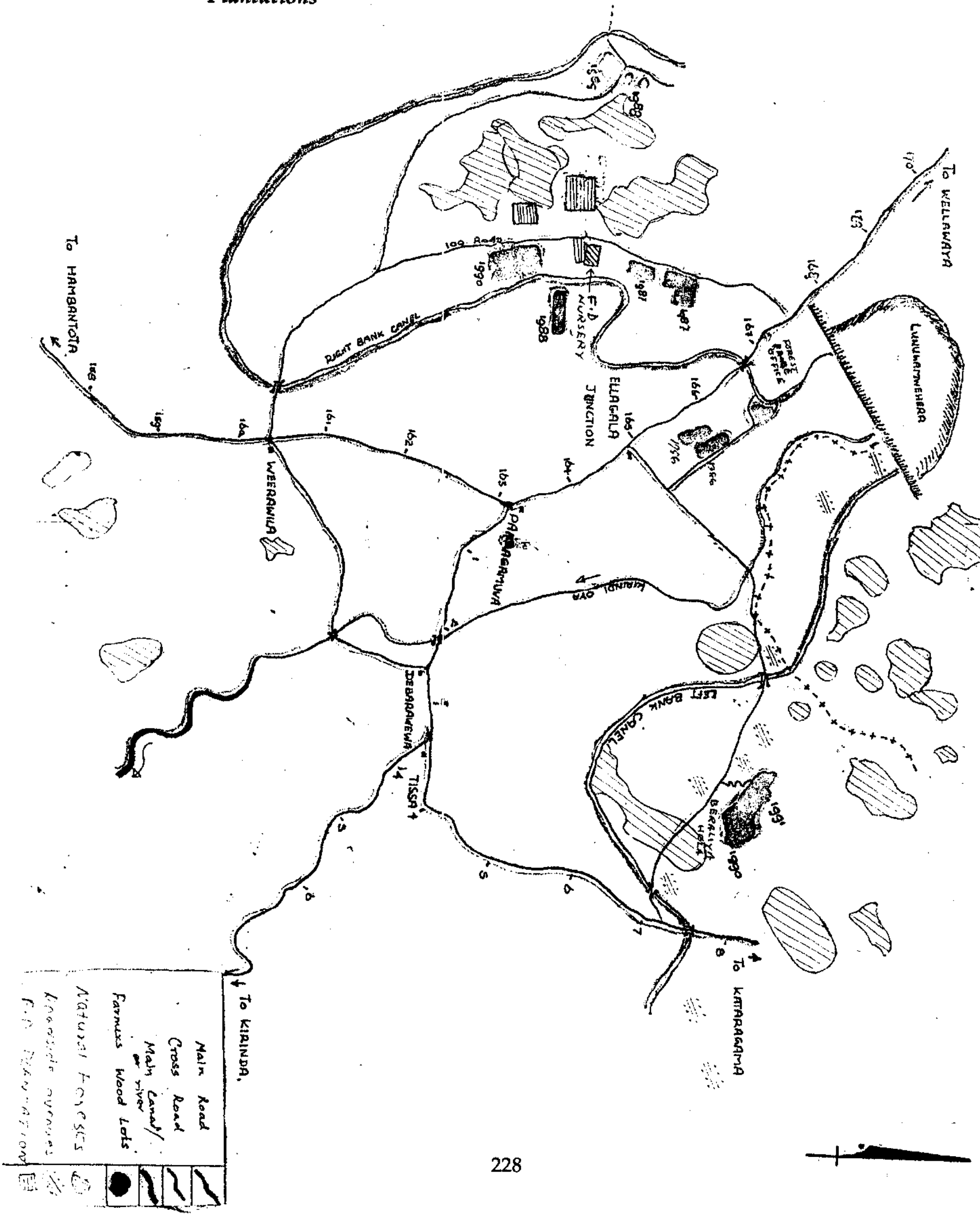
(Source : Department of Wild Life Conservation)

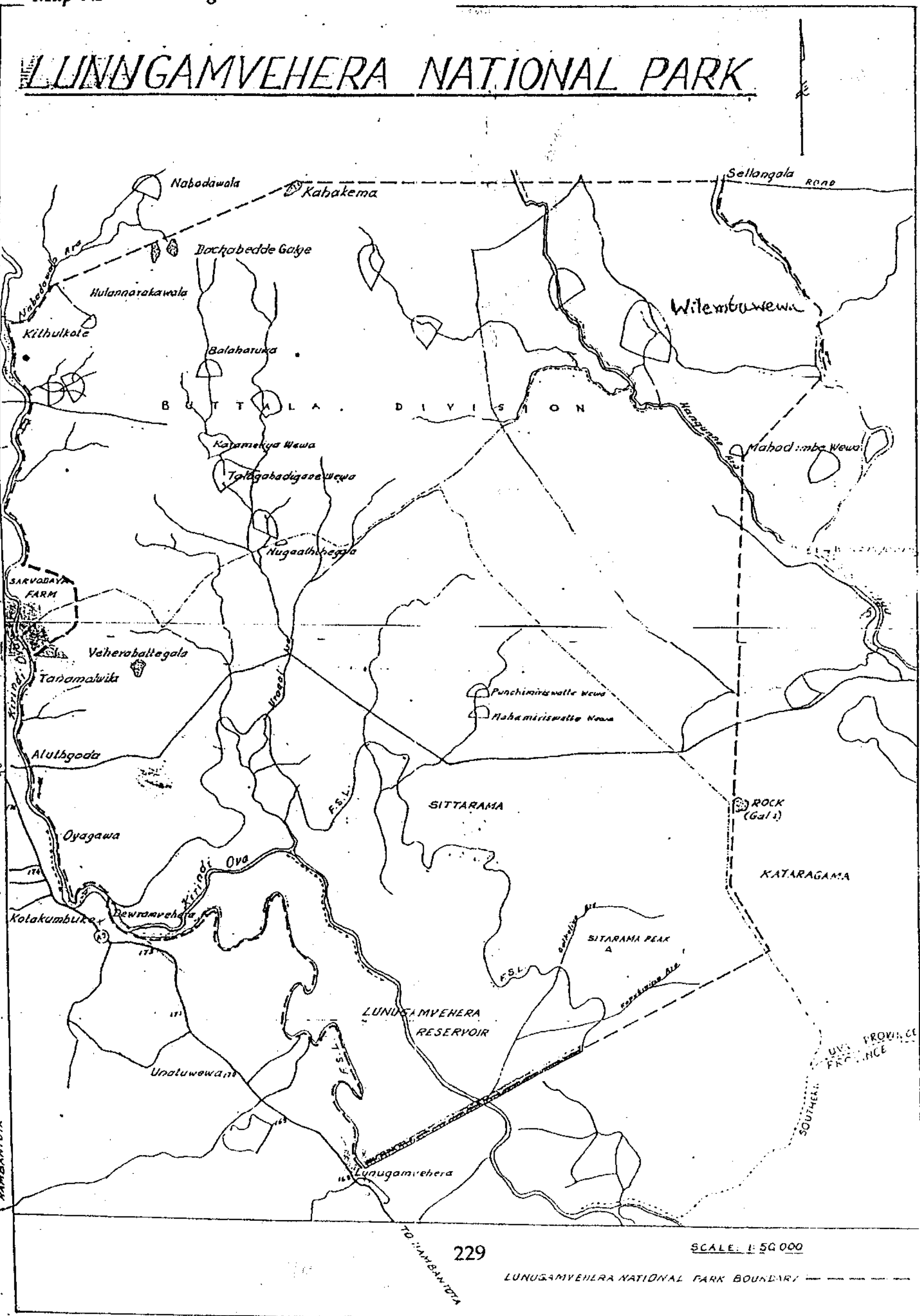
Annex 7.2 Maps

Map 7.1 KOISP Map showing Hamlets with Homelots and Medicinal Herb Gardens

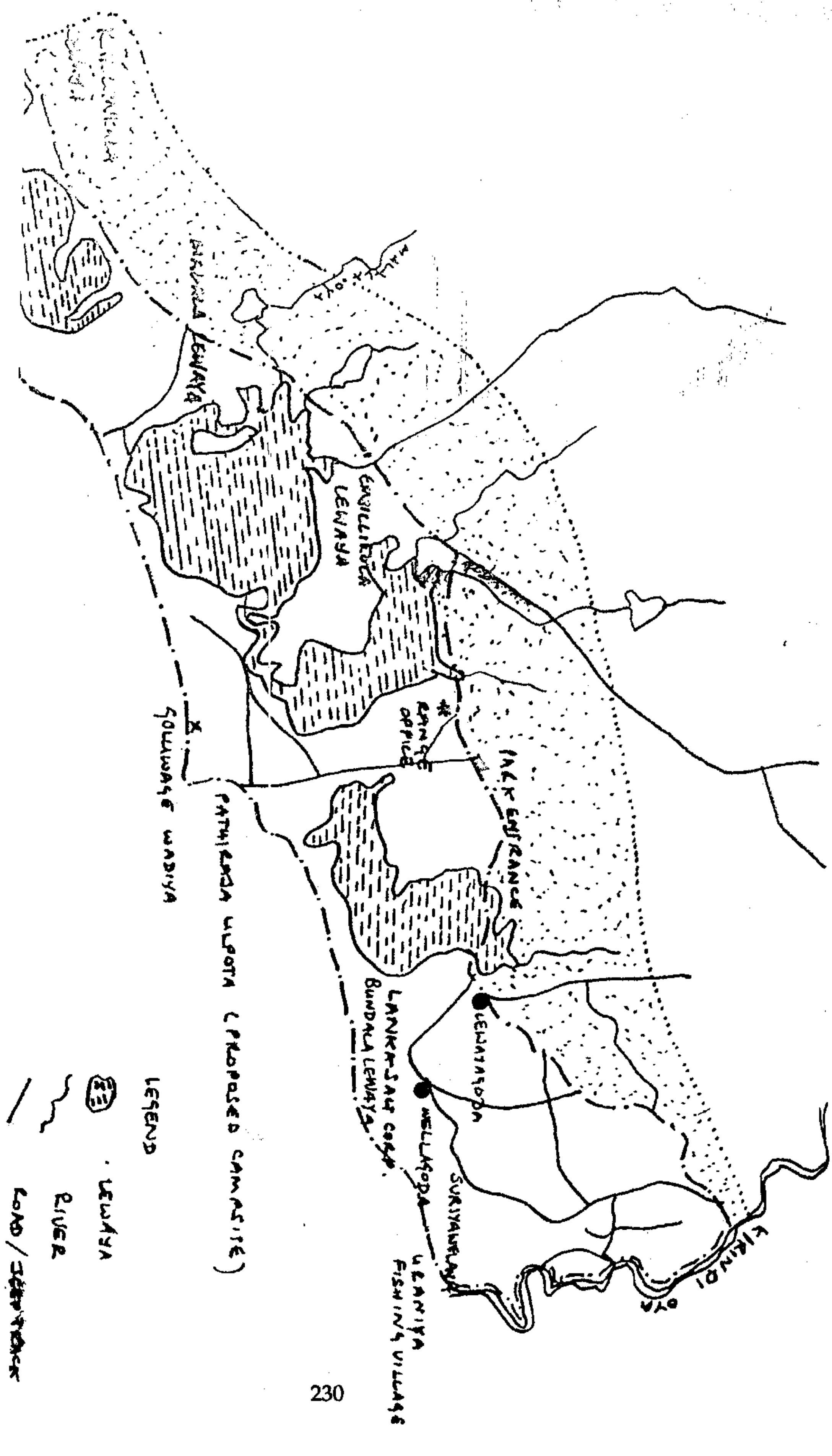


Map 7.2 ***KOISP Map showing Natural Forest Woodlots and Roadside Avenues and F.D. Plantations***

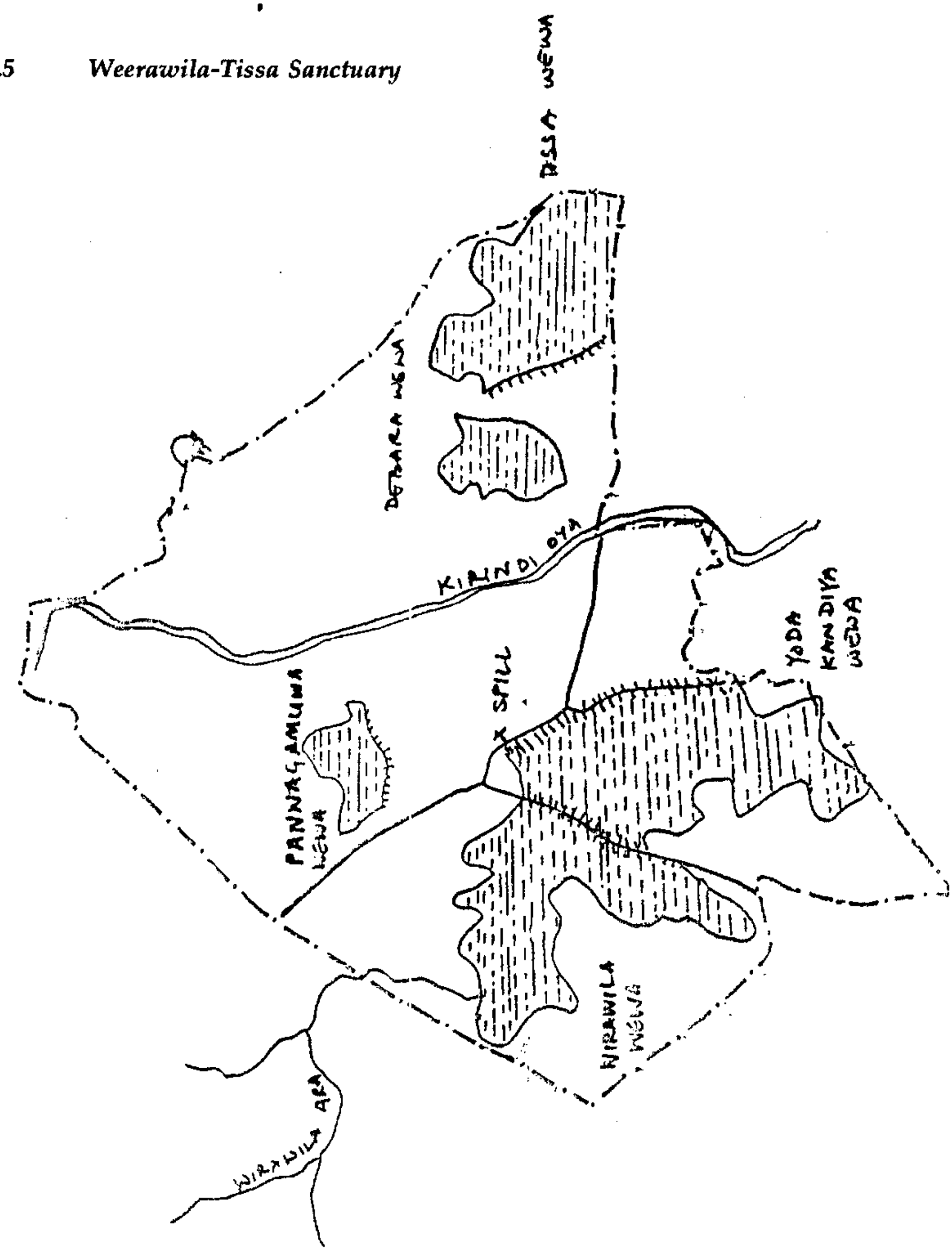


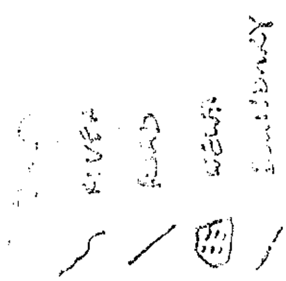

LUNNGAMVEHERA NATIONAL PARK
Nabodawala
Kahakema
Sellangala Road
Bochobedde Galge
Hulannarakawala
Kithulkote
Wilembawewa
Balaharuwa
BUTTALA DIVISION
Karameliya Wewa
Talagabadigane Wewa
Mahadimbe Wewa
Hugaalthegala
SARVODAYA FARM
Veheraballegala
Tanamalwila
Punchimiriswatte Wewa
Mahamiriswatte Wewa
Aluthgoda
SITTARAMA
ROCK (Gal)
Oyagawa
KATARAGAMA
Kirindi Oya
Kotakumbuke
Dewramvehera
SITARAMA PEAK
F.S.L.
LUNUGAMVEHERA RESERVOIR
Unaluwewa
Lunugamvehera
HAMBANTOTA
TO HAMBANTOTA
SCALE: 1:50 000
LUNUGAMVEHERA NATIONAL PARK BOUNDARY

Map 7.4 **Bundala National Park**



Map 7.5 *Weerawila-Tissa Sanctuary*





CHAPTER 8

ENVIRONMENT

8.1 Introduction

The following four components of environmental impacts resulting from (a) the construction of the Lunugamvehera reservoir upstream of the old Ellegala *anicut* diversion and (b) the development of the new irrigated land of 10,000 acres and settlement of farmer families on the Right and Left Banks of the KOISP New Irrigation System (NIS) are reported in this chapter.

(a) Disturbances in lagoon ecology of the natural lagoon systems which are located in the lower coastal plain resulting from the altered hydrology of inflow from the NIS. This also includes the Bundala bird sanctuary component.

(b) Salinity hazards arising from the leaching of soluble salts from the NIS to the command area of the Old Ellegala Irrigation System (OEIS).

(c) Modifications in the hydrology of the lower floodplain areas and the irrigated command area of the OEIS.

(d) Soil erosion in the undulating terrain of the newly irrigated lands and the silting of the natural drainage waterways located within the NIS.

8.2 Methodology

Disturbances in Lagoon Ecology

Commencing maha 1991 - 1992, two trips were made during the middle and end of that season, and two trips at the start and close of the following yala season to three lagoon areas. During these trips field observations were made making use of 1982 air photos as well as 1:50,000 ABP maps of the Survey Department. These maps provided the base for proper location and delineation of the natural features such as lagoons, streams, drainage ways, outfalls and watershed boundaries. Water samples were taken for testing at the Weerawila Agricultural Research Station laboratory for electrical conductivity.

More detailed field traverses were made within the Bundala Bird Sanctuary area. These studies continued up to late maha 1993.

Salinity Hazards

In the New Irrigation System three location areas corresponding to RB tract 1 below hamlet 3; RB tract 2 below hamlet 6; and RB tract 5 below the Agricultural Research Station were monitored for trends in soil salinity levels. Electrical conductivity measurements were made on

1:5 soil water extracts of soil samples taken. These studies continued from maha 1989 through to yala 1993.

In the Old Ellegala Irrigation System systematic sampling and testing of the quality of irrigation water at fortnightly intervals from the main Lunugamvehera and the four Ellegala system reservoirs commenced in January 1990. Corresponding soil sampling of salinity affected areas also commenced from this period and continued up to maha 1993-1994. Both *pH* and conductivity of soil solutions and soil paste 1:1 were measured for each sampling site and date.

Modifications in Hydrology

These studies are based on regular visits made to the areas mentioned from 1991, and field observations made with the aid of air-photos and Irrigation Department layout maps which showed contours of the land. Several interviews were made with farmers in the affected areas in the lower floodplain area. Detailed field inspections were carried out twice a year since 1991 around the area of the outfall of the main river and its recent altered course to the sea.

Soil Erosion and Silting

Six benchmark sites were selected from the first, second and third order drainage maps from RB tracts 2 and 5. Sharpened L iron stakes were driven into the ground in June 1991, and levels of silting noted at bi-monthly intervals. Supporting observations were made in the other tracts by rapid field inspections at 3 to 4 monthly intervals for the purpose of comparison and co-relation.

8.3 Disturbances in Lagoon Ecology and Bundala Bird Sanctuary

The drainage system and the drainage pathways of waters into the three main lagoon systems namely Bundala (*lewaya*), Embilikala (*kalapuwa*) and Malala (*lewaya*) are shown in Figure 8.1 The approximate watershed boundaries of these three lagoon systems is shown in Figure 8.2.

8.3.1 Bundala Lagoon

As shown in Figure 8.2, the Bundala lagoon is located within its own independent catchment and it is in no manner influenced or hydrologically connected to any drainage flows from the Weligatta *Ara* which conveys the drainage flows from RB tracts 5 and 6 of the NIS (see Figure 8.1). Had the proposed RB tracts 3 and 4 been developed according to the original development plans, the Bundala lagoon would have received the resulting drainage inflows from the newly irrigated lands located within these proposed tracts 3 and 4. At present the Bundala lagoon receives its limited fresh water supply exclusively from the infrequent surface run-off during the rainy season from its own catchment which is largely under tropical thorn forest or dry/arid evergreen scrub vegetation.

Some modifications to the natural hydrology of the Bundala lagoon have however been caused by activities other than those arising from the KOISP irrigation interventions These are as follows:

(a) The western portion of the Bundala lagoon (520 ha.) has been converted into a saltern which is exploited by the National Salt Corporation. The natural outlet of the lagoon to the sea is now normally blocked by a sand barrier, while the saltern and the largest part of the lagoon are cut off from this outlet by an earthen man made bund.

(b) An artificial sea outfall has been cut through the sedimentary sandstone barrier (the dune ridge) from the lagoon towards the sea to expel excess water from the lagoon. This sea outfall gets blocked too by a sand bar which is built up by wave action over a period of only a few weeks. This sand bar is breached either manually or by deploying labor during the rainy season when the water level in the lagoon rises. This action enables the entry of fish and prawn larvae into the lagoon in November-December.

A greater part of the area covered by the Bundala lagoon in its present state could be considered a natural habitat of fish, birds, and other wild life. Certain aspects of the salt making process in the salterns of this lagoon are beneficial to some forms of life especially the type of algae which prefer a salinity level of 125 ppt compared with sea water 35 ppt. This type of algae provides good food for prawn larvae. On the other hand the presence of salterns provide little benefit to fish and wildlife species. Furthermore, the January-February salt production period coincides with the invasion of a large number of migrating birds that depend for the restocking of their fat reserves on the mud and aquatic fauna formed in those parts of the lagoon that have not been converted into salterns.

In sum, it could be stated that as long as there will be no further expansion of the saltern development within the Bundala lagoon, and also assuming that there will be no irrigation development envisaged in the future for RB tract 3 and part of tract 4, there is likely to be no further negative impact on the present environmental regime of the Bundala lagoon system which is now in an acceptable state of a sustainable environmental equilibrium.

8.3.2 Embilikala and Malala Lagoons

These two lagoons as shown in Figure 8.1 are interconnected by a meandering incised channel. While the Embilikala (*kalapuwa*) is an inland lagoon with no direct outfall to the sea, the Malala (*lewaya*), as its name implies, has a direct link with the sea at the Malala *modera* or sea outfall.

The Embilikala lagoon (430 ha.) receives a large quantity of drainage water from RB tracts 5 and 6 of the KOISP through the Weligatta *Ara* in addition to the normal run-off from its own catchment. The Malala lagoon (650 ha.) receives all the drainage water from the Badagiriya irrigation system (850 ha.) in addition to the normal run-off from the Malala Oya catchment.

Inflows into these two lagoons fluctuate according to the amounts of drainage water received through the Weligatta *Ara* and the Malala Oya: the water levels in the lagoons vary between +1 msl to about +2.2 msl according to the amount of inflow. High levels of salinity

between 14 and 41 ppt occur during the dry months of July - September; low levels of salinity between 7 and 15 ppt occur during the wet months of November-December. For successful breeding of prawns the salinity of the lagoon system should be maintained between 15 to 30 ppt as compared with sea water which is 35 ppt.

Field interviews with the villagers around these lagoons reveal that the Embilikala lagoon has been subject to the most serious negative impacts since the development of the KOISP started. In the past there had been an established practice of lagoon water level manipulation whereby fish and shrimp larvae are let into the lagoon in November by cutting open the sand bar. They are then allowed to mature and harvested from January onwards. Increased flows of fresh water into the Embilikala and Malala lagoons from the KOISP scheme have now reduced the lagoon's salinity to sub-optimal levels for prawn production. Fishermen in Pallemalala village complain that the fresh water dilution from KOISP has almost completely eliminated prawn production in the Malala lagoon, and that even the few prawns that remain are harder to catch due to increased vegetation growth in the lagoon bottom.

It was not possible to estimate the degree or levels of agro-chemicals such as fertilizer and pesticides brought in with the drainage water from the irrigated lands in RB tracts 5 and 6. However, indirect evidence of the absence of a serious threat at present could be obtained from the non-occurrence of algael blooms caused by eutrophication and also from the presence of small fish species and population that are sensitive to lower threshold levels of pesticides. Measurement of the electrical conductivity of the main drainage waters from tracts 5 and 6 have shown that the conductivity of the main drainage waters is usually around five to six times that of the irrigation water supply coming in the main canal. This enrichment is mainly caused by soluble sodium salts and chlorides present in the soil which are yet getting leached out and carried in the drainage waters.

A recently constructed channel by the Irrigation Department from the south west corner of the Malala lagoon to the sea in order to discharge excess fresh water from the two lagoons was visited in late June this year. It was functioning quite satisfactorily according to its design objectives in maintaining the water levels in the two lagoons at a prescribed level (crest wall height). We were also informed that excess flooding in the lagoons has now been eliminated, and that sufficient salt water could be taken into the Malala lagoon at high tide in order to obtain the required salinity level for prawn culture. Since the outlet of this channel to the sea is located around a rocky headland there will be little or no sand bar formation at this outfall. The structures are simple, straightforward and easily managed by a field level irrigation employee.

The performance of this channel and the variation in salinity levels of the two lagoons should be properly monitored especially during the November-December rainy season and during the July-September dry seasons. This would be a basis for the necessary modifications in the management system. A small management committee made up of representatives from the ID and representatives from the farmers and the fishermen from around these two lagoons should be made responsible for the appropriate management of this vital channel. This would enable a restoration of the earlier status quo of these two lagoon systems so that the economic productivity of the prawn and fish culture could be re-established.

8.3.3 Bundala Bird Sanctuary

In the ADB preparation report of May 1986 (page 16) it was recommended that:

(a) The irrigated areas of RB tracts 3 and 4 be reduced to leave a 300 meter buffer-strip along the sanctuary boundary from the Weligatta intersection to the Kirindi Oya.

(b) The existing and scrub forest be left intact in this area, and that lots be made available for leasing to settler families for conversion to woodlots.

Since the Phase II development of the KOISP Right Bank had been curtailed and limited to RB tracts 6 (670 ha.) and tract 7 (230 ha.) due to the shortfall of water supply in the main Lunugamvehera reservoir, the development of the proposed RB tracts 3 and 4 has not taken place. The proposed area of RB tracts 3 and 4 which was designed to irrigate about 1,500 ha. has thus been left in its natural state. Only at the Weligatte village center some substantial buildings were constructed and also sporadic illicit forest clearings occurred. Some unauthorized settlements have taken place parallel and close to the main road between Weligatta and Andala in tract 4 close to and around locations with a reliable source of dry season domestic water along the smaller *Aras*. Fortunately however, there has been little or no disturbance in the natural forest cover in the proposed buffer strip located between the Bundala sanctuary and the proposed tracts 3 and 4 (see Figure 8.3). There is a small village tank settlement under the Bundala Wewa located just above the Bundala lagoon, and there are more recent government sponsored residential settlements between Bundala village and Baminiya Wewa as shown in Figure 8.3. There is the older traditional village settlement of Bundala Wellagangoda located on the sandy *regosols* about half a mile inland from the sea (see Figure 8.3). Good quality potable water is available all year round within this sandy *regosol* which supports over 30 families in this village.

A more environmentally destructive activity taking place within this area in recent times is that of shell mining. This consists of extracting fossil shells from beds which occur just beneath the ground surface on those patches of landscape which were earlier (pre-pleistocene period) under sea and since uplifted by tectonic upwarping in this region. Although this destructive activity could, in no way, be directly linked with KOISP development activities over the last seven years, it will have long term negative impacts on the environment of the Bundala National Park if permitted to expand beyond its present level.

Associated with shell mining is the cutting of trees and fuel wood collection for burning the shells for more profitable lime (*CaO*) production. This results in a depletion of the vegetation cover and also in the creation of unofficial access tracks within the sanctuary area. The forests around the lagoons are critically important to the areas ecosystem as they protect the soil cover against excessive surface erosion and consequent soil wash into the lagoons, thereby limiting their life time.

Because a part of the human population within this area depends on shell mining for their livelihood, a study should be undertaken to assess the shell resources in and around the National Park area and restrict this activity to the non-critical areas.

In short, it could be concluded that the decision to drop the development of the proposed RB tracts 3 and 4 has proved beneficial in protecting the environment of the Bundala bird sanctuary. The proposed buffer strip along the sanctuary boundary is now well in place and is not interfered by human activity. However, some degree of government intervention and control will be required to minimize the future expansion of shell mining and associated cutting of trees for fuel wood.

8.4 Salinity Hazards

8.4.1 New Irrigation System (NIS)

Initial complaints of soil salinity were reported from the newly developed lands in the NIS. These reached a peak in the 1989 maha season. Since then the areas affected by salinity have progressively declined and are now confined to the bottom most aspects of the undulating terrain within which the NIS is situated. As of maha 1993 soil salinity is found to occur only in very small areas located adjacent to the natural drainage valleys in this landscape. This occurs especially where the natural drainage ways are not functioning properly or else have been purposely blocked by unauthorized cultivators who illegally developed the drainage reservation areas. Also, the few patches of salinity in the rest of the area are confined to the small areas that lie adjacent to the major axis of the valleys in this undulating landscape. Over the period of the last five years the soluble salts initially present in this newly developed lands have been progressively leached out by the Class I quality irrigation water supply that comes from the main Lunugamvehera reservoir. As in the case of the adjacent Badagiriya Irrigation system commissioned in 1961, which had salinity problems during the initial years, a progressive decline of salinity to an acceptable level was experienced over a 10 year period. However, the irrigation water of the Badagiriya reservoir was of Class II quality and it needed about 10 years of leaching to get rid of the salts present in the soil, whereas in the KOISP NIS this process of leaching out has occurred over a span of a little more than five years on account of the better quality of the Lunugamvehera water.

As a result of the good landscape drainage characteristics of the NIS, there is adequate flushing out of soluble salts during the wet maha season when rainfall plus very high quality irrigation water supply from the main reservoir enables a rapid leaching out of the soil profile. At present very little salinity is reported for the rice crop during the wet maha season, except as mentioned earlier in a few locations at the lowermost topographical locations along the drainage ways and along the lower aspects of the main axis of the inland valleys. However, when rice is grown during the dry season after May, when irrigation supply is limited and also when the evaporation rates exceed 7 mm/day, there is yet some upward capillary movement of salts mostly during July-August which depresses the performance of the rice crop. This does not affect the non-rice OFC crops which are recommended during the dry season.

8.4.2 Old Ellegala Irrigation System (OEIS)

In the preceding years more serious complaints of salinity have come from the OEIS, where farmers reported that the soluble salts leached out from the NIS were being collected in the four old major tanks that service them.

The Old Ellegala System is situated almost totally within a flat alluvial plain. The new irrigation system in the Kirindi Oya, in contrast, is situated almost totally within the surrounding undulating, residual 'mantled plain' as shown in Figure 8.4.

The four major reservoirs of the Ellegala namely - Weerawila, Debarawewa, Tissa Wewa and Yoda Wewa - are located in the transitional landscape between the undulating residual plain and the flat alluvial plain. It can be observed from Figure 8.4 that drainage waters from tracts 1 and 2 of the new areas of the Right Bank flow into the major Weerawila and minor Pannegamuwa reservoirs. Drainage waters from tract 1 and 2 of the new areas of the Left Bank flow into the Debarawewa, the Tissa Wewa and the Yoda Wewa. A schematic cross section across the residual plain of the new areas, the reservoirs, the flat alluvial plain of the Ellegala and the river is shown in Figure 8.5.

For the last 100 years, the alluvial soils of the Ellegala have been irrigated with Class I irrigation water originating from the main Kirindi Oya and diverted to the command area through the Ellegala Anicut. This coupled with the incised nature of the downstream Kirindi Oya had prevented the building up of salts in the irrigated command area in the past 100 years.

The Ellegala also had an adequate drainage network leading to several outfalls (*basnawas*). These outfalls were damaged by the 1969 floods and have not been repaired or properly maintained since then. It is from this time that farmers in the lower reaches of the Ellegala report incipient occurrences of salinity in their areas. Salts are however flushed out during exceptionally wet maha seasons which occur approximately once in six years.

In January 1990 the Department of Agriculture commenced a program to test, once every fortnight, the quality of water in the Lunugamvehera and in the five Ellegala tanks. The results of this analysis for the years 1990 to 1993 with respect to the Lunugamvehera and the Weerawila, the Tissa Wewa and the Yoda Wewa are shown in Figures 8.6 to 8.9.

As indicated in Figures 8.6 to 8.9, the quality of the water in the Lunugamvehera was well below EC of 0.20 milli mhos per cm during the wet season from October to January and hovers around 0.25 for the rest of the year. Figure 8.5 indicates that the water quality in the Lunugamvehera, which receives its total supply from the upstream Kirindi Oya, is Class I for almost all twelve months of the year.

In the case of the Tissa Wewa and the Yoda Wewa, EC values increased to 0.75 milli mhos per cm between March and June and between August and October. EC values for the Weerawila exceeded 0.75 milli mhos per cm between March and June. Major inflow of drainage water charged with soluble salts from the new areas to these reservoirs takes place during these two periods.

During 1992, EC values for Weerawila peaked between August and September due to the reservoir not receiving inflows from the Lunugamvehera during this period. In 1993, trends were similar to 1991 with peak values for the Weerawila recorded between June and July and September and October, as shown in Figure 8.9.

It can thus be observed that while the quality of water in the Lunugamvehera can be classified as Class I, the quality of water in the reservoirs of the Ellegala fluctuate considerably during a season. This depends on whether they have received substantial amounts of salt-enriched drainage water from the new areas or not, and also on the amount of good quality water received from the Lunugamvehera via the Ellegala Anicut.

The Ellegala has now to cope with added accretion of soluble salts coming from the drainage waters of the new system as a result of the inadequate drainage. It presently acts as a sink for salts coming from both the upstream new areas and normal cyclic salts and other accretions as well.

At present there is evidence that a considerable amount of leaching of soluble salts takes place from the new areas. This rate of leaching may decrease with the passage of time through the continued leaching of salts, as happened in the adjacent Badagiriya system, provided that drainage curses are kept in a good working condition to flush out salts.

Monitoring of the quality of the drainage water at four outfalls (*basnawas*) located within the command areas of the Tissa Wewa and the Yoda Wewa commenced in May 1993. The results are shown in Table 8.1. A clear trend of increasing salinity of drainage water for the upper to the lower reaches of the command area was observed. The highest concentration of salts was recorded in the lowermost outfall near the sea, the Magama outfall which registered an EC of 1.78 milli mhos per cm by late August. The uppermost outfall at Yoda Ela registered an EC of 0.63 milli mhos per cm for the same period in August 1993. There was a decline in EC values after November because of maha rains and irrigation, except at the *Maha Basnawa* outfall, as shown in Table 8.1.

Table 8.1 Electrical conductivity (EC) of drainage waters at the respective outfalls (basnawas) 1993

Date	Yoda Ela *Basnawa*	Moda Ela *Basnawa*	Maha *Basnawa*	Magama *Basnawa*
23 May	-	-	1.72	0.92
16 June	0.71	0.77	1.72	0.90
30 June	0.56	0.73	1.48	0.89
16 July	0.67	0.73	1.48	1.26
4 August	0.63	0.67	1.70	1.46
24 August	0.63	-	1.64	1.78
9 September	0.75	0.73	1.63	-
21 September	0.74	no flow	no flow	no flow
26 November	0.58	0.67	1.64	0.71
27 December	0.54	0.67	1.77	0.72

(Electrical Conductivity (milli mhos/cm))

Based on the foregoing studies and observations the following recommendations were made for mitigating the effects of salinity:

(a) A low-cost water quality monitoring system for the five reservoirs should be sustained with a view to releasing the required amount of Class I quality water from the Lunugamvehera reservoir in order to effect the necessary dilution.

(b) There are two factors that are major contributors to the salinity problems of Ellegala. The first is the increased salinity contribution of tank water. In the future, this can be modified by dilution from Lunugamvehera water through proper monitoring of the quality of the water. The second is the drainage congestion in the Tissa and Yoda Wewa command areas and the poor drainage in micro-depressions and lower topographical locations which have poorly drained soils.

Early action should be taken to clear the drainage congestion and to keep the drainage ways free from blockage. It must be ensured that they are connected to the main arterial drains and eventually to the outfalls to the sea.

(c) As mentioned earlier, it is extremely important that the fortnightly monitoring of water quality of all reservoirs and the four outfalls (*basnawas*) be continued over the next five years. This would help to keep track of the trends in salinity and it would thus form the basis for the appropriate corrective action that would need to be taken.

Special note should be taken of the salinity levels of waters during extra-ordinary dry years such as 1992, so that the necessary levels of dilution in the old Ellegala could be maintained at the critical threshold levels.

8.5 Modification in Hydrology of the Old Ellegala Irrigation System

Prior to the construction of the Lunugamvehera reservoir the OEIS had a specific hydrological regime with the following main characteristics:

(a) During the peak flow period in November-December there was sufficient discharge in the river to scour and transport any surface bed loads of river sediment that had accumulated during the rest of the year.

(b) This scouring effect was manifest from the Ellegala anicut right down to the ocean outfall at Magama - Telulla.

(c) There was a significant deposit of the finer bed load material in the lowermost floodplain areas, especially within the last two meanders of the river around Magama before it enters the sea.

(d) The lower floodplain area was subject to flooding for periods of 10 to 14 days during the peak flow of the river which occurs around late November to mid-December each year. A deposition of a thin layer of silt took place every year in this alluvial flood plain during the flooding.

(e) The paddy lands in the whole of the OEIS were supplied with high quality water which came directly from the Kirindi Oya via the Ellegala anicut into the Weerawila, Yodawewa, Tissa Wewa and Debarawewa reservoirs.

(f) There was adequate flushing out of any accumulated salts in the flat alluvial plain of the OEIS during the wet season and these were easily carried away in the main river flow.

Consequent on the construction of the Lunugamvehera reservoir the following main changes have taken place:

(a) There is no natural scouring of the Kirindi Oya river bed especially in the section between the Ellegala anicut and the point of entry of the Weerawila *Ara* which carries the spill discharge from the Weerawila tank. There is also less scouring of the river bed from this point up to the sea outfall in the rest of the main Kirindi Oya.

(b) The sand bar at the river outfall to the sea which was earlier breached naturally by the high river flow in the November-December period has now to be artificially breached in years when there is insufficient flow-head. Fortunately, a new smaller river course has carved itself out with an outfall adjacent to a low rocky headland which functions as a natural groin and thus prevents the build up of a sand bar at its point of entry to the sea. This new river course however, can take only a smaller discharge than the main Kirindi Oya river, but is sufficient for the minimum evacuation of accumulated salts in the lower flood plain.

(c) There is no further flooding of the lower floodplain during November-December and no further deposition of any river borne material in this area. Settlers in an area of about 125 acres in this lower floodplain had a thriving settlement of coconut gardens and other tree crops. These are now adversely affected by the absence of flooding and former enrichment. This is the only adversely affected area that was found in the lower floodplain.

(d) Earlier there was very little dry weather flow in the Kirindi Oya during May-September below the Ellegala anicut. Farmers now report that in normal years there is significant dry weather flow resulting from the drainage flows that take place from the new irrigated lands in the NIS during the yala season. This has helped them to lift limited quantities of water from the river during this period and cultivate high value crops on the levee banks of the river. This was not possible before and farmers considered it a beneficial effect.

(e) The altered hydrology of the OEIS has affected both the water table and the quality of water of the wells in the homestead settlement areas in a negative as well as a positive manner. There were complaints of increasing salinity from users of wells located close to the hydrological influence of Weerawila and Yoda wewa during the dry season. Yet, the salinity was not high enough to make the water unusable. Other wells located in the homestead settlement areas further south down the course of the river have now benefitted from an enhanced water level during the dry season as compared to the former situation.

Apart from the foregoing changes that have been observed there are no other significant impacts resulting from the modification of the hydrology of the OEIS.

One positive corrective measure that could be adopted for the future is to provide for a short duration high-surge discharge from the reservoir once or twice during the wet season that would enable a scouring and flushing out those parts of the river bed that do not presently get scoured or flushed out adequately.

8.6 Soil Erosion and Silting of Waterways

As described earlier, the OEIS is almost wholly located within a slightly uplifted flat alluvial plain and has an incised major river, the Kirindi Oya, cutting through it. As to be expected there will be little or no erosion hazards nor silting encountered in this type of landscape and hydrology.

In contrast, the NIS is wholly located within an undulating, residual mantled plain with slopes varying between 3-6 percent in the upper aspect of the toposequence, and between 1-2 percent in the lower aspects of the toposequence. The soils of this residual undulating plain are 75 percent reddish brown earths RBE (*Chromic Luvisols LVx*) and 25 percent solodized solonetz SS (*Gleyic Solonetz SNg*). The RBE soils have a low structural stability and are erodible, and thus subject to erosion on sloping lands. The SS are sodic soils with an exchangeable sodium percentage of more than 15 percent and are subject to dispersion under flood irrigation until the sodium gets flushed out. However, because all the irrigable land has been bench terraced for wet paddy cultivation, the erosion hazards have been minimized. There is very little soil loss under these conditions except for some dispersed clay being carried along in the irrigation flows from field to field.

Very little soil erosion is observed in the terraced paddy fields. Much of the soil erosion, especially slumping is observed on the poorly maintained field channels, also on a portion of the distributary channels and on the unprotected banks of the main canals where the channel is located on filled sections of the channel traverse.

It should be borne in mind that almost all of this land falling within the NIS was previously under chena or shifting cultivation and no soil conservation practices were then adopted by the subsistence farmers. With a shortening of the chena fallow period in some parts of the former NIS, there had been observable soil degradation as could be observed even today immediately above the present NIS area. The terraced land development for wet paddy cultivation has arrested this adverse trend, and the irrigated land is now in good 'health'.

The removal of the forest cover for land development for irrigation purposes has had no adverse impact because a more productive and sustainable tree cover is now established around the settlement homesteads although this makes up only a smaller proportion of the area. At the same time, because of irrigation there is a more prolonged natural weed and grass cover on the land during the dry season than before which gives a longer protection to the soil surface. This also enhances the grazing capacity for the cattle herds in this area. In sum, it could be stated that the development of the NIS has had a positive environmental impact with respect to the soil erosion hazard.

In order to monitor the silting, six benchmark sites were selected on the first, second and third order natural drainage ways in June 1991 from RB tracts 2 and 5. It should be noted, that after its conversion from rainfed chena and scrubland to terraced paddy land in 1986 - 1989, the irrigated surface landscape had become stabilized by 1990. Most of the surface soil wash and silting of drainage ways and streams had taken place during this development phase and the initial irrigation phase. By 1991 the situation had more or less become stabilized.

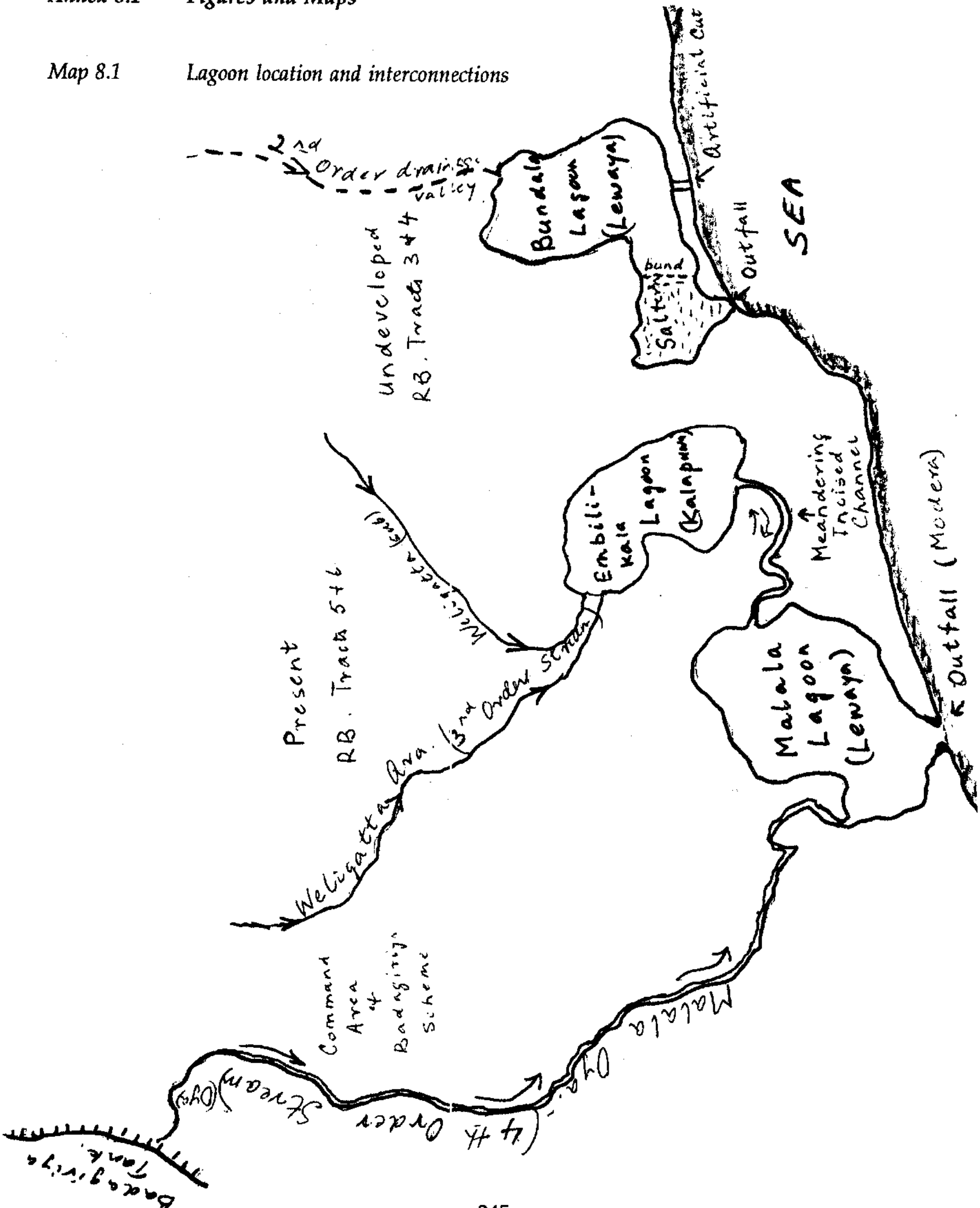
During the three year period of monitoring commencing June 1991 very little or no silting was observed in the first and second order drainage ways. Considering the fact that these locations receive their silt load mainly from the terraced irrigated land and a little from the field channels, this outcome was according to expectations.

However, in the case of the higher order drainage ways, significant silting was observed over this three year period. This was most pronounced at the tailend of the axis of the major inland valleys which is connected with the main natural drainage way. This too is now getting stabilized except during very high intensity storms which causes high run-off conditions and deposition of silt loads. A few spot checks to locate the pathways of this main component of silting indicates that a major part of this silt load comes from the less stable banks of the main canals. Especially in those locations that are used by buffalo herds as crossings thus damaging the side slopes of the main canal bund. Run-off from the poorly maintained road network also contributes to this silt wash.

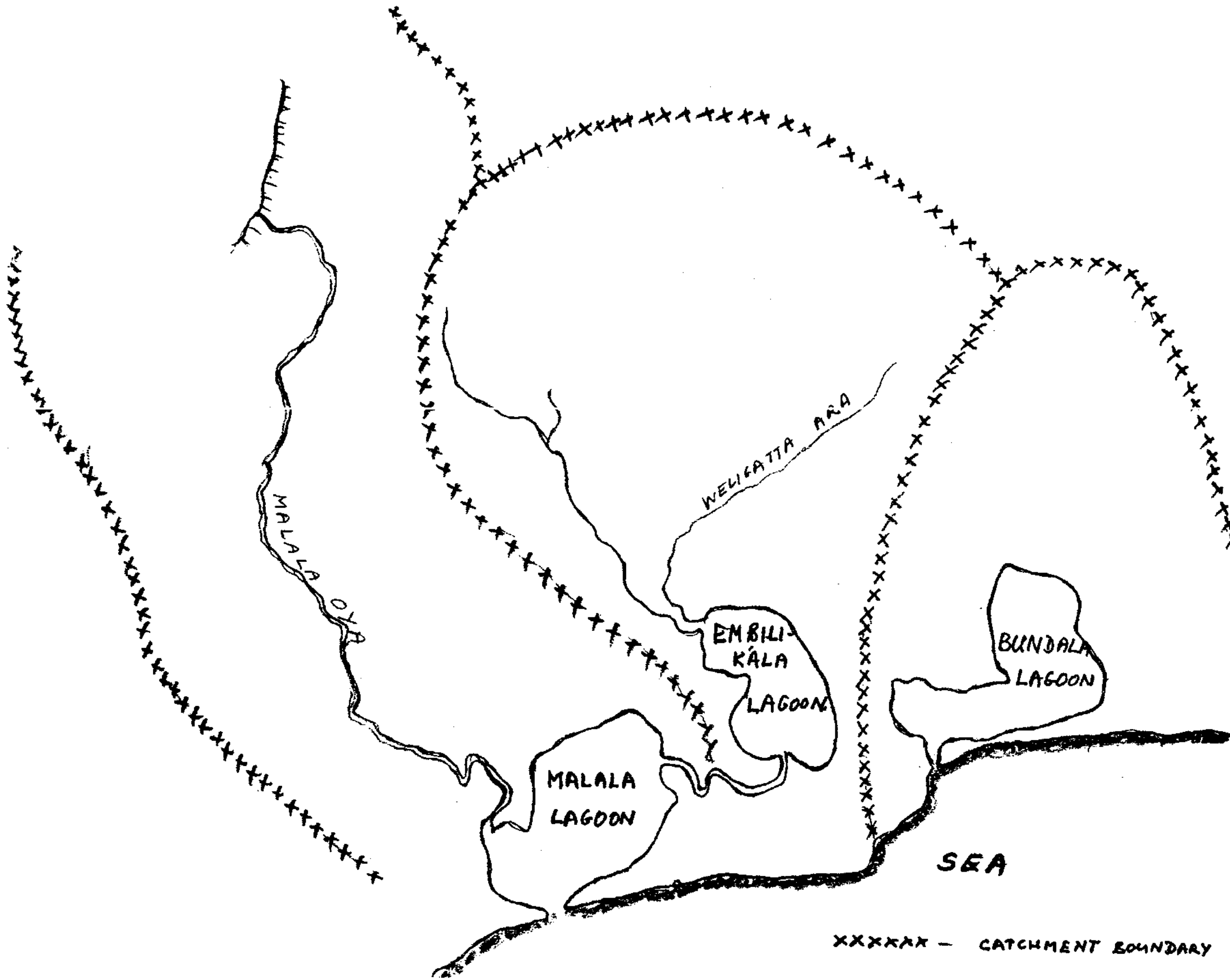
In sum, it could be stated that the terraced land development for irrigated paddy has had a positive environmental impact as far as silting of waterways is concerned. The poorly maintained road network and main canal embankments have had a negative environmental impact.

Annex 8.1 Figures and Maps

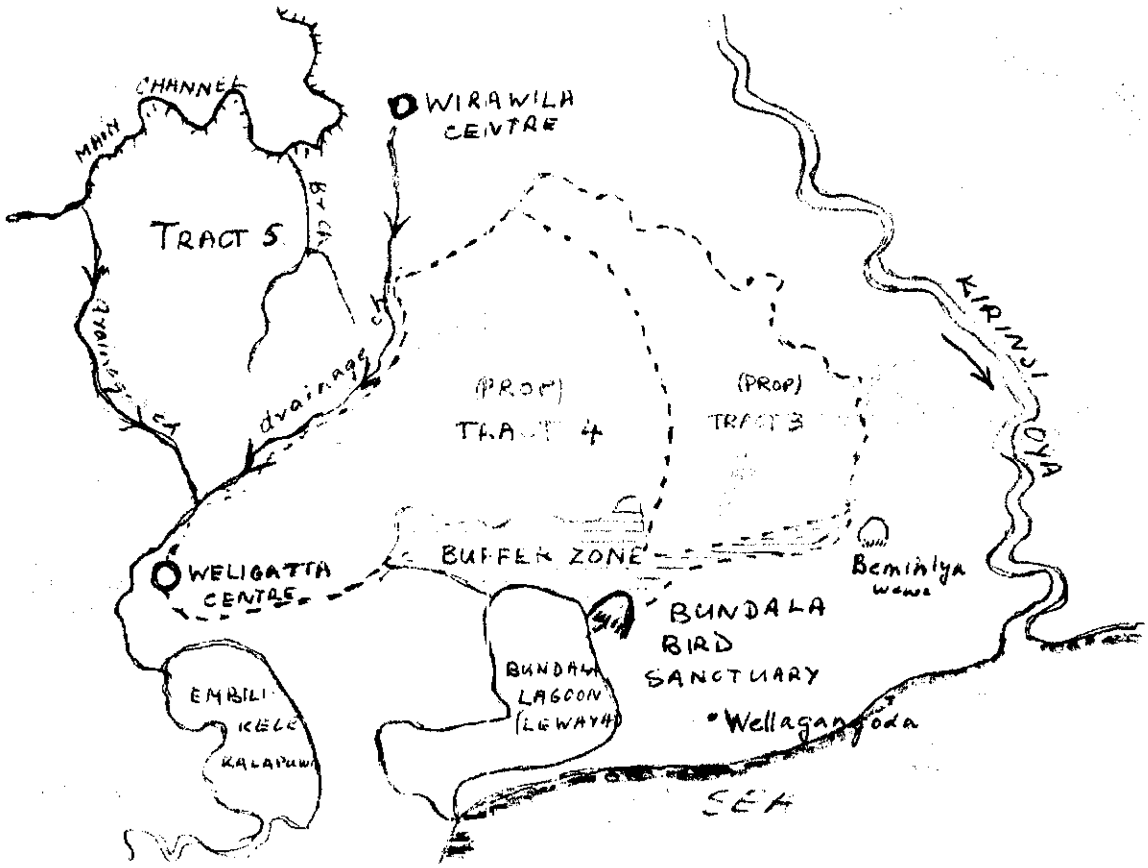
Map 8.1 Lagoon location and interconnections



Map 8.2 Watershed boundaries of lagoons



Map 8.3 *Location of Bundala Bird Sanctuary in relation to tracts 3 and 4*



Map 8.4 KOISP old and new irrigation systems

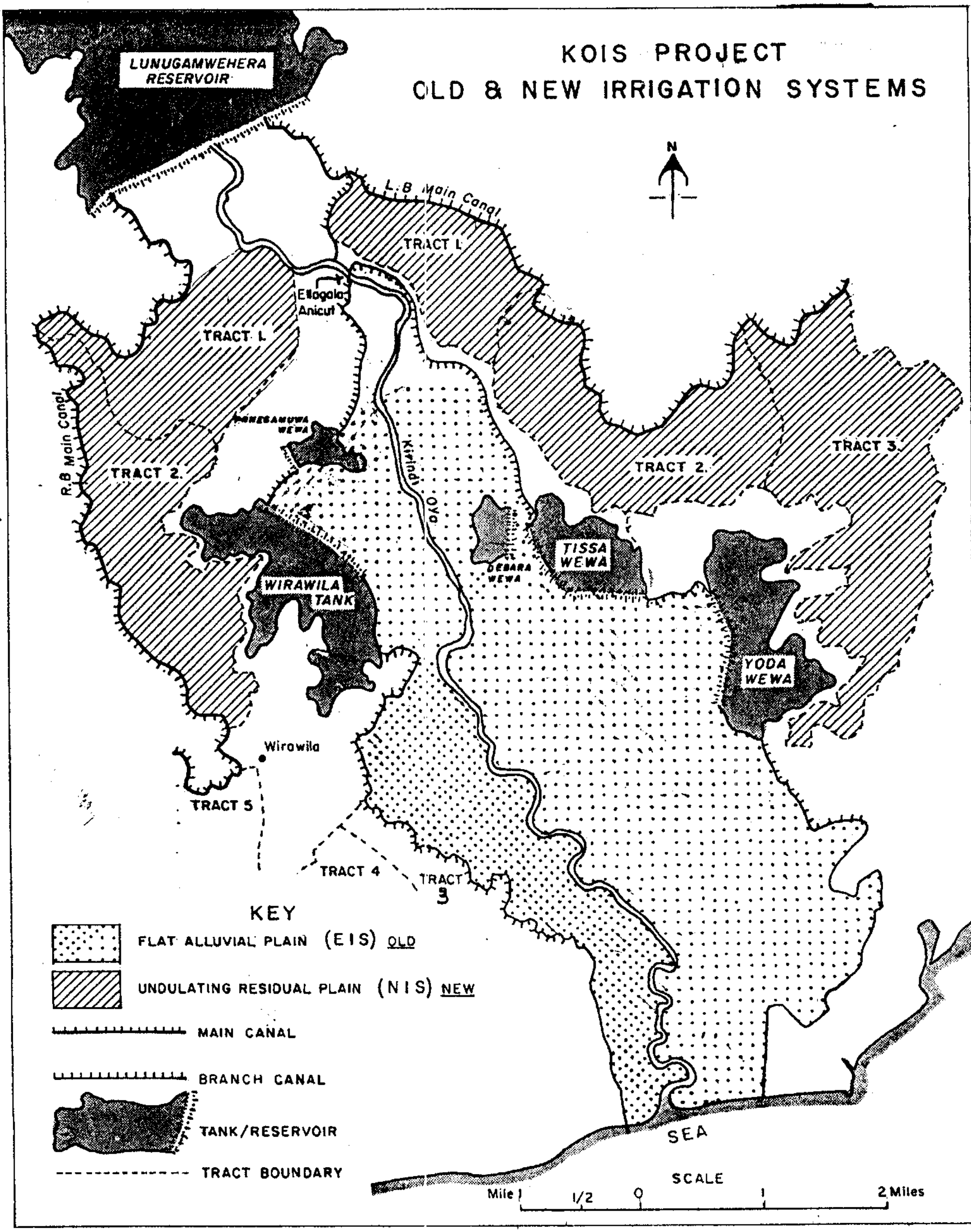
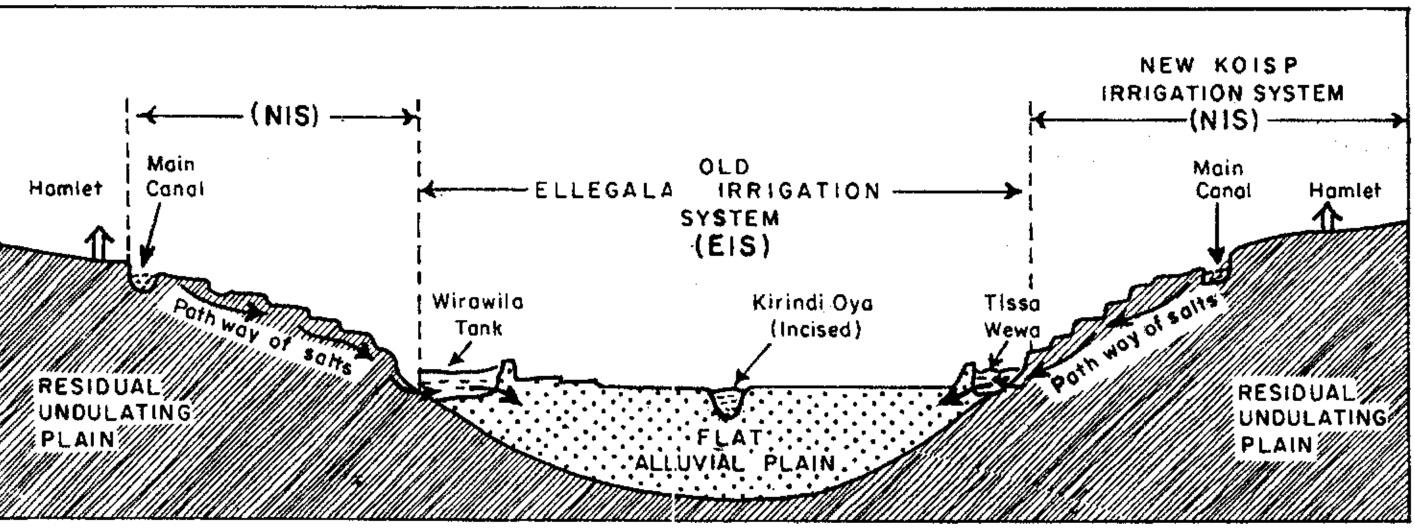


Figure 8.1 *Schematic cross section of old and new systems*



SCHEMATIC CROSS SECTION (EAST-WEST) ORIENTATION

Figure 8.2 *EC of tank waters in KOISP area - 1990*

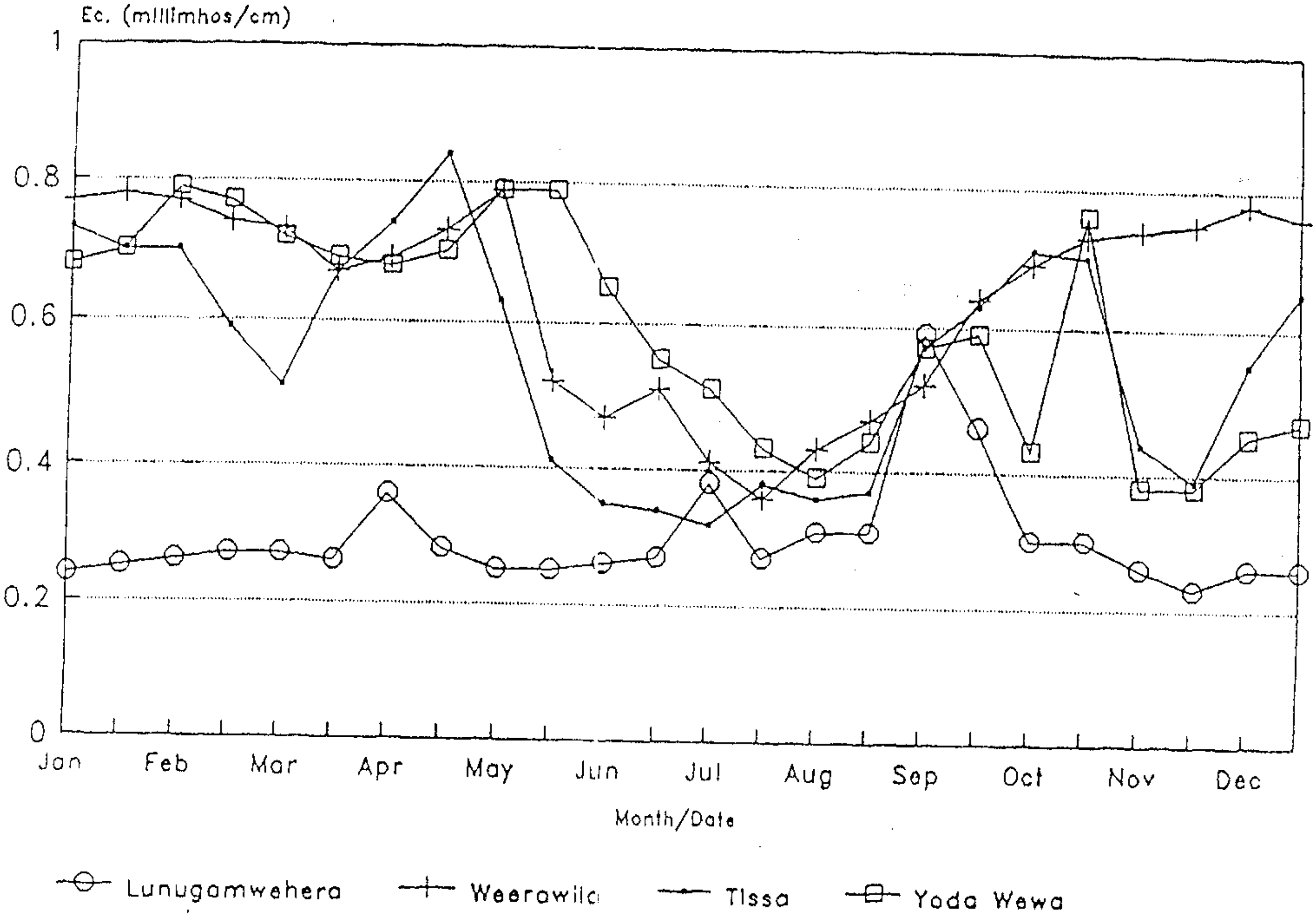


Figure 8.3 *EC of tank waters in KOISP area - 1991*

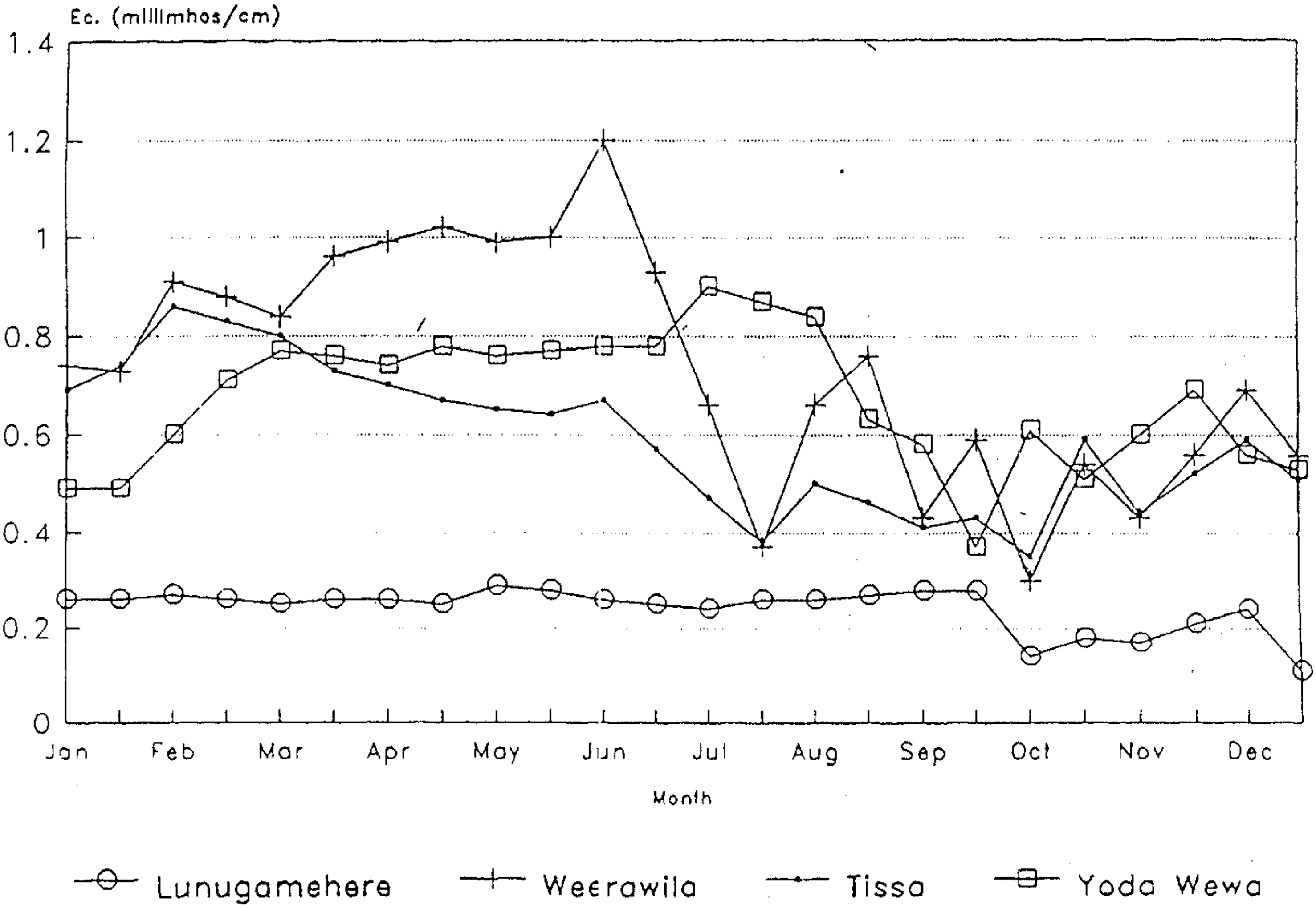


Figure 8.4 EC of tank waters in KOISP area - 1992

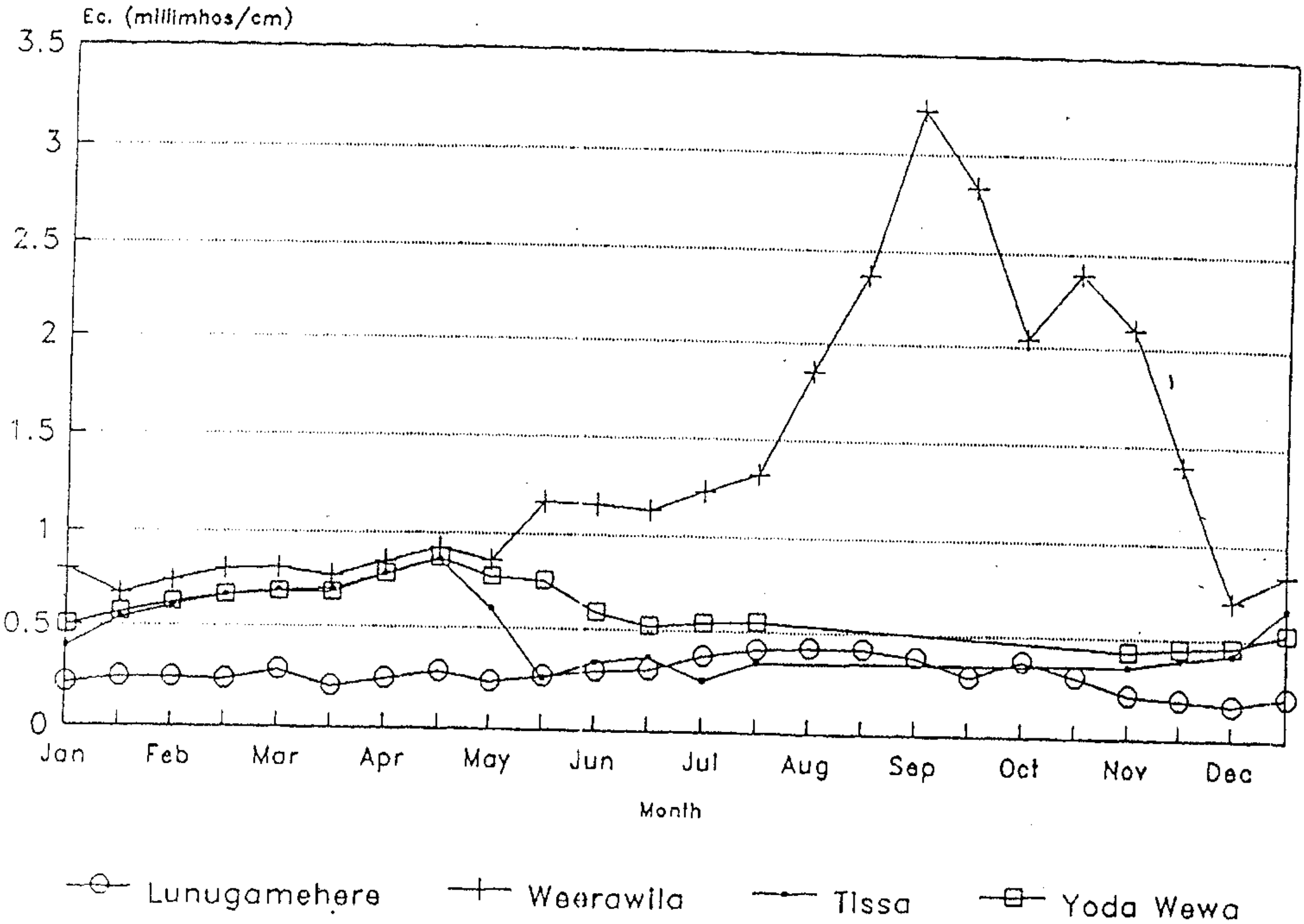
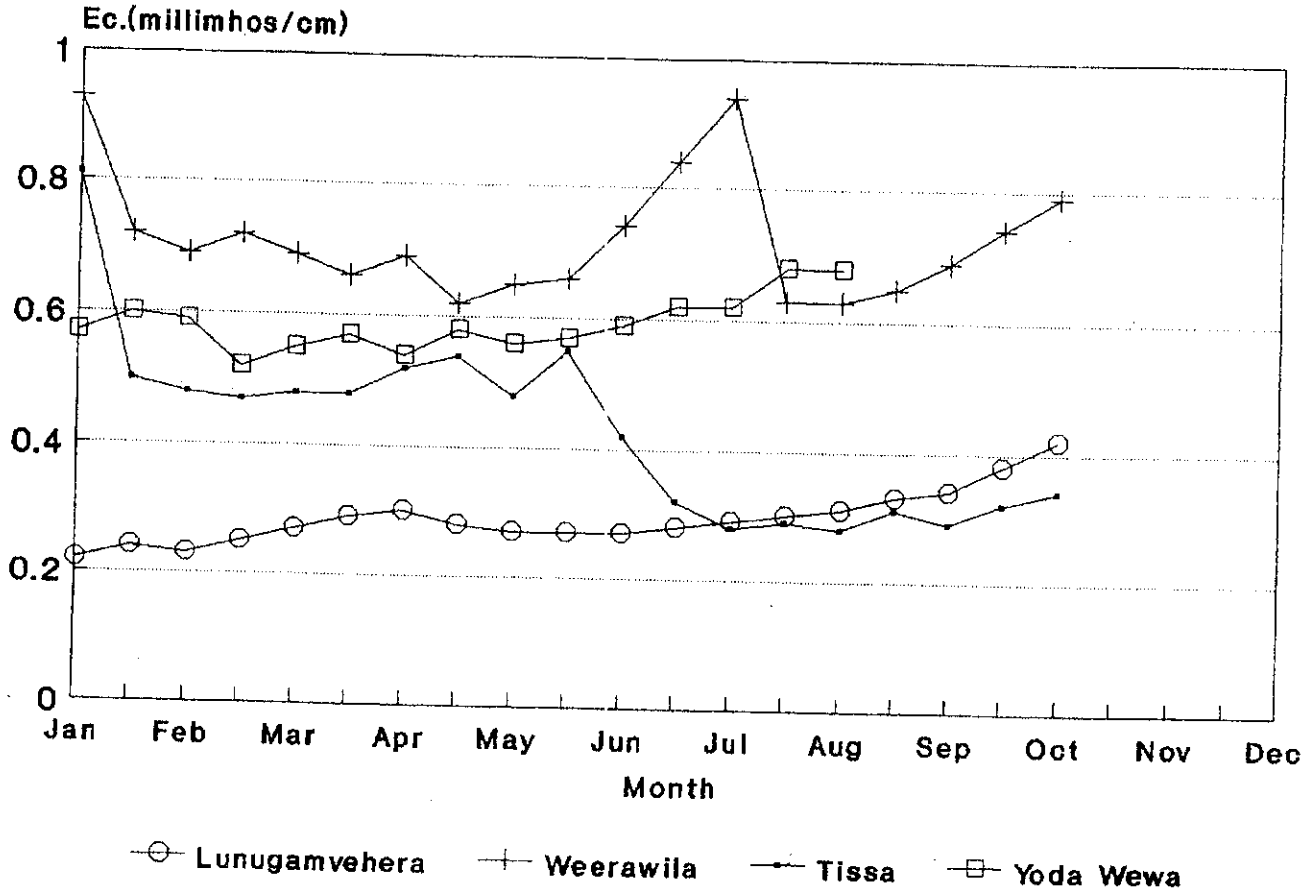


Figure 8.5 EC of tank waters in KOISP area - 1993



CHAPTER 9

KOISP PROJECT MANAGEMENT, INSTITUTIONAL DEVELOPMENT AND BENEFICIARY PARTICIPATION

9.1 Introduction

This chapter considers key aspects of a) the management of the KOISP, b) institutional development under the KOISP, and c) beneficiary participation in the KOISP. This chapter attempts to evaluate these aspects of the KOISP only in a general way; the goal is to identify lessons that can be of value to future area development projects.

The chapter is organized as follows:

(a) The first part of the chapter focusses on project management. This covers performance of the management mechanisms used to get project activities accomplished. Necessarily it focusses more on the problems than on the successes since the problems tell us about the weaknesses of the mechanisms. Because the project went on for such a long period (1977-1993), the discussion focusses only on selected major aspects of project management.

(b) The second part of the chapter focusses on institutional development under the project. This refers to creation and strengthening of the organizations needed to effectively and efficiently manage the infrastructure created by the project and to provide the services needed by the new settlers. Particular attention is given to creation of organizations among the settlers themselves. Because there are so many agencies dealing with so many subjects, the discussion is somewhat selective.

(c) The concluding section summarizes the main findings and lessons of this discussion.

Both the first and second parts pay particular attention to beneficiary participation in the activities. Modern development theory indicates that beneficiary participation in planning and execution of development projects improves the results of the projects (Esman & Uphoff 1984). Also, beneficiary participation is felt to improve the working of routine governance and management mechanisms, particularly where, as in irrigation systems, some degree of cooperation of the beneficiaries among themselves and with management agencies is required for effective management (Vermillion 1991).

9.2 Methodology

Data for this chapter were derived from a variety of sources, including published works and reports, interviews with responsible officers from the Irrigation Department, Land Commissioner's Department and Irrigation Management Division, project quarterly reports from

both Phase I and Phase II, minutes of the Project Coordinating Committee and Central Coordinating Committee, interviews with knowledgeable observers and settlers in Kirindi Oya, other project documents, the large-scale survey, and the ARTI study on beneficiary participation (Razaak & Wijetunga 1994)

Because not all respondents answered all questions on the large-scale survey, the actual number who answered is given in the tables as "N". All percentages are percentages of "N".

9.3 Project Management

9.3.1 Issues in the Management of the KOISP

The Kirindi Oya Irrigation and Settlement Project (KOISP) set out to build a new irrigation system, settle farmers and their families on the newly irrigated land, and provide various services to those families. The preceding chapters describe and evaluate the achievements of the KOISP in detail.

Project Management Agencies and Responsibilities The project management structure changed over time. Tables 9.1, 9.2 and 9.3 show the agencies and responsibilities as defined in the three project appraisal reports.

Table 9.1 Project management as defined in the 1977 Appraisal Report

Category	Agencies	Responsibilities
Executing Agencies	Irrigation Department	principal executing agency, irrigation system construction
	Land Development Department (LDD)	settlement infrastructure
	Land Commissioner's Department	settler selection and subsidies
	Department of Agriculture	agricultural extension support
Project Coordination	Central Coordinating Committee	high level coordination and support, policy guidance
	Project Coordinating Committee	project level coordination of activities
	Project Manager (ID)	irrigation system construction, overall coordination
	LDD Project Officer in Charge	settlement development
	DOA Project Officer in Charge	agricultural extension development
Monitoring & Evaluation	Ministry of Irrigation, Power and Highways	

These tables show some changes over the years:

(a) The Land Development Department was abolished in 1980. As a result, the Land Commissioner's Department (LCD) took over its functions in the project.

(b) Reflecting the importance of the settlement and irrigation system components, two special officers were placed in charge of these. Other components were under the direction of their own local personnel.

(c) The Agrarian Research and Training Institute (ARTI) was given an explicit monitoring and evaluation role. The Ministry (which also changed its name between 1977 and 1982) could not undertake specific studies of impacts on its own and had to contract them out. Since ARTI had already conducted the baseline survey under contract with the Ministry, this change merely reflected the situation.

(d) Under Phase II, the credit component was added; the Central Bank of Sri Lanka was made responsible for it.

(e) Other new components were added to Phase II but were made the responsibilities of existing executing agencies.

Table 9.2 Project management as defined in the 1982 Appraisal Report

Category	Agencies	Responsibilities
Executing Agencies	Irrigation Department	principal executing agency, irrigation system construction
	Land Commissioner's Department	all settlement work
	Department of Agriculture	agricultural research and extension support
Project Coordination	Central Coordinating Committee	high level coordination and support, policy guidance
	Project Coordinating Committee	project level coordination of activities
	Project Director	overall coordination
	Project Manager (Settlement)	settlement development
	Project Manager (Irrigation)	irrigation system construction
Monitoring & Evaluation	Agrarian Research and Training Institute	

Although the Land Commissioner's Department was responsible for three new components, in practice two of these were given over entirely to the agencies that actually carried them out. These agencies were:

- Forest Department - woodlot development

- Draught Animal and Dairy Development Program (an agency under the Mahaweli Authority of Sri Lanka) - livestock farm development

The donors also had a clear interest in the project. The Asian Development Bank (ADB), as the leading donor, was delegated project oversight responsibility by the other donors. ADB played an active part in aspects of management, including providing technical advice and overseeing various contracts.

In addition, of course, there were numerous other organizations that played various parts in the project under various agreements and contracts with the responsible agencies listed above. Some, but not all, of these are mentioned below.

Table 9.3 Project management as defined in the 1986 Appraisal Report

Category	Agencies	Responsibilities
Executing Agencies	Irrigation Department	principal executing agency, irrigation system construction
	Land Commissioner's Department	settlement, marketing, livestock, woodlots
	Department of Agriculture	seed production, agricultural research and extension support
	Central Bank of Sri Lanka	credit
Project Coordination	Central Coordinating Committee	high level coordination and support, policy guidance
	Project Coordinating Committee	project level coordination of activities
	Project Director	overall coordination
	Project Manager (Settlement)	settlement development
	Project Manager (Irrigation)	irrigation system construction
Monitoring & Evaluation	Agrarian Research and Training Institute	

Project Management Issues Discussed in this Chapter This chapter will focus attention on seven areas:

(a) Overall project planning errors, including the overestimation of water availability, failure to deal with the displacement of cattle,

and the miscalculation about the possible degree of crop diversification.

(b) Problems in irrigation system construction, particularly the problems of cost overruns and construction delays.

(c) Problems in settlement, including the problems caused by the advanced alienation policy and the difficulty in keeping settlers in the new areas.

(d) Difficulties in coordination, particularly with regard to problems that fell outside the purview of the major participating agencies such as crop diversification and the cattle problem.

(e) Weaknesses in the benefit monitoring system for the project.

(f) Beneficiary participation in project planning and construction.

(g) Beneficiary participation in rehabilitation of the Ellegala Irrigation System.

Although many aspects of the KOISP went very well, this section focusses on the problems in an attempt to learn how to improve project management for future projects.

Financial management is not discussed here as it is the subject of auditor's reports. However, reference is made to the effects of the various problems on total project costs. The fact that the costs about doubled over the life of the project requires explanation.

9.3.2 Project Planning Problems

There were a series of controversial decisions and errors that occurred in the planning of the KOISP, including:

(a) The location of the dam.
(b) Overestimation of water availability in the Kirindi Oya.
(c) Projecting the planting of non-paddy crops in most of the new areas.
(d) Problems with the dam foundation.
(e) Planning to use wells to provide domestic water for the settlers.
(f) Failing to plan for the displacement of the cattle.

These six issues are taken up in this section.

Dam Location The much discussed decision about the dam location was apparently motivated by the need to maximize the new area to be brought under irrigation rather than by consideration of what would be the most cost-effective approach. The Lunugamvehera location required building a much larger dam than sites upstream would have required, thus raising the

cost greatly. In view of the fact that water availability is much less than expected, this may have been a costly decision (Seneviratne 1993, Nijman 1992).

The dam location is not further discussed here. If an alternate site had been chosen, the resulting project would have been so different from the KOISP that a comparative evaluation is purely speculative.

Water Availability The irrigation evaluation shows that water availability in the Kirindi Oya was badly overestimated. It also shows that there has been a major drop in average rainfall since 1973 and suggests that the overestimate is due to the weather change rather than errors in data collection or analysis. Given this fact, it would not have been possible to totally avoid the problems of overestimation.

However, it might have been better to be more cautious in planning around the estimated figures. Seneviratne (1993:198-199) points out that the Irrigation Department initially recommended impounding only 205 MCM to irrigate a command area of about 10,000 hectares. Based on the then estimates of water availability, ADB consultants suggested instead impounding 245 MCM and irrigating 12,000 hectares. The caution shown by the Irrigation Department turned out to be well justified. Such caution should be recommended.

Another approach suggested by Nijman (1992: 130-140) would have been to design the project in such a way that the very high initial investment is avoided so that the work could go in stages and be evaluated as it proceeds.

Non-Paddy Crops The project planners were aware of the potential shortage of water in the Kirindi Oya. Even though irrigated land in Sri Lanka is customarily used for paddy, the project plans were forced to assume the planting of other field crops (OFCs) to reduce water demands. The 1977 Appraisal Report shows that the planners thought that about 60 percent of the new areas would be planted in OFCs. The 1982 Phase I Appraisal Report basically proposes the same cropping pattern. Both Appraisal Reports recognized that farmers are not accustomed to these crops in irrigated land and made provisions for adaptive trials and extension services to provide the means necessary for farmers to learn to produce them.

Merely making it possible to produce a crop does not guarantee that farmers will adopt it. In particular, farmers want to be able to sell their crops, hence markets are needed. Whether the markets existed nor the access that farmers would have to them were not considered carefully by the planners, except in the case of cotton. This fact was recognized later; Phase II added a marketing component.

The proposed cropping pattern appears to have been designed to fit the estimated water availability without full consideration of the needs of the farmers. As a result there has been only a small shift to OFCs.

The Dam Foundation and Planning for Dam Construction Early reconnaissance studies for the development of the Kirindi Oya, including studies of the Lunugamvehera dam site, failed to include any geological investigations (Munesinghe 1986). For the feasibility study of the dam site, 46 borings were made from which it was concluded that the basic rock foundation was

adequate (Sivapatham 1986; Munesinghe 1986). As pointed out by Sivapatham (1986), this sample was not great enough to determine the geological variations in the dam site.

Thus, after excavations began in 1980, it was found that the proposed dam site was not totally suitable. Much more detailed investigations, including the drilling of another 157 bore holes and various excavation works, were necessary to define the geology well enough to allow for satisfactory redesign of the dam. The required changes took time and added greatly to the costs (Munesinghe 1986).

Preliminary investigations were also carried out to determine the availability of the materials needed for dam construction (Sivapatham 1986). Again because of the variability of the site, the estimates turned out to be overoptimistic; ultimately materials had to be brought from further away, significantly increasing costs of construction.

Sivapatham (1986) concluded that design changes during construction were inevitable. It is clear, however, that more thorough investigations of the dam site during the feasibility period, particularly investigations that tried to evaluate the variability of the geology, would have gone a great way toward improving the cost estimates. This suggests that the norms for deciding how many borings, etc, are needed should be reevaluated so that other projects do not face the difficulties faced by the KOISP.

Domestic Water Supply Without investigating groundwater, project planners planned to use dugwells to provide domestic water for the settlers. Problems arose in 1982, leading to investigations that showed suitable groundwater was not generally available and to the decision to build a piped water system that takes its water from the Lunugamvehera Reservoir. This decision also raised costs significantly. An investigation of the groundwater during the planning of the project was needed.

Displacement of Cattle Although the Hambantota area has long been famous for its dairy products and cattle herds, the planners seem not to have given thought to the consequences of taking over the large areas of graze for the cattle for small-holder irrigated agriculture. There was, and still is, a problem in counting the herds in the area; however, cattle are numerous, a fact known long before the project was finalized. There is now a "cattle problem" in Kirindi Oya since cattle cause much crop damage, particularly to OFCs.

The main problem seems to have been that the project was planned by irrigation, settlement, and agriculture specialists. Neither livestock specialists nor local residents were included.

Needed: Basin Thinking, a Better Data Base, and More Consultation If the issue of the dam location is left aside, all of these planning problems resulted, at least in part, from inadequate information for planning. Better information on water availability, on the geology of the dam site, on the availability of groundwater, on the distribution of soil types, on crop markets, and on cattle would have enabled the planners to anticipate most of the major problems that occurred, many of which raised the costs and reduced the benefits of the project.

What could have been improved?

(a) The KOISP was meant to more efficiently exploit the resources of the Kirindi Oya basin, particularly the water resources. It would have helped to have considered the problem from a basin-wide viewpoint, this might have induced caution about water availability since others were also interested in exploiting the water resources. Also, consideration of the basin water resources would have required investigations into groundwater thus correcting one of the major deficiencies.

(b) More time and effort should have been spent on gathering the basic data before project plans were completed. Soil surveys, groundwater surveys, studies of the local economy, etc, could have been carried out. These studies would have taken time and delayed the start of the project. However, it is likely that the delays in planning would have been shorter and less costly than the delays and problems in implementation that were ultimately caused by lack of this knowledge.

(c) Much more extensive consultations with the local population would have helped. Better information on the cattle problem, the groundwater problems, whether markets existed, perhaps even on the water availability issue could have been gathered from knowledgeable local persons. Such consultations should have complemented the detailed technical studies.

(d) Particularly given the lack of detailed geological and hydrological knowledge of the project area, more caution in planning would have been warranted. A project design that would have been implementable in stages might have helped.

9.3.3 Delays in Construction of the Irrigation System

As shown in Chapter 1, the quality of construction of the irrigation system is considered good and complaints about design are few, although more consideration could have been given to reuse of water to improve efficiency.

However, the 1977 Appraisal Report estimated that it would take four years to complete the dam and six years to complete the construction of the whole system. In fact, it took eight years to complete the dam and the whole system was never completed. Also, costs increased tremendously during the period.

By South Asian standards, these delays and cost overruns were not excessive. For example, work began in 1961 on the Gandak Project in Bihar and has not yet been completed. Although a much larger project than Kirindi Oya, it had correspondingly larger funds and resources made available to it.

The Irrigation Department did all of the designs for the system and a small portion of the construction. By far the largest part of the construction was done by contractors working under the Department's supervision. The following factors contributed significantly to construction delays at Kirindi Oya:

(a) Inadequate data for designs.
(b) Problems with contracting and procurement.
(c) Weaknesses in construction supervision.

Each of these is taken up below.

Inadequate Knowledge As pointed out in the preceding section, the basic data on the geology and water resources of the area was insufficient for the design of the dam. The dam had to be redesigned to move the spillway, with significantly increased cost. The spillway also had to be redesigned and unplanned rock work was needed to make the spill stable, thus also greatly increasing costs (Munesinghe 1986). Inadequate knowledge also led to a controversy about the dewatering needs for the dam core trench and delayed the work, again increasing costs (Atapattu 1986).

Available data were also inadequate for network planning; channels often had to be realigned and structures often moved from the designed location (Atapattu 1986). During the first three years of the project, the designs group worked in Colombo and based its designs on the inadequate maps and field surveys available. The designs thus were often useless. Only in 1982 was the designs group moved to Kirindi Oya so that they could check actual field conditions and adapt the designs to field realities.

The available data was also inadequate for construction planning. For example, the contractor had to go further away than estimated for soil and rock needed for the dam construction, thus increasing costs and time delays.

One delay came about when construction of the main canals was halted in 1981 while they were redesigned as double banked canals instead of single banked canals. This change came about as a result of pressure from consultants. Nijman (1992:193) points out that, because no one has studied the comparative advantages of the two designs under different conditions, the Irrigation Department could not defend its initial decision.

Problems with Contracting and Procurement There were significant delays and problems with contracting and procurement processes. The most important of these was the delay in awarding the contract for the dam construction. The original work plan assumed that the contractor would be fully mobilized by mid 1979. The contract was not awarded until 1980 and the contractor did not begin work until September 1980.

One major reason for the delay was that, although the Irrigation Department selected the contractor through normal tender processes, because the contract was large, it had to be approved by the Cabinet. The Cabinet forced a change from the original awardee, a private concern, to the River Valleys Development Board (RVDB), a government agency. One of the reasons for awarding it to the RVDB was that the RVDB had significant unused capacity and it was felt important to make use of that capacity.

Procurement of equipment and spare parts - one of the major immediate causes of delays - was slowed not only by government processes but also by the need to get ADB approvals.

Construction Supervision The Irrigation Department had great problems keeping some of the contractors on schedule. For example, the Land Development Department was to build the construction supervision camps for the Irrigation Department. The work was done very slowly for obscure reasons. The result was that major part of the camps for the Irrigation Department personnel at Kirindi Oya were completed only after 1980, two years late.

The Irrigation Department did an excellent job of assuring that the quality of work on the dam was good. However, the Department seemed to have relatively little control over the scheduling of work by the dam contractor. The RVDB kept falling farther and farther behind schedule, even when schedules were relaxed to accommodate their problems. On more than one occasion the RVDB closed down its operation for some weeks. According to the quarterly reports and both RVDB and Irrigation Department officers, the RVDB's problems in keeping to the schedule included:

- There were great difficulties with equipment maintenance. Many of the quarterly reports show earthmoving machinery availabilities between 50 and 65 percent for the quarter. One source (de Silva 1986) explained that, although the RVDB had civil engineering capabilities, it was very weak in mechanical engineers and attempt to use foreign consultants turned out poorly. Another factor is that it took a long time to get spare parts; one quarterly report claimed that it took 162 days.

- The RVDB had an undisciplined work force that could not be fired because the RVDB, although officially autonomous, was subject to government employment rules.

- Because of security problems, particularly in 1983, the government kept strict control on explosives; this led to delays in getting the needed explosives.

The biggest problem, however, was a problem with cash flow. The RVDB never seemed to have enough cash. To keep the work moving, the Irrigation Department not only provided the mobilization advance and the equipment and spares as per the contract, but also gave numerous special advances, and made direct payments to suppliers for fuel and materials (Wimalabandu 1986). This help was not sufficient to keep the RVDB on schedule.

Attempts were made to resolve the problems. The Irrigation Department's Chief Resident Engineer met fortnightly with the RVDB's project managers to review progress and solve problems. However, a former Chief Resident Engineer noted that orders given to the RVDB or suggested solutions reached at these meetings generally had to be ratified in Colombo, often at the Central Coordinating Committee meetings, before they became effective (Atapattu 1986:135).

After 1982, the donors required that the Irrigation Department have an expatriate Project Implementation Consultant to expedite the project. His contributions to the project are unclear; however, he was clearly disliked, in part because he was taken to be a sort of watchdog (Nijman 1992:179).

The major threat that a client has over a contractor is to cancel the contract. Ultimately, the Irrigation Department took part of the dam contract from the RVDB, over their protests, and awarded it to another contractor.

There were also delays on the construction of the main canals. A variety of arrangements were used, larger contracts, small contracts, and force account. A few of the larger contracts went reasonably well, but others went so badly that the Irrigation Department canceled them, although only after giving them periods of up to a year to improve performance. They had relatively little trouble getting the small contracts completed. The work on downstream development went quickly with small delays. For downstream development, the Irrigation Department gave small contracts to local contractors.

The basic problem seems to lie in the balance of power between construction supervisor and contractor. With small contractors, the Irrigation Department is quite willing to demand performance and threaten to cancel contracts. A small contract can easily be awarded to a new contractor without causing major delays. Canceling a large contract, however, leads to delays because of a) lengthy procedures in awarding a new contract, b) the start up time needed by a new contractor, and c) because a large contractor often has the resources to protest effectively. In the case of the dam contract, the RVDB had political support to consider.

Construction delays added greatly to the project costs, not only because of rising prices, but also because various inputs had to be increased to match the construction period. Thus, consultants' services, earthmoving machinery, support for settlers, and other items had to be kept available over longer periods than planned. The weak control that the Irrigation Department had over large contractors also added to the cost by requiring the government to cover finance costs and other items that should have been covered by the contractors.

Improving the Construction Management This discussion suggests the following:

- Either a) better data on the area should be provided through better project planning studies as recommended in section 9.3.2, or b) provision should be made in the design and construction process itself to get the data. In the latter case, additional funds have to be provided to cover the redesigns, etc, that will arise.

- Sri Lankan government procurement rules should be streamlined and their compatibility with donor rules should be checked. It should be possible to get the donor to agree to a set of government rules so that getting donor approvals is not required.

- Reducing direct political intervention in the procurement and contracting processes is also needed. This requires a clear policy from the government supported by appropriate enforcement

procedures. Dropping the requirement for Cabinet approval for the award of large contracts would be a first step; requiring Cabinet approval invites political intervention. Adequate policy supervision can be provided by requiring Cabinet approval only of the tender documents and estimates. The actual award can then be left to the formal tender procedures which require transparency.

- Improving the balance of power between a large contractor and the Irrigation Department can be partly achieved if contracting procedures are streamlined and the threat of political influence is removed. These changes will reduce the pressure to keep a poorly performing contractor. Also, contracts should be made as small as is compatible with efficiency. A number of small contracts has disadvantages. It places a greater management burden on the construction supervisor. Also, there are potential advantages of scale in a single large contract. Clearly the advantages and disadvantages of large contracts have to be weighed against each other.

There are no magic solutions to these problems, but the delays and cost overruns could clearly have been reduced if some of these changes are made.

9.3.4 Problems in Management of the Settlement Process

The settlement process at Kirindi Oya included several separate tasks: surveying the area, selecting the settlers, allotting each settler family a house site in a hamlet and farm site, providing initial support for the settler family until their income starts to flow, constructing the basic public infrastructure, training the settlers in irrigated agriculture and other needed skills, and solving problems of the settlers as they occur. All of this was handled by the Land Commissioner's Department (LCD).

For the most part, the process flowed smoothly. Once the settlers were selected the LCD did a very good job of providing the basic help they needed; there are few complaints. Also, the work proceeded more or less on the schedule set by the irrigation system construction.

However, three major problems have arisen:

(a) "Advanced alienation" created problems with land boundaries and increased costs of settlement.

(b) Political interference in the selection process aggravated the problem of nonresident settlers.

(c) The construction of the piped water system was beset with delays.

Each of these is discussed separately below.

Consequences of Advanced Alienation "Advanced alienation" refers to the practice of settling farmers on the land before the irrigation system construction is complete. It is done to prevent problems with squatters who come whenever they learn that an area is to be developed.

In Kirindi Oya, the first settlers were given their allotments in the second half of 1983. At that time, it was expected that the first water issues from Lunugamvehera would be made in 1985. In fact, dam construction was delayed an extra year; the first water issues were made in 1986. Because of the delays in construction of the irrigation system, some settlers had to wait almost three years before cultivating their allotments. LCD was responsible for supporting them during this period. Although it was expected that food and other direct support would be provided for no more than 18 months, some settlers needed help for much longer, thus raising costs.

Besides the cost of supporting the settlers, a more serious problem was created. In many cases, LCD officers had to identify the settlers' allotments before the irrigation channels were constructed or even before the detailed designs were done. Often the survey markers were hard to find or were lost. As a result, many settlers ended up with a false idea of their plot boundaries. Also, when actually constructed, the channels were often realigned because the initial designs were based on insufficient data. As a result, some land that was supposed to be irrigated, fell out of command, and other land came under command. Because of these problems, a great many disputes have arisen between settlers over the boundaries of the allotments.

LCD has not been able to resolve most of these problems. Their procedure calls for getting the agreement of all of the local allottees. However, since some allottees got larger allotments than they should have, they are reluctant to cooperate.

These problems have not been caused by advanced alienation alone; if the irrigation system construction had proceeded on schedule, many of the difficulties would not have occurred.

Consequences of Political Intervention in Selection of Settlers A current problem in the new areas of Kirindi Oya is the "nonresident allottee." These are persons who have resources elsewhere that they use for making a living. Because water for cultivation has not been plentiful many such persons either rent their land out to others or work their allotments only when water is actually issued. These allottees do not participate in farmer organizations; they also rarely live up to their obligations to clean channels, etc (Stanbury 1989; IIMI 1994). According to LCD's own survey (Dissanayake 1993), about 18 percent of the allottees fall into this category. Because of the resources they have elsewhere most of the non-resident allottees did not meet the criteria for selection.

Although hard figures are lacking, it is widely reported by many persons, including the LCD officers directly involved, that most of these persons received their allotments as a consequence of interventions by politicians in the selection process. It appears that some politicians used their power to reward their own supporters in disregard of the criteria for selection. It is felt that most of the non-resident allottees got in through political intervention.

While LCD has the legal power to revoke the allotments of such persons, in practice revoking allotments is rather difficult and rarely done. In particular, those who command sufficient political support to get allotments may also command the support to prevent the LCD officers from revoking the allotments.

Clearly, there is a need to avoid political intervention. However, direct intervention is a major component of Sri Lanka's political culture. Changing the situation is likely to require a major change in the political culture. The alternative is for the government to create a watchdog agency charged specifically with keeping this process free of political intervention. Such an agency, however, can work only as long as it is supported by the most powerful politicians.

Delays in Constructing the Piped Water System As discussed in section 9.3.2, failure to investigate the groundwater resources of the area led to a failure to plan for adequate domestic water supplies. The Irrigation Department took responsibility for finding the solution although it falls within the settlement component.

In 1983, the Irrigation Department requested help from the National Water Supply and Drainage Board (NWSDB). In 1984, the NWSDB recommended a piped water system using Lunugamvehera Reservoir water. This was accepted in 1984 and initial agreement for funding was received from the donors by 1985. The NWSDB was asked to act as a consultant to undertake the system design, prepare contract documents, and handle the construction supervision. Plans were prepared and by mid 1986 it was presumed that all work would be completed by the end of 1989 (Selvarajah & Manoharan 1986). However, due to slowness in approving the designs by one of the donors and to other procedural delays, the first stage construction contracts were not awarded the second half of 1988 and the work was not completed until mid 1992. The consultancy contract with NWSDB for the second stage was not signed until the end of 1989, and the second stage contracts were awarded only in late 1991 and early 1992. The second stage is still under construction.

The piped water supply system raised project costs, not only because the piped water system was more expensive than digging local wells, but also because, until the system was completed, the LCD had to supply water to the hamlets in bowsers. The delay in completing the system simply raises costs higher.

As with irrigation system construction contracting, the main difficulties lay in the contracting process and in the fact that the Irrigation Department has little power over the NWSDB. The plans and contracts were much delayed by the need to donor and Cabinet approval for each. Also, the NWSDB is an agency of equal rank with the Irrigation Department, the Irrigation Department has no power over it. The solutions to these problems are, as noted before, to streamline the contracting process and to find ways to give the Irrigation Department greater control over the contractor.

Reducing the Problems Although this chapter is focussed on problems that arose during the settlement process, the real causes of the problems lie elsewhere:

- The problematic consequences of advanced alienation were greatly aggravated by the delays in irrigation system construction.

- The nonresident allottee problem has been aggravated by political intervention in the selection process.

- The delay in construction of the piped water system is due to the same political and administrative constraints that caused the delay in irrigation system construction.

A fully effective solution to these problems is likely to require major changes in political and administrative processes that will take time. However, recognition and publicizing the detrimental consequences of these features of political and administrative processes will make change possible.

In the meantime, these problems can be reduced, if not eliminated, by conscious planning of ways to deal with them. If the responsible agencies and officers can be given sufficient public backing by respected bodies such as outside donors, international institutions, and highly respected public officials, the officers can often be strengthened enough to resist the influences that cause the problems (cf the case at Kirindi Oya during maha 1993/1994 reported in IIMI 1994).

9.3.5 Project Coordination

The KOISP had special mechanisms to assure that the needed coordination and project functions were carried out. These included:

- Project Director
- Project Manager (Settlement)
- Project Manager (Irrigation)
- Central Coordinating Committee
- Project Coordinating Committee

There were other participating agencies, including the Department of Agriculture, the Central Bank of Sri Lanka, the Irrigation Management Division, the Forestry Department, the Draught Animal and Dairy Development Program, and others. Each of these agencies appointed its own local person responsible for project activities. These persons sat on the Project Coordinating Committee and the heads of their agencies were generally invited to the Central Coordinating Committee.

Project Managers and Project Director The 1982 Appraisal Report, which established the project management structure, does not explicitly define the responsibilities of the two Project Managers. There seemed to be no need.

To the Irrigation Department, the person in charge of a large construction project is the Chief Resident Engineer (CRE). The CRE was thus appointed as the Project Manager (Irrigation). He was located at Kirindi Oya. The first CRE was appointed in 1980 after the RVDB contract was signed.

Over the life of the project, the CRE played two roles. First, he oversaw the irrigation system construction. Second, during the latter part of the project period, he oversaw operations

and maintenance of the Kirindi Oya Irrigation System. Although nominally responsible for construction of the water supply scheme, responsibilities were surrendered to the NWSDB. Similarly, according to KOISP organization, he was partly responsible for supervision of IMD's farmer organization efforts. This responsibility, however, conflicted with the INMAS definition of roles and was left to the IMD.

The Project Manager (Settlement) was appointed by the Land Commissioner's Department to oversee the settlement activities. He was located in Kirindi Oya. To give him legitimacy in the government hierarchy, he was simultaneously appointed as an Assistant Government Agent (Lands). The first Project Manager (Settlement) was appointed in 1982 so that settlement work could be gotten underway to receive the first settlers in 1983.

The Project Manager (Settlement), because the LCD was responsible for a variety of functions, theoretically should have supervised the performance of other agencies for project activities. Practically, however, most of the persons who served as Project Manager (Settlement) focussed their efforts on construction of infrastructure and settlement and let the other agencies handle their own affairs.

The Irrigation Management Division, of course, also has had persons entitled "Project Manager" at Kirindi Oya. The confusion of these multiple positions has been pointed out by IIMI (Merrey & Somaratne 1988; IIMI 1990).

The 1982 Appraisal Report created the position of the Project Director and said that he is "responsible for the overall coordination of the Project and, in particular, for the supervision of the Project Manager (Irrigation) and liaison with the Project Manager (Settlement)." The Project Director had to be an officer from the Irrigation Department because the Irrigation Department was the principal executing agency. The Irrigation Department officer appointed as Project Director was the Senior Deputy Director (Major Construction) based in Colombo. As Senior Deputy Director he provided guidance and support to the CRE. However, he had no power over the other participating Departments - this is evident from the definition of his relations with the LCD Project Manager. Practically, therefore, the Project Director did two coordination tasks - he handled financing of the activities and he prepared quarterly progress reports. None of the Project Directors attempted to take control of the project as a whole or to provide effective direction to the other agencies.

The Central Coordinating Committee The Central Coordinating Committee was a high level committee including the heads of the participating agencies and their superiors. The Central Coordinating Committee was supposed to meet once a quarter in Colombo. In fact, it missed quite a few quarters, particularly in the turbulent late 1980's.

A review of Central Coordinating Committee minutes and discussions with a few regular participants indicates that by far the largest amount of time at the meetings was spent listening to progress reports from the various agencies. This served to keep the various members of the Committee informed but for the most part there was no decision-making.

However, the Central Coordinating Committee played a key role in legitimating some major decisions that significantly modified project components. For example, the Central

Coordinating Committee had to approve the piped water scheme not originally envisaged. Occasionally, also, the Central Coordinating Committee addressed itself to solving problems that fell outside the areas of competence of the participating departments. For example, the Central Coordinating Committee directed the actions taken to successful ameliorate the negative impacts of drainage water on prawn fisheries in the Malala Lagoon.

For the most part, however, the Central Coordinating Committee served as a monitoring body rather than as a project planning and decision-making body. Central Coordinating Committee meetings rarely had any impact on day-to-day work at Kirindi Oya.

The Project Coordinating Committee The Project Coordinating Committee was a field level committee including not only the local heads of the participating agencies but also the Government Agent of Hambantota District and the heads of other district agencies; in the field and in some reports it was called the District Coordinating Committee. Early on, the Government Agent chaired the meetings, but he later stopped attending and delegated the Project Manager (Settlement), who was simultaneously Assistant Government Agent (Lands) as chairman. The Committee had monthly meetings regularly throughout the life of the project.

Discussion with officers, review of minutes of the meetings from the late 1980's (earlier records were mostly lost through fires), and review of quarterly reports, reveals that the Project Coordinating Committee generally addressed itself to issues rather than listening to progress reports. One key function it played was to enable the schedule of activities being carried out by one agency to be dovetailed with the schedule of activities of other agencies. This is a key project coordination task.

Some officers commented, however, that while communication at the Project Coordinating Committee was very good, there was no way to enforce its decisions so the outcome was less good. As is the case throughout Sri Lanka, local agency officers are rarely delegated the power to make key decisions. Many decisions therefore could not be implemented without the approval of the Colombo head offices, thus vitiating the coordinating power of the Project Coordinating Committee.

After 1986, the Project Coordinating Committee also addressed itself to making key seasonal irrigation and crop planning decisions for the Kirindi Oya System. It competed with the INMAS Project Committees, and later with the unified Project Management Committee, in this role. Since these committees are primarily farmer committees, they are more appropriate for this role than was the Project Coordinating Committee which included only officers. As discussed elsewhere (IIMI 1994), using the Project Coordinating Committee in this role was not fully satisfactory.

The Project Coordinating Committee, however, did not serve as a place where problems outside the competence of any one agency could be solved jointly.

IMD's Project Manager and the Project Management Committee on which sit Farmer Representatives are also charged with coordination responsibilities. There are reports of rivalry and opposition between the IMD Project Manager and the Project Manager (Settlement) between 1986 and 1988 over this matter (Merrey & Somaratne 1988).

Successes and Failures of Project Coordination Despite these coordinating mechanisms, the agencies implementing the project generally acted independently; the components were managed separately rather than in a coordinated manner.

Theoretically, project planning can provide the necessary coordination among components. If the planning is good, all activities fit together properly and the individual actors can do their jobs in full confidence that the whole will work out correctly. The only coordination needed should be mutual adjustments in timing.

However, the planning for the KOISP was not of the caliber to take the place of coordinated efforts. The result is that major problems that did not fall within the competence of any single participating agency were not addressed well. Here two such problems are discussed: the cattle problem and crop diversification.

(a) **The Cattle Problem**

The cattle problem consists of the fact that the owners of the large herds of cattle in the area have difficulty in finding pasture. As a result, the cattle often wander freely near cultivated areas and damage crops. This problem was ignored by project planners; even the Phase II livestock component is focussed on supplying small numbers of high quality cattle to farmers, not to solving the larger cattle problem.

The solution to the cattle problem involves some combination of finding pasturage for the herds, perhaps including finding ways to share the cultivated area, and reducing herd size. Finding a solution requires coordinated help from the LCD and other government agencies concerned with land administration and help from livestock agencies.

Although reference was made to the problem in Project Coordinating Committee minutes from 1983, no coordination exists and no solutions have been found. The most promising attempt is the development of the Cattle Owner Farmer Organizations discussed in section 9.4.3 below.

(b) **Crop Diversification**

Effective promotion of OFCs among farmers requires help from the Department of Agriculture to teach farmers how to grow OFCs, help from the Irrigation Department to make sure water is delivered in the right amounts at the right time, help from unspecified agencies to prevent crop damages from elephants and cattle, and help from marketing specialists to identify and provide access to markets for the crops. Although crop diversification is a key requirement for the success of the KOISP, the KOISP coordination mechanisms did not supply an effective means of getting the needed coordinated efforts. No progress was made until 1989.

The most difficult problem in promoting OFCs is marketing. None of the agencies has the necessary means to provide direct assistance. Under KOISP Phase II, the LCD was made responsible for marketing. Their efforts were limited to hiring a consultant and to constructing local marketplaces and stores for others to use.

Beginning in 1988 the Project Manager (Settlement) tried to find a way to get the needed cooperation. He convinced the Project Coordinating Committee, which could not do it, to create

a subcommittee to deal specifically with this problem. The IMD Project Manager from the new areas was named as chair and farmer representatives were invited to sit on the subcommittee. The Department of Agriculture in particular responded enthusiastically by carrying out a large number of demonstrations of various OFCs. The LCD contributed by providing barbed wire to keep cattle out and the Irrigation Department tried to develop effective water delivery schedules. The subcommittee also enlisted help from cooperatives and others who are experienced in marketing.

As a result of these efforts, together with some efforts under IIMI's program, there has been some shift to OFCs at Kirindi Oya (IIMI 1994). Farmer participation in the subcommittee helped to make this possible. Also the fact that the subcommittee focussed its efforts on one problem that all recognized as crucial helped. However, the results are still far from what was contemplated at the beginning of the project.

Improving Project Coordination Organizations in Sri Lanka, particularly government organizations, are strongly hierarchical with clear lines of authority. Effective coordination among departments is very difficult. Officers are generally not rewarded for it, since rewards come only from their departmental superiors, and sometimes are punished for it.

In this situation, the only fully satisfactory way to get interdisciplinary cooperation is to create a new agency. This was the idea behind the original Gal Oya Development Board, the Mahaweli Development Board, and the Mahaweli Department of Sri Lanka.

However, as shown by the partial success of crop diversification in Kirindi Oya, committees can achieve a degree of coordination beyond merely adjusting time schedules. Two points should be noted:

- The primary key is to find a way to reward the officers on the committee for solving the problem. IIMI's experience at Kirindi Oya shows that officers respond to opportunities for learning and for public recognition, when it is not a one-shot opportunity but something based in a relationship that lasts over a reasonable period. IIMI could provide these kinds of opportunities and got some excellent cooperative efforts. Even having farmers on a committee can help provide rewards if the farmers are willing to provide some public recognition and support.

- This kind of reward scheme is not sustainable over a long period, hence the second key is to focus the committee on a relatively limited and well-defined task. If the task is well-defined and limited, then a) the members have a better chance of achieving something, and b) they can claim the credit (or take the blame) for the outcome with less argument over where the credit belongs. Both of these are necessary.

9.3.6 Benefit Monitoring and Evaluation

All agencies have to monitor their progress in achieving their tasks. Benefit monitoring and evaluation consists of measuring the impact of the project as it proceeds so that corrections in goals and plans can be made. For the KOISP, this task was entrusted to the Agrarian Research and Training Institute (ARTI).

For this component, ARTI has carried out a baseline survey and a midterm evaluation study and a large number of studies on specific aspects of the project, including credit, nutrition, employment generation, and many more. These studies generated a great deal of information on the area and on the effects of the project. Many of these studies are excellent and provide good data about the project and its impacts.

Two aspects of ARTI's work kept it from serving the needs of the project as well as it might have:

- ARTI did not establish a continuous monitoring program to provide feedback to KOISP management. This was surprising because for the Water Management Project, ARTI established a continuous monitoring system at Gal Oya that made major contributions to the success of that project.

- The results of ARTI studies often came out late and were thus less useful for planning and decision-making than they could have been. The quarterly reports in several places refer to delays in producing the reports and in some cases the Central Coordinating Committee demanded faster action.

As a result, it is difficult to point to actions taken by project management as a result of ARTI's efforts.

On at least one occasion, ARTI responded quickly to a need for information. In January 1993, after there appeared reports of crops being plowed under in Kirindi Oya as a result of the Minister's decision to change water allocations, the project management asked ARTI to estimate the crop damage. Although not an indepth study, the information was useful to several people in trying to deal with the consequences of that season. This case suggests that less elaborate studies and more rapid reporting of information might have served project management needs better.

A continuous monitoring system that could provide rapid feedback of key information would have had two effects. First, it would have provided managers from many departments information that they should have to make decisions in unusual cases. Second, the fact that ARTI had a continuous monitoring program would have made project participants more conscious of their performance and might have improved overall project performance.

9.3.7 Beneficiary Participation in Project Planning and Construction

Participation in Project Planning and Design ARTI's study on beneficiary participation (Razaak & Wijetunga 1994) points out that, according to the officers, there was no system to involve local persons in the planning of the irrigation systems or settlements. In the ARTI survey of farmers carried out for this study in 1992, 22 percent of the respondents said that they had taken part in the land survey to prepare the blocking out plans. Another 19 percent said that they had been involved in the planning of the irrigation network. However, it appears that they merely provided unskilled labor as part of the field surveys. There was thus no effective beneficiary participation in project planning or design.

Participation in Construction There were two main construction activities: construction of the irrigation system and construction of the settlement facilities. The largest part of irrigation system construction took place between 1981 and 1985. Settlement facility construction was much less in total amount than irrigation system construction since settlers had to build their own houses. Also the bulk of it came later in the project and used smaller amounts of labor.

Local persons were recruited to provide construction labor. Senanayake and Wijetunga (1987:39-41) estimate that during the 1980-1985 period, 13 percent of the skilled labor and 27 percent of the unskilled labor came from the project area. They also estimate that project construction generated 1.2 million mandays of labor in 1984 of which 23 percent came from the local area. If the 1984 figures are typical of the whole period, the total local employment may have reached 1.66 million mandays out of an estimated total of 7.2 million mandays. In the 1992 ARTI survey, 99 percent of the settlers surveyed indicated that they had contributed to road construction; 69 percent indicated that they had contributed to construction of the canal system; 32 percent indicated that they had worked on buildings. In all cases, these contributions were made either through *shramadana* work or wage labor.

These findings indicate that the project brought significant income to the local population, particularly to the settlers who came in 1983, 1984, and 1985, before the irrigation system was operational. Interviews with settlers confirmed that work was plentiful only in the early period, after 1985 there was far less work and more settlers competing for it.

9.3.8 Beneficiary Participation in Ellegala Rehabilitation

There are limitations to beneficiary participation in new system construction because of lack of beneficiaries - settlers have not arrived yet - and because of lack of technical knowledge. These considerations do not apply to a rehabilitation effort. For that reason, beneficiary participation in Ellegala System rehabilitation is considered separately.

Rehabilitation and improvement work on the Ellegala Irrigation System was carried out three times under the project. More than usual maintenance work was done between 1982 and 1985. That work is not considered here because it was not done as a project. Rehabilitation work was carried out in 1986-1987. Further improvements were made in 1992-1993 under the title "Rectification of Irrigation Difficulties" (RID). The goal of all three efforts was to improve the system so that it could make more efficient use of irrigation water.

It is generally accepted that the 1986-1987 rehabilitation effort was a partial failure. It was noted in Chapter 1, that many of the Ellegala farmers in the large-scale survey feel that rehabilitation failed due to the poor construction quality; some structures collapsed in short periods. Other reasons noted were that only the main channels were improved, other channels, including much needed drainage channels, were ignored.

On the other hand, the RID work is accepted as being more successful, in part because RID took up the drainage works and some other works neglected the first time.

The large-scale survey asked Ellegala farmers about their participation in both of these rehabilitation programs. Tables 9.4 and 9.5 show the results. There may have been some confusion in the minds of some of the respondents about the questions since some comments about the first rehabilitation referred to farmer organizations and other items that did not exist at the time so that Table 9.4 may overstate the degree of participation in the first rehabilitation.

These tables clearly contrast with each other. The reported degree of participation in RID is twice as high as the reported participation in the first rehabilitation. Also reported satisfaction is higher, though not as much as degree of participation.

Table 9.4 *Farmer participation in 1986-1987 Ellegala Rehabilitation*

	#	N	%
Reported consultations about rehab needs	36	176	20%
Took part in construction work	41	167	25%
Pleased with the results	75	136	55%

Little effort was put into getting farmer participation in the 1986-87 rehabilitation. Forty-six of the respondents commented on why they were not consulted for the first rehabilitation. Nineteen of these (41 percent) said that the Irrigation Department officers did the work for their own benefit. No other comment was given by more than four respondents; the remainder were simple statements that there was no consultation.

On the other hand, considerable effort in getting farmer participation was provided during RID. Irrigation officers held joint walk-throughs of channels with farmer organization leaders and others to identify needs. They held meetings with farmers to discuss plans. Much of the construction, including almost all of the work on field channels, was done through construction contracts taken by the farmer organizations.

Table 9.5 Farmer participation in rectification of irrigation difficulties

	#	N	%
Reported consultations about rehab needs	80	167	48%
DCO took construction contract(s)	98	176	56%
Pleased with the results	95	151	63%

Table 9.6 contrasts complaints made by the respondents about the results of the two rehabilitation efforts. Although similar percentages of complainants touched on the main items - quality of construction, planning and design, and lack of funds - the number of complainants is much lower for RID than for the 1986-1987 rehabilitation effort. Also, for RID, one class of complaints - DCO contract problems - exists that did not exist during the first rehabilitation. During the first rehabilitation all work was done by private contractors. The rest of the complaints were too vague to classify.

Although the reported degrees of satisfaction for the two efforts are not so very different, all other data indicate that the efforts to get farmer participation during RID paid off with much more satisfactory results from the farmers' point of view.

Table 9.6 Complaints about rehabilitation work

	1st Rehab			RID		
	#	N	%	#	N	%
No of complainants	54	179	30%	18	179	10%
Poor quality construction	34	54	63%	11	18	61%
Poor planning/design	14	54	26%	2	18	11%
Insufficient funds	2	54	4%	1	18	6%
DCO contract problems	-	-	-	4	18	22%

9.4 Institutional Development

9.4.1 Institutional Development under the KOISP

Development of three kinds of organizations were necessary for the KOISP:

(a) Farmer organizations to help manage the irrigation system and to represent farmer interests.

(b) Local government agencies to manage the infrastructure created and to serve the settlers.

(c) Private organizations to handle business and many other needs of the increased population brought into the area by the project.

Farmer Organizations Farmer organizations have been created with government sponsorship and help under Sri Lanka's participatory irrigation system management policy. They include two kinds of organizations: irrigation based farmer organizations (FOs) and cattle owner farmer organizations (COFOs).

Government Agencies A variety of local government agencies are needed to manage the infrastructure developed by the KOISP and to provide services to the newly settled population. The number is far too great to consider in detail in this report. Certain selected ones only are discussed below.

Private Organizations These include not only private businesses and semi-government organizations such as cooperatives, but they also include mutual benefit societies such as village Death Donation Societies, Rural Development Societies, and many others. These are too numerous to discuss here. For the development of local mutual benefit societies, see Razaak & Wijetunga, 1994.

Questions Discussed There are two key questions about institutional development under the KOISP: a) Have the needed organizations been created? and b) Have management responsibilities been transferred to them? These two points are discussed below for the farmer and government organizations.

9.4.2 Irrigation Based Farmer Organizations

Organizational Efforts at Kirindi Oya FOs were created in Kirindi Oya by the Irrigation Management Division (IMD) under the Integrated Management of Major Irrigation Systems (INMAS) program. Under the INMAS program, IMD assigns a Project Manager to each system to oversee the organizational work. Where funds are available, IMD also hires one or two Institutional Development Officers and several Institutional Organizers to work directly with farmers.

The basic INMAS organizational model has four components:

(a) Field Channel Groups (FCGs)
(b) Distributary Channel Organizations (DCOs)
(c) Subproject Committees (SPCs)
(d) Project Management Committee (PMC)

DCOs and FCGs are farmer organizations. The DCO is the legally recognized organization while the FCGs are subgroups that select Farmer Representatives (FRs) to form the DCO Committee, an executive committee that governs the DCO. DCO officers, generally a President, Secretary, and Treasurer are elected from among the FRs either by the general membership or by the DCO Committee.

SPCs and the PMC are joint management committees on which sit Farmer Representatives from the DCOs and officers from the appropriate government departments including the Irrigation Department, the Irrigation Management Division, the Agriculture Department, the Agrarian Services Department, and others.

Following adoption by the government in 1988 of the participatory management policy, it became policy that operation and maintenance of distributary and field channels be handed over totally to farmer organizations in return for exemption from collection of operation and maintenance fees. This is called "turnover."

The basic function of the FOs are to assist with the management of the irrigation system. Under the participatory management policy, FOs are responsible for a) distribution of water below the distributary channel headgate, and b) maintenance of the distributary channel and field channels. FOs can take on other functions if they so wish.

The most important function of the PMC, assisted by the SPCs, is to develop the seasonal plan. These committees also attempt to resolve other problems brought to them, particularly problems that require the assistance of one of the government agencies.

Organization efforts were initiated in Kirindi Oya in 1986 with the assignment of two IMD Project Managers to Kirindi Oya, one for Ellegala and Badagiriya and one for the new areas. Support was provided from KOISP funds to the IMD for hiring Institutional Organizers to work with the farmers. Although some organizations were formed in 1986 - the first PMC meeting was held in the new areas in November 1986 (Merrey & Somaratne 1988) - until 1990 the organizations had relatively little importance and were not very effective.

In 1990, the two Project Management Committees were merged into one and four Subproject Committees were created - one for the Right Bank, one for the Left Bank, one for Ellegala and one for Badagiriya. In addition, tank committees for Ellegala were created and the existing DCOs were reorganized, particularly in Ellegala. One of the IMD Project Managers was withdrawn at the time.

According to the IMD, there are currently 690 FCGs and 59 DCOs in Kirindi Oya and Badagiriya in addition to the 4 SPCs and one PMC. The IMD also reports that all 59 DCOs have been registered under section 56A of the Agrarian Service Act and all have taken over both operations and maintenance responsibilities for their distributary channels.

The next three sections discuss the organizational strength of the FOs, FO performance in their activities, particularly irrigation management activities, and the performance of the PMC and SPCs.

Organizational Strength As shown in Table 9.7, almost all farmers surveyed in the large-scale survey consider themselves members of their local farmer organizations. A slightly smaller percentage are acquainted with their local Farmer Representatives.

Although almost all farmers know about the farmer organizations and are acquainted with their Farmer Representatives, they are relatively ignorant about many aspects of the functioning of the farmer organizations:

(a) While 75 percent of the new area farmers who answered the question knew when their DCO committee meets, only slightly over one-third of the new area farmers actually answered the question. While almost all the Ellegala farmers answered the question, only 62 percent knew when their DCO committee meets. The situation is similar but slightly better with regard to the general membership meetings.

(b) Although 84 percent of those in the new areas who answered knew whether their DCO has funds or not, only about one-third of the farmers answered. While almost all Ellegala respondents answered the question, only 63 percent knew the answer.

(c) Most farmers answered the question about whether they were satisfied with the handling of funds by the farmer organizations; however, only about 40 percent of the respondents in both areas were satisfied.

These findings suggest that everyone is aware of the farmer organizations. However, lack of knowledge about meetings and about the status of FO funds implies a lack of communication among members. The general dissatisfaction with funds handling implies problems in this area as well. These findings agree with IIMI studies that identified lack of communication between Farmer Representatives and other farmers as a major problem (IIMI 1990: 70). For example, in Right Bank tract 1 DC 5 during maha 1991/1992, the DCO President did not bother to consult the members of the DCO Committee when he decided to hire 34 persons to clean the canal (IIMI 1992:36). It was found from a survey of members of the same organization that almost no farmers knew that the PMC had a role in seasonal decision making. An IIMI survey of farmers served by the Eastern High Level Canal from Tissawewa in Ellegala showed that, although 99 percent of the farmers considered themselves members of the farmer organization, only 61 percent of the farmers knew that there was a DCO, and smaller numbers knew that higher level joint committees existed (IIMI 1993:85).

Table 9.7 *Farmer organizational strength*

Item	New Areas			Ellegala			Overall %
	#	N	%	#	N	%	
FO members	291	299	97%	163	178	92%	95%
Know FR	274	298	92%	146	176	83%	89%
Know DCO meetings	79	106	75%	109	175	62%	67%
Know general meetings	81	106	76%	136	173	79%	78%
Know FO has funds	89	106	84%	112	177	63%	71%
Fund handling OK	119	287	41%	63	164	38%	40%

One major problem in the new areas has been the fact that many farmers are not resident the whole year round or had leased out their lands to others. For example, during maha 1991/1992, it was found that 52 percent of the members of the DCO at Right Bank tract 1 DC 5 had leased out their lands to others and did not farm that season (IIMI 1992:48). In the tract 5 DC 7 DCO, prior to maha 1992/1993, not one FR was available; one had resigned, one resided in Kirindi Oya only part time, and the others all resided elsewhere except when there was cultivation (IIMI 1993:75). The ARTI study also identified non-residence as a major problem in the new areas.

A final problem in the new areas is that social divisions hamper the functioning of the DCOs. One DCO has been created to serve Right Bank tract 5 DCs 1, 2, and 7. This DCO includes farmers mainly from hamlet 11 but also some farmers from hamlet 10 and from hamlet 8. The latter two groups pay no attention to the DCO leaders, in part because they have to travel far to attend meetings (IIMI 1993:73-74).

Table 9.8 shows data from IMD's Monitoring, Evaluation, and Feedback report for June 1993, the most recent complete report. This is based on monthly reports sent by all of the DCOs to IMD. Data are reported by DCO. These data imply that the DCOs' organizational strength is reasonably good except in the area of finances. The fact that 31 percent of the DCO committees in the new areas did not meet should not be surprising since there was no cultivation in the new areas at the time.

However, it generally has been the Institutional Organizers who filled out the reports rather than the DCO leaders themselves. The Institutional Organizers, of course, have an interest in making the DCO appear to function well; hence we believe that these reports cannot be fully trusted. Also, IMD has not been able to collect a full set of reports since June 1993, indicating weakness in both the DCOs and the Institutional Organizer program.

Table 9.8 *DCO status as reported to IMD, June 1993*

Item	New Areas			Ellegala			Overall %
	#	N	%	#	N	%	
DCO committee meeting not held	8	26	31%	1	33	3%	15%
Under 50% FCGs not active	1	26	4%	0	33	0%	2%
DCOs requiring help in handling finances	16	26	62%	11	33	33%	46%
Financial reports not up to date	0	26	0%	1	33	3%	2%
DCO has insufficient funds	15	26	58%	10	33	30%	42%

Farmer Organization Performance Table 9.9 shows the activities of the farmer organizations as reported by the respondents to the large-scale survey. Overwhelmingly, respondents reported that farmer organizations organize channel cleaning and maintenance. A slightly lesser percentage reported that they solve irrigation problems. However, the respondents reported that the farmer organizations undertake few other activities.

Because they are the major activities, this discussion will be restricted to irrigation activities.

Table 9.9 *Farmer organization activities*

FO Function	New Areas			Ellegala			Total %
	#	N	%	#	N	%	
Organize maintenance	287	293	98%	162	172	94%	97%
Solve irrigation problems	256	293	87%	130	171	76%	83%
Facilitate credit	66	287	23%	11	170	6%	17%
Arrange inputs	29	285	10%	11	170	6%	9%
Solve ag problems	91	285	32%	35	168	21%	28%
Organize comm. activities	120	279	43%	66	165	40%	42%

The large-scale survey asked questions about who actually handles distributary channel operations and maintenance. The results are shown in Table 9.10. This table implies that almost no DCOs operate their distributary channels but the great majority maintain their channels. Interviews indicate that the Irrigation Department provides funds to the DCOs for maintenance; they do not have to raise their own funds.

Table 9.10 Farmer participation in distributary channel O&M

Item	New Areas			Ellegala			Overall
	#	N	%	#	N	%	%
Operated by ID	285	297	96%	101	176	57%	82%
Operated by DCO	3	297	1%	62	176	35%	14%
Other/not known	9	297	3%	13	176	8%	5%
Maintained by ID	43	297	14%	46	178	25%	19%
Maintained by DCO	239	297	81%	126	178	71%	77%
Other/not known	15	297	5%	6	178	4%	4%

The ARTI study indicates that the majority of farmers feel that the FOs do a good job of assuring equitable distribution of water on field channels, thus ending many water disputes. IIMI findings are more equivocal. A survey of farmers in Right Bank tract 1 DC 5 during maha 1991/1992 showed that most farmers are satisfied with FO performance in water distribution and arranging canal maintenance. However, almost half of the sample said that the FRs did not try to solve irrigation problems (IIMI 1992:50). A similar survey among farmers on tract 5 DC 7 in maha 1992/1993 showed that 80 percent believed that the FRs did not try to solve irrigation problems (IIMI 1993:77). Findings in Tissawewa's Eastern High Level Canal during the same season disclosed real water distribution problems that were not solved by the FO (IIMI 1993:87).

Even in maintenance there are problems. The farmers in Tissawewa's Eastern High Level Canal clean their field channels after land preparations begin as a normal practice (IIMI 1993:86).

Table 9.11 shows data from IMD's Monitoring, Evaluation, and Feedback report for June 1993 on FO operations and maintenance performance. This shows that no DCOs were actually taking responsibility for operations. However, it also shows that water distribution was very good and that seasonal maintenance (channel cleaning) was well done in Ellegala. The reported satisfactory maintenance for the DCOs in the new areas is false since there was no cultivation in the new areas. Most DCOs met the standard of completing 30 percent of their planned actions during the month; however, this is a very low standard.

Table 9.11 DCO performance as reported to IMD, June 1993

Item	New Areas			Ellegala			Overall %
	#	N	%	#	N	%	
DCOs responsible for distribution on DC	0	26	0%	0	33	0%	0%
Unsatisfactory water distribution within DC	1	26	4%	3	33	9%	7%
Satisfactory maintenance in all FCs	15	26	58%	32	33	97%	80%
Over 70% of planned actions not completed	5	26	19%	2	33	6%	12%
Over half FC problems not solved	2	26	8%	0	33	0%	3%

Overall, farmer organizations have taken over maintenance but not operations. Their performance in maintenance seems to be satisfactory and they clearly have helped improve water distribution, at least on the field channels.

As reported in Chapter 1, farmers in the large-scale survey indicated willingness to take on more management functions. The great majority of the farmers feel that they can do routine maintenance better than the Irrigation Department can. Also, about half the farmers feel that the farmer organizations can successfully handle operations if turned over by the Irrigation Department and about 40 percent of the Ellegala farmers feel that the Ellegala tanks should be operated jointly by Irrigation Department officers and farmers. This should be contrasted with the case in 1991 when both operation and maintenance responsibilities were handed over to the Right Bank tract 1 DC 5 DCO. Then the farmers forced the DCO leaders to return those responsibilities to the Irrigation Department after a few weeks because of water problems (IIMI 1992:48).

These results imply that a) the farmers generally understand the idea of participatory management, b) they are not averse to the idea of farmer responsibility for aspects of operations and maintenance, and c) more can be done by farmers. Also, they indicate that only partial turnover of management functions to farmer organizations has occurred. Since there is good evidence that farmer participation helps improve system management, these are hopeful signs.

Joint Management Committee Performance The most important function of the joint management committees, particularly of the Project Management Committee, is making seasonal plans, including making the key water allocation decision each season. IIMI reports indicate that the PMC has begun to play a strong and effective role in seasonal planning (IIMI 1994).

As mentioned above, a few years ago many farmers were ignorant of this important function of the PMC. Awareness has increased but it is still low. Table 9.12 shows the answers of the respondents to the large-scale survey to questions on the joint management committees. It is clear that only a minority is aware of when these committees meet and what they discuss. As shown, only 12 percent are satisfied with them. However, this does not mean that the others are not satisfied; the great majority of the respondents - 76 percent in the new areas and 72 percent in Ellegala - do not know what they do so they cannot state whether they are satisfied.

Fifty-two respondents (34 in the new areas and 18 in Ellegala) gave reasons why they were not satisfied with the performance of the SPCs and PMC. The single most important reason (15 answers) was that decisions of these committees were not implemented by the agencies. Almost as prevalent (14 answers) was the opinion that these committees cannot find solutions to the problems. Five respondents in the new areas felt that the PMC favors the Ellegala farmers, presumably in water allocations. Four others in the new areas felt that the PMC makes bad decisions, again presumably because they allocate water to other areas. The remaining answers were all unique and are not reported here.

Table 9.12 Joint management committee performance

	New Areas			Ellegala			Total
	#	N	%	#	N	%	%
Know SPC meets monthly	46	295	16%	20	178	11%	14%
Know SPC subjects	67	297	23%	29	162	18%	21%
Know PMC meets monthly	24	293	8%	13	175	7%	8%
Satisfied with SPC/PMC	29	273	11%	21	155	14%	12%

Overall Evaluation of the Farmer Organizations The key points about the farmer organizations are a) they have been formed but are not strong, and b) there has been only partial turnover of operations and management responsibilities to them.

The data presented here imply the seemingly paradoxical findings that

- The FOs are well known to and well accepted by farmers - virtually all farmers claim to be members of their local FO - but are also relatively ineffective.

- Although the majority of farmers do not know clearly what the Subproject Committees and the Project Management Committee do, these committees now effectively play a part in seasonal planning.

The DCOs are the only farmer organizations that are recognized by the agency officers. Thus, no matter what the organizational weaknesses are, they offer the promise of serving as a means of interacting more effectively, from the farmers' point of view, with the agencies (cf conflicts between the FOs and the "independent" FO during maha 1992/1993 as reported in IIMI 1993). Also, the PMC is clearly the body most fitted to do seasonal planning (IIMI 1994).

Overall, while the FOs and joint management committees at Kirindi Oya have problems, they have recognition and legitimacy so that they can be developed to the needed level with appropriate inputs.

9.4.3 Cattle Owners' Farmer Organizations

Table 9.13 briefly describes the three cattle owners' farmer organizations (COFOs) in the Kirindi Oya area. All were formed in 1991 on the initiative of the Project Manager (Settlement) for the KOISP. These organizations are called "farmer organizations" because they are registered as such under the Agrarian Services Act (Dissanayake 1993).

As explained by the Project Manager (Settlement), now the Divisional Secretary at Lunugamvehera, the purpose of the COFOs is to solve the "cattle problem" at Kirindi Oya. The "cattle problem" refers to the extensive damage done to crops, particularly non-rice crops, by cattle searching for forage. There are two strategies being followed by the COFOs to solve the "cattle problem":

(a) First, the COFOs are working with the Divisional Secretary and others to find alternative graze for the herds. They have asked the government to set aside some crown land outside the Kirindi Oya area for this purpose. The request is being looked into.

(b) Second, the COFO leaders try to work with the FO leaders to resolve disputes and losses due to cattle damage to crops in an efficient and amicable manner.

It is not yet apparent whether the COFOs will be able to achieve a solution to the "cattle problem." However, because of the promise of this approach, the various concerned agencies are trying to work with the COFOs. Representatives of the COFOs now attend Project Management Committee meetings (Dissanayake 1993).

Table 9.13 *Cattle owners' farmer organizations*

COFO Name	Area	Membership
Magampura COFO	Ellegala	149
Ruhunu COFO	Right Bank	225
Beralihela COFO	Left Bank	82

9.4.4 Government Agencies

Local government agencies needed to manage the new infrastructure created by the KOISP under today's governmental system include the following:

- Irrigation Department - to manage the irrigation system
- Irrigation Management Division - to support the farmer organizations
- Department of Agriculture - to provide extension, research, and training services
- Local Government - to manage various local facilities
- Various Central Government Agencies - to man the communal facilities

The following discusses only the development of these agencies for their responsibilities.

Irrigation Department The Irrigation Department created a special organizational structure for the construction activities of the KOISP. This included a Chief Resident Engineer to oversee all work, Resident Engineers for the Headworks, Right Bank, and Left Bank, and various support staff for all four (Merrey & Somaratne 1988).

When irrigation began in the new areas in yala 1986, the Right Bank and Left Bank Resident Engineers were placed in charge of O&M for their respective areas and the Headworks man was in charge of water releases from the dam. In addition, after maha 1986/1987, a Senior Irrigation Engineer (Water Management) was appointed to work with the consultants charged with devising an operational system for Kirindi Oya and to provide assistance to the Chief Resident Engineer on operations matters.

Operations and maintenance in Ellegala in 1986 was the responsibility of the Irrigation Engineer, Tissamaharama Division, who reported to the Deputy Director of Irrigation, Hambantota Range. However, the Irrigation Engineer was simultaneously appointed as Resident Engineer for the Ellegala rehabilitation work. For this job he reported to the Chief Resident Engineer of the KOISP.

There has been a gradual change from this organization toward the normal Irrigation Department O&M organization. In 1992, the Irrigation Engineer, Tissamaharama, was transferred and the Tissamaharama Division was combined with the Left Bank and placed under the Resident Engineer, Left Bank. In 1994, the Resident Engineer, Right Bank, was made the Chief Resident Engineer and the functions of the two offices were combined.

It is expected that gradually the Department will reduce the staff at Kirindi Oya down to a single division headed by an Irrigation Engineer answerable to the Deputy Director of Irrigation, Hambantota Range. This process is going on but it has not yet been fully scheduled.

The Irrigation Department staff have not decreased as fast as the construction activities. This has been advantageous in helping to establish improved operating systems and an improved seasonal planning system (IIMI 1994). However, the current staff is, by Irrigation

Department norms, expensive to maintain. Some loss of effectiveness may occur as the number of staff drop unless the farmer organizations can take over some of the O&M responsibilities.

Irrigation Management Division The Irrigation Management Division (IMD) is responsible for creating and supporting farmer organizations. As explained above, IMD's structure calls for a Project Manager for the Kirindi Oya System, two Institutional Development Officers - one for the new areas and one for Ellegala - and a number of Institutional Organizers. The latter are temporary employees, generally recruited on two year contracts. Historically, IMD has had trouble recruiting and retaining Institutional Organizers.

Currently, IMD has two Institutional Development Officers - one of whom is acting as the Project Manager - and six Institutional Organizers stationed at Kirindi Oya. This would probably be more than enough if the farmer organizations were relatively strong. However, as noted earlier, the farmer organizations are not very strong. There is a real need to strengthen IMD at Kirindi Oya.

Department of Agriculture Strengthening agricultural research, extension, and training was one of the main goals of the KOISP right from 1977. Chapter 5 discusses the organization and staffing of the Department of Agriculture for agricultural research, extension, and training for Kirindi Oya.

That chapter notes that the physical infrastructure exists - including the research station and District Training Center at Weerawila. However, it points out that the extension staff is very thin, particularly since the village extension workers no longer are attached to the Department of Agriculture but to the Provincial Council. The result is that few farmers benefit from extension services and training is not being done. On the other hand, research to solve problems at Kirindi Oya is being carried out and is known to the farmers.

Local Government and the Land Commissioner's Department "Local government" term refers to the generalized local government structure. That structure has changed over the years. Prior to the introduction of the Provincial Councils, the lowest level officers were the *Grama Sevakas* who answered to the Government Agent through Assistant Government Agents. The Government Agent also had other staff who served specialized functions.

Currently, the basic unit is the Division. This has a legislature called the *Pradeshiya Sabha* and a Divisional Secretary who is partly answerable to the *Pradeshiya Sabha* and partly to the Provincial Council. The Divisional Secretary has a set of local level workers called *Grama Niladharis* to serve the needs of specified village areas. He also has the assistance of various low level employees of some of the national departments, including the Land Commissioner's Department, to help with specific functions.

When the settlers first arrived in the new areas, the Land Commissioner's Department (LCD) provided virtually all services, including government services. In particular, LCD named local leaders called *kattinayakes* to work with the LCD's own Field Instructors and Colonization Officers to solve all local problems. However, once the settlers in a hamlet became economically independent of the LCD, the *kattinayake* organization was abandoned and the number of LCD officers reduced. Then as local government officers were named, they took over many functions.

The local government structure has been fully created for the new areas. All of Kirindi Oya is under two Divisions - the Lunugamvehera Division and the Tissamaharama Division. Most local government functions have been transferred from the LCD to the Divisions. However, although the "link" roads have been turned over to the *Pradeshiya Sabhas*, the LCD is still responsible for maintaining hamlet roads.

The LCD staff has been greatly reduced over the years. Most of the remaining field staff have now been transferred to the supervision of the Divisional Secretaries so that they can solve land problems and disputes within the Division. The LCD's project office now has a skeleton staff operating until it can complete transfer or all buildings and functions to other government agencies.

Various Central Government Agencies As shown in Chapter 3, the LCD created a large number of physical facilities for communities, including: schools, cooperative stores, other stores, community centers, health centers, post offices, marketplaces, and agrarian service centers. The schools, health centers, post offices, and agrarian service centers were to be turned over to and manned by, respectively, the Department of Education, the Department of Health, the Post Office Department, and the Department of Agrarian Services (with other agricultural agencies). The other facilities were for the use of the public.

Basically, none of these departments have been able to fully staff and equip these facilities. For example, as pointed out in Chapter 3, while only one of the 24 schools built by the KOISP is not functioning, none are fully staffed and equipped. Lack of staff and equipment are the most important shortcomings felt by the settlers. These problems are not unique to Kirindi Oya schools nor to the other facilities but are common problems throughout Sri Lanka. Most government officials attribute such problems to lack of government funds.

Overall Development of Government Agencies This discussion suggests that the government has done the minimum necessary to make the facilities functional. However, the government's financial weaknesses prevent the facilities from being as well developed as possible. Also, as pointed out for agricultural extension services, there remain unresolved problems of division of responsibility between the Provincial Councils and Divisional Secretariats on the one hand and the central government agencies on the other.

9.5 Lessons

This section summarizes the findings and suggests lessons to be drawn for future projects.

Lessons for Project Planning KOISP project planning had some major shortcomings which have threatened the cost effectiveness of the project and has given rise to further problems. The biggest shortcoming was a lack of sufficient information. The following suggestions are made to improve project planning in similar projects:

(a) Water resource development projects like the KOISP need to take a basin view of the resources. Planning on the basis of basin development would have encouraged better investigation of all

water resources, including groundwater which was totally ignored in planning the KOISP.

(b) Good geological, soils, and economic information is needed and should be provided with thorough investigations made before the preliminary design of the major structures. A primary consideration in these investigations is assuring that local variability has been adequately assessed.

(c) An alternative to more thorough investigations is inclusion of a significant amount of unallocated resources in the project budget to cover changes needed and inclusion of a more thorough investigation in the project work plan. This alternative would not have been adequate for the KOISP since the cost escalations were so huge that no project planner would have predicted them.

(d) The project planners failed to consult the residents in the area in any meaningful way. Careful consultations with the residents during the project planning period would likely have made some problems evident that were missed by the project planners, like the cattle problem at Kirindi Oya.

Reducing Construction Delays The KOISP suffered severe delays, particularly in construction of the irrigation system and in construction of the water supply scheme. These delays were a major cause of the cost increases and helped cause the land problems now plaguing the new areas. The following suggestions might help future projects avoid these delays:

(a) Sri Lankan and donor contracting and procurement procedures should be streamlined and simplified to avoid major delays. One cause of slow contracting is the requirement for Cabinet approval of the award of large contracts. This requirement should be dropped not only because of the delay but also because it encourages political interventions.

(b) In Sri Lanka, the balance of power between agencies supervising contracts and large contractors is weighted too heavily in favor of the latter, partly because of lengthy contracting procedures and political involvement in contracting. Power needs to be rebalanced by a) streamlining contracting procedures as mentioned above, and b) using the smallest contracts consistent with efficient project management.

Reducing Political Interventions The direct intervention of politicians in settler selection has been constantly reported verbally. For KOISP, this intervention aggravated the "non-resident settler" problem. As noted above, politicians also oversee the award of large construction contracts. Reducing the direct role of politicians in these areas would help to prevent some of the reported abuses, such as ignoring settler selection criteria.

While reduction of direct intervention by politicians overall will require a major cultural change, specific efforts, including widespread publicity about the problems, can be directed at specific situations. This can only happen, however, when the top political authorities make it happen.

Project Coordination For the KOISP, the various executing agencies worked largely independently of each other. Coordination mechanisms functioned primarily to keep finances flowing, to ratify major changes in the project, and to adjust time schedules. Although the mechanisms proved adequate to solve many problems, they were not able to address those problems whose solutions require cooperative planning and effort from two or more agencies. There are two ways to provide coordinated effort that have worked in Sri Lanka:

(a) Creation of a special interdisciplinary project agency like the Gal Oya Development Board or the Mahaweli organizations can provide coordinated efforts. However, this is expensive and it has so far proven impossible to kill these agencies once their job is over. For example, the main dam contractor, the RVDB, is the descendant of the Gal Oya Development Board.

(b) Using limited purpose committees whose members include agencies that can provide special rewards to the participants or that include farmers who can provide personal satisfaction. This is not as satisfactory a solution as the a special agency but it does not give rise to the problems created by special agencies.

Benefit Monitoring and Evaluation The benefit monitoring and evaluation system for the KOISP has produced a great deal of useful information in special studies. However, for purposes of project management, a continuous monitoring system that could provide frequent and rapid reports would have been more useful. Such a system is suggested for future large projects.

Farmer Organizations and Participation in Irrigation System O&M Under Sri Lanka's participatory irrigation system management policy, farmer organizations have been created at Kirindi Oya to take over management of distributary channels and below and to share in the management of the whole system through the joint management committees.

Today, the farmer organizations exist and are well recognized by the farmers. However, most are weak and do not play a significant part in system operation. While they do handle aspects of maintenance, they do so in conjunction with the Irrigation Department. The joint management committees exist and play a significant role in seasonal planning. However, that role is not generally understood by the majority of the farmers, thus showing that linkage between Farmer Representatives and other farmers is a major weakness in the participatory management structure.

Given the importance of the participatory management policy and the greater success that has been found elsewhere in Sri Lanka, there is a clear need to invest more effort in strengthening the farmer organizations at Kirindi Oya. Resolving the "non-resident settler" problem is probably necessary for strengthening the farmer organizations in the new areas.

Cattle Owners Farmer Organizations The Cattle Owners Farmer Organizations have been created recently to help solve the cattle problem. So far they have not been able to do so. This initiative should be supported.

Government Agencies Virtually all facilities created by the KOISP have now been transferred to the agencies that will manage them routinely. Almost all special project management offices and bodies have been disbanded. There are two exceptions: a) the Irrigation Department has not yet completed the transition of a construction organization to an O&M organization, and b) the Land Commissioner's Department maintains a skeleton office that deals with a few remaining responsibilities, including maintenance of hamlet roads.

No full evaluation of the agencies that have taken over was attempted. However, it appears that all suffer from the funds and manpower shortages endemic in Sri Lankan government agencies. Solutions to this problem will require major changes in government practices and attitudes beyond the scope of this paper.

Beneficiary Participation in the KOISP Beneficiary participation in planning of the KOISP was virtually nil. Participation in construction activities, particularly in irrigation system construction during the early 1980's was a significant source of income to early settlers and others in the area.

While there was little participation in the early Ellegala rehabilitation work, there was significant participation in the planning and execution of the Rectification of Irrigation Difficulties in 1992-1993. The greater participation in the latter program was a major reason for the greater success.

While providing unskilled construction labor is clearly beneficiary participation of a sort, it is not the type of participation that provides the greatest benefits to the project. As shown by Esman & Uphoff (1984), it is *participation in decision-making* about the project that contributes the most to development. While local farmers, particularly those few who were in the area when the project was being designed, could not contribute significantly to technical aspects of dam and irrigation system design, their involvement might have prevented some of the planning mistakes that were made, such as ignoring the cattle problem and depending too heavily on non-rice crops. This point is also demonstrated by the results of the different Ellegala rehabilitation programs.

CHAPTER 10

COST-BENEFIT ANALYSIS

10.1 Introduction

The Kirindi Oya Irrigation and Settlement Project is one of the largest development projects implemented in the southern region of Sri Lanka. Construction of the project began in 1978, but due to cost overruns and inadequate funding, work on the project was halted for a short period. Rehabilitation of the existing areas as well as start up work continued till a re-appraisal of the project was completed in 1982. The project was reformulated into two phases, Phase I for the construction of the dam and provision of irrigation facilities for half the extent earmarked for the project and the settlement of half the number of farm families in the irrigated areas. The second phase was for the provision of irrigation facilities for the balance area and the settlement of the rest of the allottees. The first phase was completed in 1986, about three years behind the original schedule. The second phase of the project began in 1987 and was completed in 1994, about two years behind schedule. Under Phase II, only about 25 percent of the balance area was provided with irrigation facilities due to the lack of water resources and a similar proportion of farm families settled under the project.

The objective of the cost-benefit analysis component of the study is to determine the actual economic impact of the project as against the originally projected economic benefits. The project became partly operational in 1986 with the completion of Phase I and the release of water to the old area and to a major proportion of the newly developed area. Work under Phase II, which included the balance civil works and new components such as livestock, forestry, wildlife conservation and environment was completed only in 1994. There were considerable cost as well as time overruns during project implementation. Projections of water resource availability made at the time of project preparation could not be realized despite the fact that the best possible data was used in the analysis. Therefore the projected area could not be provided with irrigation facilities. The reduced water availability has been attributed partly to the declining rainfall trend observed in the project area in the recent past. The cropping patterns that were originally conceived for the project could not be implemented, resulting in a reduction in the area cultivated under the project. Thus a cost-benefit analysis of the project at this stage of implementation would help to evaluate the financial and economic viability under the current circumstances, which are considerably different from those assumed at project formulation stage. Eight years of operation of the project and several research, monitoring and evaluation studies have provided considerable information on the changed circumstances and the performance of the project up to the present. All available such data have been used in the analysis to determine whether the originally estimated project benefits could be attained over the balance life of the project.

The project has also generated intangible as well as indirect benefits and costs, some of which could be measured if reliable data can be obtained on their impacts. The major indirect benefits include increased economic activities in the area due to businesses, trade, manufacturing and services. Somewhat more direct benefits include that of inland fisheries, which has shown an increasing trend after the project. Intangible benefits include, improvement to aesthetic and recreation values. Such benefits could provide economic benefits by attracting tourism and other

development to the area. The environmental as well as other indirect negative impacts of the project appear to be minor when compared to the direct and indirect benefits. These impacts were not apparent at the time of formulation or implementation of the project. However the reformulated project has included provision for ameliorating some of the adverse environmental impacts by including a forestry, environmental and wild life conservation component. An evaluation of some of the impacts of these components is documented elsewhere in this report. An attempt will be made to incorporate the measurable impacts in the cost-benefit analysis. Such an analysis depends largely on the availability of reliable data on the impacts.

10.2 Methodology

10.2.1 Data: Sources and Constraints

Project investment costs were obtained from the records of the Irrigation Department (ID). There were three sources of data recorded in different formats according to the needs of the user in the ID; the Annual Accounts, Progress Reports and Department Files. The progress reports did not include the central overhead costs. The department files provided more detailed breakdown of costs but such data were not available consistently for all years. The Annual Accounts provided complete records of expenditure over the entire project implementation period, but the data are presented in an accounting format and aggregated by major components, not ideally suited for Cost Benefit Analysis. The cost data from the Annual Accounts which appeared to be the most reliable were used in this analysis. This was supplemented by data from other sources where necessary.

Data on cost of production for paddy and other field crops were obtained from the Department of Agriculture Publications for the Hambantota district. This data had a sufficiently detailed breakdown of costs suited for cost benefit analysis. No other detailed cost of production studies have been done on a continuing basis for the project area. The District average cost of production figures were supplemented by data from the various studies undertaken in the project by ARTI, IIMI (IMCD studies) and Ruhunu University. Operation and Maintenance costs were available for the old areas only for recent years. Costs for previous years were estimated assuming a similar level of expenditure for the previous years and deflated by the GDP agriculture sector deflator. World Market prices for traded commodities were obtained from various sources including, FAO Commodity Bulletins, World Bank publications, as well as the Fertilizer Secretariat of Sri Lanka. Local farm gate prices were obtained from the Census and Statistics Department, ARTI, DOA and Central Bank. Gaps in the data were either estimated or filled using data from other sources. Data on crop production and cultivated extent of the old irrigated areas were the most difficult to obtain, particularly for the years prior to 1986. More reliable data on cropping intensities, yield levels and cropping patterns were obtained for the new areas from evaluation studies undertaken by IIMI and ARTI for this project. But such data were scarce for the old areas. Every available data source was checked for relevant information and for cross reference purposes and the source that appeared to be the most reliable was used in the analysis.

Indirect benefits and costs were estimated in special studies supplemented by data collected from other sources. Much of the data on indirect economic/financial benefits obtained from the survey were not very reliable, as many respondents were unwilling to reveal information pertaining to financial returns, profits, etc. However it was possible to obtain

reasonably good estimates of the value of a few of the indirect benefits and costs, such as the value of incremental benefits from inland fisheries and the losses due to salinity and reduction in prawn fisheries. These were incorporated in the cost benefit analysis. The rest of the data were analyzed for purposes of providing a qualitative description of some of the non-agricultural benefits. The results are presented in a later section of this chapter.

10.2.2 Methodological Aspects

A formal cost-benefit analysis based on actual costs and benefits of the project was undertaken. For this purpose, actual production, cost and price data were collected from the period of formal commencement of the project in 1978 up to completion of both Phases of the project in 1994. Rehabilitation of the old area commenced in 1981. Partial operation of the project began in 1986, with the release of water to part of the new areas and to all of the existing areas. The entirety of the currently developed area was provided with irrigation facilities in late 1990. The project life was therefore estimated at 50 years beginning in 1991 and ending in year 2040. Projections of production cost and benefit streams for the period 1995-2040 were made using constant 1994 prices. It was assumed that relative prices would remain constant during this period except for rice and fertilizers for which price projections estimated by the World Bank were used. Costs and benefits were evaluated on the basis of world market prices for tradable commodities (rice, fertilizer), and adjusted local prices for non-tradables. All values were converted to 1994 US dollars on the basis of the G-5 MUV Index[1].

Annual investment costs were broken down by major components. Market investment costs were converted to economic costs using conversion factors developed for the National Planning Department by Bradford University[2] consultants. Since the level of taxation has been taken into account in working out these conversion factors, there was no necessity to deduct the transfer costs such as taxes and duties to arrive at the economic costs (Vehicles and equipment imported directly for this project and consultants hired for the project were subject to the normal taxes and duties applicable to the rest of the economy). Construction costs of the dam and distributary systems were first converted to labor, materials and machinery costs, using a sample area analysis. Irrigation Department technicians at the Kirindi Oya Project undertook this task by analyzing sample areas of the dam, headworks, spillway, main, distributary and field canals, to breakdown costs into the three broad components of labor, machinery and materials. Conversion factors were then applied to the three component costs to estimate the economic costs. For the other cost components, total costs were converted by the sectoral conversion factors.

Current (1994) data on cost of production, income and prices of crop and livestock production were obtained from the special surveys conducted by the Ruhunu University for this study. These costs were projected for the future years at constant 1994 prices. This was supplemented by data from the recently concluded Irrigation Management and Crop

[1]Unit value index in US dollar terms of manufactures exported from the G-5 countries (France, Germany, Japan, UK, and USA), weighted proportionally to the countries' exports to the developing countries.

[2]Report on Shadow Prices for Sri Lanka, Development and Project Planning Centre, Bradford University, UK, May 1991.

Diversification (IMCD) Study by IIMI in the project area. Average cost of production figures for the Hambantota District were used for the years prior to 1994. Sectoral conversion factors were used to convert these costs to economic costs, excepting for fertilizers for which world market prices were used. Since a good breakdown of costs was available it was possible to use the different conversion factors for the different components such as labor, machinery, chemicals, transport, etc. Market prices were obtained from the Department of Census & Statistics, Central Bank, ARTI and DOA. The DOA prices for Hambantota District were used to determine returns from crop and livestock production. Economic returns of paddy were estimated using world market prices, suitably adjusted for local costs such as handling, packaging, transport and storage. For livestock, forestry and other field crops, market prices were converted to economic prices using sectoral conversion factors.

Net benefit streams were calculated with and without project for the old areas, which consisted mainly of the incremental paddy production from the area. It was assumed that the extent and productivity of certain highland as well as chena crops grown in the old areas prior to the project did not change with the implementation of the project. A similar assumption was made for livestock in the old area. Incremental benefits from Other Field Crops (OFC) grown in the old irrigated areas were included in the benefit stream. For the new area, incremental benefits from paddy, OFCs, livestock and forestry were included in the benefit stream. The estimated cropping intensity and area cultivated in the scheme, particularly in the old areas prior to the project, were based on discussions with officials, farmers and researchers as well as on a few past records. The following were included in the analysis: production costs, investment costs, O&M costs and benefits foregone. All costs and benefits were converted to constant 1994 US dollars, for the analysis. A separate analysis of the new and old areas was also undertaken. Sensitivity analysis was undertaken for cost, price and cropping pattern changes.

10.3 Project Costs

The project was estimated to cost Rs. 570 million in 1977. This was subsequently revised in 1982 and 1986 to Rs. 1,500 and Rs. 3,000 million respectively. The final cost of the project over a 15 year period of implementation was Rs. 2,700 million. This is almost a 500 percent increase over the original estimate. The dollar cost of the project increased from $ 52 million to approximately $ 100 million, nearly a two fold increase. The dollar cost was contained due to the depreciation of the SL Rupee against the US dollar, over the extended period of implementation lasting over 15 years. Details are provided in Table 10.1.

Table 10.1 Kirindi Oya project costs

	Year	Exchange Rate (US$=SLRs.)	US$ Million	SLRs. Million
1.Original Estimate	1977	11.0	51.8	570.0
2.Revised Estimate	1982	15.0	106.0	1,526.0
3.Re-appraised				
Phase I	1986	27.5	79.8	2,195.0
Phase II	1986	27.5	28.9	795.0
Total			108.7	2,990.0
4. Re-revised				
Phase I	1987	28.5	65.0	1,850.0
Phase II	1987	28.5	33.1	943.0
Total			98.1	2,793.0
5. Actual Costs				
Phase I	1994		70.0	2,050.0
Phase II	1994		16.0	650.0
Total			86.0	2,700.0
6. Actual Costs as				
Percent of (1)			166.02	473.68
Percent of (2)			81.13	176.93
Percent of (4)			87.67	96.67

Sources : ADB Project Appraisal Reports, 1977, 1982, 1986.
Irrigation Department, Annual Accounts and Progress Reports, 1978-1992.

It can be seen from Table 10.1 that the later revisions of the project are more in line with actual costs. The scope of work was reduced due to the lack of water resources. The original cost estimate would in fact have been marginally lower, based on the actual area of the distribution system constructed. However the actual expenditure was close to the updated project costs, confirming that the project did incur cost overruns. The cost overruns were probably due to inadequate project preparation or poor project design.

Table 10.2 provides a breakdown of project costs according to the major components of expenditure.

Table 10.2 Kirindi Oya project investment cost breakdown

Cost Component	Cost in Rs. Million	Percent of Total Cost
Dam	1169.1	43.3
Distributary System	243	9
Other Civil works	253.8	9.4
Vehicles & Equipment	256.5	9.5
Administration & O&M	286.2	10.6
Water Supply & Roads	91.8	3.4
Land Settlement	129.6	4.8
Consultancy, Training & Project Management	124.2	4.6
Other	145.8	5.4
TOTAL	2700	100

Source : Annual Accounts & Progress Files Irrigation Department 1978 - 1994

An analysis of the project costs shows that a little over 40 percent of the total cost was spent on the dam. If the distributary system is also included, this proportion rises to 52 percent of the total costs. The high level of expenditure on the dam was partly due to unforseen foundation problems discovered during the excavation stage of dam construction. The long delays in implementation of the project also added to the cost. As this is relatively a high cost dam, the full benefits can be achieved only if the maximum possible area is developed for irrigation. Unfortunately for the KOISP, the full area could not be developed due to inadequate water resources. A third of the area planned was not developed causing a reduction in benefit flows from the project. If water availability in future proves to be as originally projected, the existing command can be increased, at minor cost, to cover a further 3,000 ha.

The cost of vehicles, equipment, water supply, roads and other civil works (buildings), make up about 23 percent of total costs. All construction activities of the project make up 75 percent of the total costs, thus making this project heavily construction biased. About 10 percent of the project cost was spent on administration and O&M, with the balance being shared by the rest of the project components. The contribution made by the project for O&M is relatively high when compared to other similar existing projects. It is unlikely that this level of expenditure can be sustained for this project once funding from external sources comes to an end. The benefit

stream could be adversely affected if O&M allocation for the project from local or government sources declines after project completion.

10.4 Project Benefits

Benefits expected from the project could not be realized due to various reasons. Although it was envisaged that a large extent would be grown with OFCs, the irrigation design was more suited for rice cultivation. The farmers also preferred to grow rice. Thus mixed cropping of rice and OFCs had considerable implementation difficulties and the expected cropping intensity and cropping patterns could not be achieved. The project envisaged the construction of a dam across the Kirindi Oya and irrigation facilities to cover 8,300 ha. of new lands and supplementary irrigation facilities for 4500 ha. of existing irrigated lands. However only two thirds or 5,342 ha. of new lands were actually provided with irrigation facilities, because as analyzed in the Irrigation section of the report, reservoir inflows have been 25 percent less than expected on the basis of pre-project analysis of river flows. In large part this is explained by a series of very low rainfall years. It is not yet clear whether this is along term trend. The full extent of the existing irrigated area was provided with supplementary water. The cropping intensity in both areas was to rise to 1.7 according to project estimates. However the actual cropping intensity of these areas as observed over the last few years was 1.6 (about 95 percent of the expected value) in the old area and 0.9 (52 percent of estimate) in the new area. Only about 60 percent (5,200) of the targeted number were actually settled on the new lands. Details are provided in Table 10.3.

Table 10.3 Estimated versus current benefits of KOISP

	(A)	(B)	(B/A)
	Estimated at Appraisal	Currently Estimated or Actual	Current / Actual as of Estimated
1. New Irrigation Facilities (ha.)	8,300	5,342	64.4
2. Rehabilitation (ha.)	4,600	4,600	100.0
3. Cropping Intensity			
Existing Area	1.7	1.6	94.1
New Area	1.7	0.9	52.9
4. Incremental Production			
Paddy (mt.)	44,000	24,000	54.5
OFC (mt.)	11,400	1,600	14.0
Milk (Million Litres)	4.1	0.7	17.1
5. Forest Development (ha.)	1,000	250	25.0
6. New Settler Families	8,200	5,100	62.2
7. Employment Creation			
Construction (Million Man Days)	n.a.	5.5	
Construction (Man Days/Year)	n.a.	305,556	
Production (Million Man Days)	8.0	2.6	32.5
Production (Man Days/Year)	790,000	155,000	19.6

Sources : ADB Project Appraisal Reports, 1977, 1982, 1986.
Current Study Estimates, IIMI, 1994.
A Study on Employment Creation in Kirindi Oya, ARTI, 1987.

It was also expected that half the extent in the new lands and a smaller proportion in the old areas would be grown with OFCs. However this expected diversification did not take place. Less than 10 percent of the lands were actually diversified. This too in very water short years and with much efforts from the management. The lack of enthusiasm for OFCs was due to many reasons. These included, lack of know-how and finances, price fluctuations and the resulting uncertainty of incomes, inadequate facilities for irrigating OFCs, soil and topographic conditions, etc. However in water scarce situations farmers have been persuaded to diversify with good success, although their preference would be to grow paddy.

In terms of the incremental annual outputs envisaged by the project, the achievement for paddy was 55 percent (24,000 mt.), and that for other field crops 14 percent (1,600 mt.). Incremental milk production was 17 percent of the target (0.7 million liters). The old area received priority in water allocation, due to the water rights enjoyed by the old area farmers. Thus the new area has remained water short since the inception of the project, while the old area farmers have almost doubled the cropping intensity. Productivity increases in the scheme have been slow, but the new areas have produced higher yields than the old areas. If the entire planned area (8,000 ha.) had been developed, incremental paddy production would have increased to 35,000 mt. (80 percent of target) and incremental OFC production increased to 2,500 mt (22 percent of target). Milk production failed to meet projections due to a reduction in livestock numbers resulting from the loss of traditional grazing lands to the project. OFC production did not increase as projected because these crops are not preferred by the farmers. The project design should have recognized this problem, either by a reduction in the planned area or by ensuring that the planned cropping patterns were acceptable to farmers and could be enforced. The project has generated 5.5 million man days of incremental employment in the construction phase and 2.6 million man days in production activities since the commencement of construction of the project in 1978. The latter is much less than that envisaged by the project.

Forestry area to be developed was restricted to 25 percent of the target. However the planted forest areas have performed well and the returns are expected to be high. According to the Forest Department figures the number of plants raised in the nurseries was 1,042,549. The targeted extent of woodlots was 400 ha. (1,000 acres). This extent was to be distributed among 540 families, with usufruct rights up to 25 years. A total of 441 farmer families have been allocated woodlots, who have actually planted 250 ha. (611 acres). A total of 15 medicinal herb gardens have been established on 1 acre blocks. Roadside plantings were completed on 46 kilometers of roads. A total of approximately 2,000 ha. were planted under all programs in the project area. Better results on woodlots would have been achieved if the promised long leases were given to the farmers (refer p.206, Volume II of this report for more details).

10.5 Cost-Benefit Analysis

10.5.1 Assumptions for Cost-Benefit Analysis

The main assumptions for cost benefit analysis for the old and new areas with and without project are listed in Table 10.4.

Table 10.4 Assumptions used in cost benefit analysis

	Without Project in Old Irrigated Area	With Project in Old and New Irrigated Areas
1.Paddy yields	2.8 mt/ha. from 1981 rising to 2.9 mt/ha. in 1995	3.8 mt/ha. in 1994 rising to 6.0 mt/ha. in 2003
2.OFC yields OFC1 OFC2	1.2 mt/ha. 0.5 mt/ha.	2.0 mt/ha. from 1995 1.0 mt/ha. from 1995
3.Fertilizer use in paddy	Remains constant at 1994 levels for the balance period of the project.	No change up to 1994, then rises gradually till 2010 and remains constant thereafter.
4.Cropping intensity of paddy	Remains at 1.3, beginning 1981	Increases to 2.0 in 1995 in the old area and 1.1 in the new area
5.Cropping intensity of paddy and OFC	Paddy 1.3; OFC 0.0	Paddy 1.7; OFC 0.2 in OIA Paddy 0.8; OFC 0.1 in NIA
6.Livestock	No change	Incremental benefits from NIA only
7.Chena & Highland	No change	No incremental benefits from OIA
8.OFC in irrigable areas	Little or no OFCs grown prior to 1986.	Incremental benefits only after Phase I completion in 1986
9.Cost of production of paddy	Remains constant at Rs. 22,000/= form 1994 onwards	Increases by 5% after 1986 up to Rs. 23,300/ha. in 1994 and to Rs. 23,900/ha. in year 2010.
10.Investment costs		Assigned according to the proportion of water use in the two areas: NIA - 65% and OIA - 35% of investment cost.
11.Economic prices for paddy & fertilizers	World Market Prices suitably adjusted for local services	World Market Prices suitably adjusted for local services
12.Economic prices for OFC & Milk	Conversion factors of 0.87 and 0.774 respectively	Conversion factors of 0.87 and 0.774 respectively

Paddy

Paddy is the main crop grown in the scheme. Some diversification has taken place in the paddy areas over the last ten years of operation of the project. Diversification has been more successful during water short years. It also needed considerable efforts on the part of project management to induce farmers to diversify. In the old areas most farmers have opted for two seasons of paddy. These farmers have resisted diversification because of the priority accorded to them for water rights in the scheme. Table 10.5 shows the cropping intensity under paddy cultivation in both areas after the release of water to the scheme in 1986. Thus a paddy-paddy combination has been used for the base case analysis under conditions of high rainfall and good water availability . A combination of paddy and OFCs has been used as an alternate case under an average rainfall regime and lower water availability. In the case of the old area, rehabilitation work started in 1978 and project impact is estimated to have begun in 1980/1981. Therefore, paddy yields without project were estimated at 3 mt/ha. in maha and 2.6 mt/ha. in yala beginning this date. Additional water releases to the old area began in 1986. This improved the reliability of water supplies and induced farmers to add more fertilizers and other inputs. Cropping intensity as well as yields appeared to have improved as a result. It has been therefore assumed that with project implementation, crop production costs started to increase only from this date. It is assumed that with project, only the fertilizer input would increase from about 360 kg/ha. in 1994 to 420 kg/ha. in the year 2010.

Table. 10.5 Area cultivated and cropping intensity in the KOISP

	Old Irrigated Area		New Irrigated Area	
Year	Area (ha.)	CI	Area (ha.)	CI
1986	7,416	1.53	879	0.21
1987	7,387	1.52	2,406	0.57
1988	8,563	1.77	5,316	1.25
1989	8,205	1.69	5,316	1.25
1990	8,368	1.73	2,256	0.45
1991	8,972	1.85	6,362	1.25
1992	5,180	1.07	5,038	0.94
1993	7,019	1.45	4,290	0.8
1994	7,449	1.54	4,861	0.91

Sources: IMCD Reports, IIMI, 1989-1994; DOA Reports.

Economic returns have been estimated using world market prices of rice, with adjustments made for local costs. The conversion factors listed in Table 10.6 have been used in estimating the economic costs of production of paddy. For fertilizers, world market prices have been used, with the local costs of packaging, transport and storage adjusted by the appropriate conversion factors.

Table 10.6 Conversion factors for economic COP of paddy

Component	Conversion Factor
Labor (surplus)	0.722
Machinery	0.776
Seed	0.87
Chemicals	0.65
Transport	0.841
Fertilizers	World Market Prices

Other Field Crops (OFCs)

OFCs have been categorized into two, OFC1 and OFC2. OFC1 are high yielding and high input crops yielding higher net returns. OFC2 are low yielding, low input crops yielding lower net returns. The cost of production and net returns of OFC1 in 1994 was estimated at Rs. 22,670/ha. and Rs. 37,330/ha. respectively in 1994. The cost of production and net returns from OFC2 were estimated at Rs. 12,560/ha. and Rs. 9,440/ha. respectively. Table 10.7 shows the area under OFCs in the project since 1988.

Table 10.7 OFC cultivation in KOISP

Year	Area (ha.)
maha 1988/1989	303
yala 1989	66
maha 1989/1990	209
yala 1990	248
maha 1990/1991	1,943
yala 1991	238
maha 1991/1992	1,306
yala 1992	208
maha 1992/1993	1,468
yala 1993	1,120
maha 1993/1994	1,491

Sources: 1. *The South-East Dry Zone of Sri Lanka: Crop Diversification in the KOISP, ARTI, 1993.*
2. *Ruhunu University Survey,1994.*
3. *IMCD Report, Sept. 1993,IIMI.*

The returns from OFC cultivation are high, but farmers prefer to grow rice for various reasons. OFC1 requires high cash inputs (fertilizer, seed and chemicals). Labor requirements are also high as harvesting of crop is carried out over a longer period. Extension services are limited. Producer prices of OFC are subject to considerable variations. Farmers face difficulties in marketing (lack of transport, high marketing margins, lack of storage, high losses of perishables, etc.). OFC2 , particularly green gram, cow pea, maize, etc are low water using crops and drought tolerant. They also require less cash inputs and therefore are the preferred crops among OFC growers.

Most of the OFCs (85 percent) were grown in the Newly Irrigated Area (NIA). The composition of the OFCs grown over the 11 seasons is given below.

Green Gram	-	45 percent
Cow Pea	-	17 percent
Ground Nut	-	10 percent
Chilies	-	9 percent
Vegetables	-	8.5 percent
Onions	-	6 percent
Others	-	4.6 percent

The above shows a predominance of low income OFCs like Green Gram and Cow Pea being grown in the area (OFC2). The high percentage under these crops probably indicates a rational farmer response to restricted, unreliable irrigation. This trend should be changed if income from OFCs cultivation is to increase. For the purposes of this analysis, the following are the compositions of OFC1 and OFC2 combinations. OFC1 crops would be mainly irrigated but some would be grown under rainfed conditions in maha. OFC2 would be mainly rainfed or under supplementary irrigation in maha and yala.

OFC 1 - Mainly Irrigated

Chilies	-	15 percent
Onions	-	15 percent
Ground Nut	-	20 percent
Soy Beans	-	15 percent
Vegetables	-	20 percent
Other	-	15 percent

OFC 2 - Mainly Rainfed

Cow Pea	-	30 percent
Green Gram	-	40 percent
Maize	-	10 percent
Gingelly	-	5 percent
Mixed	-	15 percent

The average market price of OFC1 and OFC2 are estimated to rise to Rs. 30/kg. and Rs. 22/kg. respectively in 1995. The economic returns have been estimated using a conversion factor of 0.87.

Livestock

It has been assumed that incremental returns from livestock would be obtained only from the NIA. Survey data has shown that the livestock population declined after the project, mainly due to a reduction in grazing areas. Milk yields dropped after the project, from 1.1 liter/day for cattle and 0.94 liter/day for buffalo in 1985/1986 to 0.88 liter/day and 0.76 liter/day by 1990. From 1990 onwards milk yield started to increase and in 1994 it had reached 0.9 liter/day for cattle and 0.80 liter/day for buffalo. Beyond 1994 the yields are expected to increase at the rate of 0.5 percent for cattle and 0.3 percent for buffalo. The cattle and buffalo population in the NIA is estimated at 5,000 and 10,000 respectively. The population is expected to rise at 0.5 percent for cattle and 0.3 percent for buffalo to 15,500 and 11,300 animals respectively. The proportion of animals milked is estimated at 40 percent for cattle and 23 percent for buffalo. This proportion is expected to rise at the rate of 0.1 percent after 1994. The lactation period for cattle and buffalo is estimated at 100 and 60 days/annum, respectively. The total production of milk is expected to increase from about 1 million liters in 1994 to 2.2 million liters in year 2040. The cost of production of a livestock unit (3 animals) was estimated at Rs. 775/= and the net returns Rs. 215/= in 1994. Livestock income was estimated from three sources; milk, meat and curd. The economic returns from livestock was estimated using a conversion factor of 0.774.

Forestry

The measurable economic benefits of the forestry component of the project comes mainly from the woodlot program. A total of 250 ha. (611 acres) were planted under this program. The stocking of trees in the planted area amount to about 244,000. These trees if allowed to grow for 30 years will produce very valuable timber. Between now (1994) and the thirtieth year about 25 percent of the stocking will be removed as small timber, poles and fuel wood. The value of these intermediate products could be estimated at Rs. 1 million. The balance trees which could be estimated at about 180,000 is valued at of about Rs. 2,000/= per tree on an average. The total value of the trees planted will amount to Rs.360 million. The cost to the settlers of planting these woodlots is estimated at between Rs. 7,000 and Rs. 10,000 per hectare per annum, for about three years. These trees can be harvested on a selective basis from the thirtieth year to the fiftieth year to provide considerable income to the settlers. The benefit provided by the woodlots in ameliorating the climatic conditions cannot be quantified in financial terms alone. Their effect provides a healthy environment for people and animals to live and provide shelter from wind and dust storms. The soil will be improved by addition of organic matter and improved soil moisture. Quantification of these benefits are difficult. Wood will provide raw material for the carpentry industry and all the lops and tops of the felled trees will provide fuel wood for the households. As most of the trees are good flowering species, bee keeping can be started as a subsidiary business. The economic returns from forestry has been calculated using a conversion factor of 0.841.

Investment and other project costs

Investment costs were converted to economic costs using conversion factors estimated by the National Planning Department. Initially the total costs were broken down by the various cost components. Individual cost components were further broken down by labor, materials and machinery where possible. These were then converted to economic costs using the sectoral or other conversion factors. A similar procedure was adopted for other project costs. Table 10.8 provides a list of cost components and conversion factors used.

Table 10.8 Conversion factors used in estimating economic costs

Cost Category	Component	Percent	Conversion Factor
Dam	Scarce labor	3.7	0.785
	Machinery	86.3	0.776
	Materials	10	1.05
Distributaries	Scarce labor	27.6	0.785
	Machinery	47.2	0.776
	Materials	25.2	1.05
Rehabilitation	Labor	57	0.785
	Machinery	25	0.776
	Materials	18	1.05
O & M	Labor	66	0.785
	Transport	7	0.814
	Materials	27	1.05
Equipment			0.776
Roads			1.06
Buildings			1.06
Agric. development			0.785
Land development			0.785
Land settlement			0.785
Livestock			0.774
Training & Consultants			0.906
Monitoring & Evaluation			0.785
Administration			0.785
Miscellaneous			0.785

Source : Report on Shadow Prices for Sri Lanka, Bradford University, UK, 1991.

The total investment cost has been assigned to the two areas according to the proportion of water use. The OIA obtained 25 percent of the Lunugamvehera reservoir water through direct deliveries and an additional 10 percent from drainage flows. It was also assumed that the OIA shared much of the other benefits accrued as a result of the construction of this project. Therefore 35 percent of the total investment cost was assigned to the OIA, and the balance 65 percent to the NIA in the separate analysis undertaken for the new and old areas. The rehabilitation costs were assigned entirely to the old area.

Indirect costs and benefits

Indirect costs such as the losses due to a reduction in prawn fisheries and that due to salinity have been incorporated in the analysis. Indirect benefits from an increase in inland fish production attributed to the project have also been included in the analysis. Loss in production due to salinity appears to be minor and is valued at Rs 1 million annually. Loss in prawn fisheries is valued at Rs 4 million per annum. Incremental benefits from additional production of inland fish in the project area is estimated at Rs 3.6 million per annum.

10.5.2 Results

The projected Economic Rate of Return (ERR) of the KOISP in 1977 was 17.6 percent. This was later revised to 11.0 percent for Phase I of the Project, and 13.6 percent for both Phase I & II, in the reappraised project report of 1982. The ERR in the Base Case as estimated by this study was 6.25 percent for the whole Project, which is substantially lower than the anticipated rate of return. The Financial Rate of Return (FRR) was lower at 2.98 percent.

The results of the Base Case and Alternate Case assumptions are given in Table 10.9.

Table 10.9 Estimated rates of return - KOISP

	Cropping Intensity		Rates of Return	
	Paddy	OFC	ERR	FRR
Base Case				
OIA	2.00	0.00	10.70	5.99
NIA	1.10	0.00	3.97	0.98
Both			6.25	2.98
Alternate				
OIA	1.70	0.20	10.16	5.88
NIA	0.80	0.10	3.12	0.46
Both			5.56	2.70

If sufficient water is available for rice cultivation very little or no OFC will be grown either in the old or new areas, therefore the Base Case can be considered an optimistic scenario. In an year when water supplies are average, farmers can be induced to grow OFC, therefore the Alternate Case which includes OFC in the cropping pattern is a feasible alternative. The cropping intensities assumed for the alternate case were considered by many officials who have worked in the area to be a feasible proposition in a water short situation. In this case the ERR reduces to 5.56 percent. Net returns from paddy are lower than that obtained from high income OFCs but lower or equal to the low income OFCs. Therefore farmer income may increase with greater diversification to OFCs. The economic farm gate prices of paddy were consistently higher than market farm gate prices, whereas the economic farm gate prices of OFC were generally lower than market farm gate prices. Consequently, higher economic returns were obtained for cropping patterns with larger extents under paddy, indicating that the country would gain from cultivating more paddy. On the other hand, OFC could be imported at lower cost, but it would affect farmer incomes.

10.5.3 Sensitivity Analysis

Sensitivity analysis was undertaken for cropping pattern, price and cost changes. Results of the sensitivity analysis for the base case are shown in Table 10.10. This shows that the rate of return is more sensitive to an output price decline than a production cost increase. A 30 percent increase in production cost, reduces ERR by about 0.50 percent, while a similar level of price decline reduces ERR by about 2.0 percent. A 30 percent price decline together with a 30 percent cost increase reduces ERR by 2.7 percent.

Table 10.10 Sensitivity analysis - cost and price changes for the base case

	ERR %	FRR %
Base Case		
Old Area	10.70	5.99
New Area	3.97	0.98
Both	6.25	2.98
Production Cost Increase of 30 percent		
Old Area	10.27	5.35
New Area	3.37	-0.29
Both	5.75	2.11
Output Price Decrease of 30 percent		
Old Area	8.58	3.82
New Area	1.99	-1.84
Both	4.28	0.64
Output Price Decrease and Production Cost Increase of 30 percent		
Old Area	7.98	2.80
New Area	1.02	-6.86
Both	3.54	-1.10

Source : Study Estimates , IIMI, 1994

The results of the sensitivity analysis for the alternate case are shown in Table 10.11. They are similar to the base case and the impacts on the ERR are of the same order of magnitude.

Table 10.11 Sensitivity analysis - cost and price changes for the alternate case

	ERR %	FRR %
Alternate Case		
Old Area	10.16	5.88
New Area	3.12	0.46
Both	5.56	2.70
Production Cost Increase of 30 percent		
Old Area	9.77	5.36
New Area	2.53	-0.72
Both	5.11	1.94
Output Price Decrease of 30 percent		
Old Area	8.13	3.86
New Area	1.21	-2.18
Both	3.68	0.54
Output Price Decrease and Production Cost Increase of 30 percent		
Old Area	7.59	3.06
New Area	0.23	-6.27
Both	3.00	-0.85

Source : Study Estimates , IIMI, 1994

Project benefits derived from the old area were higher than the new area. A separate analysis of the new and old areas was undertaken with the full investment costs assigned to the new area. The ERR for the OIA increased from 10.70 percent to over 900 percent, while the ERR of NIA declined from nearly 4 percent to 2.4 percent. A further analysis showed that ERR of the NIA increased marginally (0.02 percent) when the indirect costs and benefits were excluded, but the ERR of the whole project remained unchanged. If the originally planned area of 12,930 Ha is developed (a further 3,000 ha.), at an additional cost of 20 percent of the total cost (Rs 540 million) then ERR goes up to 7 percent in the base case and 6.35 percent in the alternate case, on the assumption that the cropping intensity of this newly developed area would be 1.5. The results of above analysis are shown in Table 10.12.

Table 10.12 Sensitivity analysis - other assumptions

	ERR %	FRR %
Investment cost assigned fully to NIA - Base Case		
Old Area	978.61	668.47
New Area	2.39	-0.34
Both	6.25	2.98
Indirect costs and benefits excluded - Base Case		
Old Area	10.70	5.99
New Area	3.99	1.01
Both	6.25	2.98
Development of full area (12,930 ha.) Base Case - Cropping intensity OIA - Paddy 2.0 NIA - Paddy 1.25		
Old Area	10.70	5.99
New Area	5.58	2.26
Both	7.06	3.55
Development of full area (12,930 ha.) Alternate Case - Cropping intensity OIA - Paddy 1.7; OFC 0.20 NIA - Paddy 0.9; OFC 0.25		
Old Area	9.78	5.39
New Area	4.75	2.00
Both	6.35	3.36

Source : Study Estimates , IIMI, 1994

Sensitivity of ERR to cropping pattern changes were also examined. The results show that a higher proportion of paddy in the cropping pattern increases the ERR, mainly due to the fact that economic prices of paddy are generally higher than market prices. The results of the analysis are shown in Table 10.13.

Table 10.13 Sensitivity analysis - cropping pattern changes

Area	Cropping Intensity	ERR %	FRR %
High rainfall / water regime - Paddy only			
Old Area	Paddy - 2.0	10.55	5.91
New Area	Paddy - 1.2	4.27	1.22
Both		6.37	3.07
High rainfall / water regime - Paddy / OFC			
Old Area	Paddy - 1.8; OFC - 0.2	9.95	5.51
New Area	Paddy - 1.0; OFC - 0.3	4.41	1.97
Both		6.19	3.26
Average rainfall / water regime - Paddy only			
Old Area	Paddy - 1.7	9.63	5.30
New Area	Paddy - 1.0	3.65	0.72
Both		5.63	2.53
Average rainfall / water regime - Paddy / OFC			
Old Area	Paddy - 1.6; OFC - 0.2	9.29	5.08
New Area	Paddy - 0.8; OFC - 0.2	3.81	1.56
Both		5.57	2.85
Low rainfall / water regime - Paddy only			
Old Area	Paddy - 1.5	8.92	4.85
New Area	Paddy - 0.7	2.52	-0.19
Both		4.74	1.89
Low rainfall / water regime - Paddy / OFC			
Old Area	Paddy - 1.4; OFC - 0.2	8.53	4.61
New Area	Paddy - 0.6; OFC - 0.2	2.90	0.80
Both		4.75	2.23

Source : Study Estimates , IIMI, 1994

The analysis indicates that overall project rate of return is marginally above the 6 percent Economic Discount Rate (Opportunity Cost of Capital) estimated for Sri Lanka[3]. The opportunity cost of capital is based on the real rate of foreign borrowing. The financial rate of return was lower than the ERR. The project is just barely viable in terms of the measured economic benefits from the project. However if one takes into account other indirect benefits, and the possibility of a higher level of cropping, with improved water management and change in weather patterns, the future returns may improve considerably.

10.6 Non-Agricultural/Indirect Benefits and Costs

There has been a substantial increase in agriculture related and non-agricultural economic activities in the project area. Business as well as service activities such as rice milling, tourism, inland fisheries, groceries, marketing, and transportation etc. have expanded considerably after the project, while most of its indirect benefits have come after the establishment of KOISP, other development projects implemented in the region have also contributed to this. The value of the indirect benefits could not be included in the cost-benefit analysis, due to lack of reliable data on such impacts. A survey was undertaken to estimate the indirect impacts of the project. Some reliable data on the number of businesses and non agricultural or agriculture related enterprises that have come up in the project area was obtained. The following section analyses the results of this survey.

10.6.1. Inland Fisheries

Inland fisheries is a major income generating activity for some families resident in the project area. There are six major tanks including Lunugamvehera tank, in the area. Fishing is done mainly in Weerawila, Tissa Wewa, Yoda Wewa and the Lunugamvehera tank. After the construction of Lunugamvehera reservoir, fishing in all tanks have increased. This is mainly due to the improvement in the availability of water in these tanks. Changes in the fishing population of these tanks are given in Table 10.14 below.

[3]Report on Shadow Prices for Sri Lanka, Development Planning Centre, Bradford University, UK, 1991 pp 87-93.

Table 10.14 Fishermen

Name of Tank	Number of Fishermen	
	Before Project	After Project
Weerawila	20	33
Pannegamuwa	--	--
Tissawewa	8	30
Debarawewa	--	--
Yodawewa	15	40
Lunugamvehera	--	24
Total	43	127

Table 10.14 provides data only of the permanent fishermen engaged in fishing in the respective tanks. During the season more fishermen from various places for fishing in these tanks. It was difficult to obtain much data on the seasonal fishing population.

Fish Production

Prior to the commencement of the Lunugamvehera project, the average duration of fishing was about eight months. This has increased to 12 months after the project in Weerawila. It is about 10 months in Yoda Wewa and Tissa Wewa. According to the information gathered from fishermen, there has been an increase in the yield of fish despite the absence of any fish breeding program. The assistance provided by the Department of Fisheries ceased in 1990.

Fish production in four tanks in the area is given in Table 10.15.

Table 10.15 Fish production

Name of Tank	Before Project	After Project
Weerawila		
Number of Fishermen	08	33
Fishing Duration (months)	08	12
Average yield (kg/day/person)	15	20
No. of fishing days (per month)	20	20
Total production (kg/year)	19,200	158,400
Tissawewa		
Number of fishermen	08	30
Fishing duration (months)	08	10
Average yield (kg/day/person)	10	20
No. of fishing days (per month)	20	20
Total production (kg/year)	12,800	120,000
Yoda Wewa		
Number of fishermen	15	40
Fishing duration (months)	06	10
Average yield (kg/day/person)	15	17.5
No. of fishing days (per month)	20	20
Total production (kg/year)	27,000	140,000
Lunugamvehera		
Number of fishermen	-	24
Fishing duration (months)	-	12
Average yield (kg/day/person)	-	23
No. of fishing days (per month)	-	20
Total production (kg/year)	-	132,480
Grand total kg/year	59,000	550,880

The results show that there has been a large increase in fish production in the scheme. The above is an estimate of only the permanent fishermen resident in the project area. The increase in the fish catch is a result of increased availability of water in the reservoirs for a longer period of time.

Returns from Inland Fisheries

The bulk of the production costs are for fixed assets like boats and nets. The cost of a boat is Rs. 7,000/= approximately and it has a life span of about 7-8 years. The cost of a net is about Rs. 5,000/= and it could be used for about a year. The variable costs include costs of labor, operation and maintenance of boats and nets and transportation. Assuming a labor cost of Rs. 16,000/=, O&M and transport cost of Rs. 2,000/= per annum, the total cost per fisherman is Rs. 25,000/=. The average price of fish is Rs. 12/kg. On this basis, the value of production increased from Rs. 0.7 million before the project to Rs. 6.5 million after the project. The incremental value of production due to the project could be assumed to be approximately Rs. 5 million annually if the natural increase without the project is subtracted from the incremental value. The net income per fisherman exclusive of own labor has increased from Rs. 15,000/= per annum prior to the project to over Rs. 40,000/= after the project. This is a minimum valuation of the indirect benefits from the project excluding benefits to migrant fishermen.

10.6.2 Marketing of Agricultural Products

Marketing of agricultural produce is handled mainly by the private sector in the Kirindi Oya project area. The private marketing sector consists of individuals, wholesalers, middle men and market places (*polas*). Private traders have their own buying points. Farmers and middle men bring their agricultural produce to these places. There are four market places (*polas*) in the project area. Two were established before the project. They are located at Pannegamuwa and Debarawewa. Two other *polas* were established after the project; one in Lunugamvehera and the other in Beralihela for the left bank area of the new system. The Pannegamuwa *pola* is the most important of the four, since the bulk of the wholesale marketing is done here.

The Pannegamuwa *pola* was established in 1952. The person in charge of this *pola* for the last 15 years was interviewed in our survey. According to him, wholesale marketing of agricultural produce has declined after the project. This apparently was due mainly to the decline in chena cultivation. Before the project, the major produce sold in bulk was chili, pumpkin, vegetables etc. The number of bulk sellers (wholesalers) has declined from 500 to about 200, after the project. The number of bulk purchasers of produce (wholesale buyers) has also declined from about 150 to 75 after the project, indicative of the decline in wholesale trading in this important market place. On the other hand the number of retail sellers have increased in Pannegamuwa *pola* due to the increase in population after the project and the greater demand for produce in the local area. In the 1970's there were about 50 retailers operating in this *pola*, this number has increased to about 175 after the project.

10.6.3 Non-Agricultural Business Activities

A study was undertaken in May and July 1994, to estimate the growth of non agricultural business activities in the project area. In the first instance we tried to obtain a list of all enterprises from the Divisional Secretariats (DS), which are expected to register all business

enterprises in the area. The information available with the DS was incomplete because a large number of business activities were not registered. The DS had information only on the registered business activities. Therefore other sources of information were also explored.

The Enterprise Development Program had also conducted a survey of non-agricultural business activities in Hambantota district through *Grama Niladharies*. It was possible to obtained a list of all non-agricultural business activities in the area, from this survey. However, information on business activities in Lunugamvehera area was not available. Therefore information for this area was obtained from the Lunugamvehera Divisional Secretariat.

Over 26 types of business activities were found in the area. These have been classified under five major groups, as follows:

1. Manufacturing and Processing
2. Business and Trade
3. Supporting Services
4. Personal Services
5. Unspecified

Mills, bakeries, metal products, wood and paper products and food manufacturing activities are categorized under Manufacturing and Processing. Textile shops, groceries, hotels and restaurants etc were grouped under Business and Trade category. Under the Supporting Services category, motor and bicycle repair work shops and petrol stations have been included. Tailoring shops, laundries, medical clinics, barber shops etc are classified under the Personal Services category. Sport clubs and other community based business activities were classified under community activities. Business activities not under any of the other categories or not specified are grouped under the Unspecified group. All the business activities have been grouped into two categories: those established before the project (before 1985) and after the project (after 1985). The results are summarized in Table 10.16.

Table 10.16 Business activities

Business Activity	Before 1985	After 1985	Total
Manufacturing and Processing	28 (20.7)	107 (79.3)	135 (100)
Business and Trade	74 (19.5)	305 (80.5)	379 (100)
Support Services	07 (18)	31 (82)	38 (100)
Personal Services	11 (31)	36 (69)	44 (100)
Community Activities	03 (75)	01 (25)	04 (100)
Unspecified	08 (18)	36 (82)	44 (100)
TOTAL	128 (20)	516 (80)	644 (100)

Note: Figures in parenthesis are the percentages in each category.

The above shows that out of a total of 644 business establishments, 516 (80 percent) were established after the Lunugamvehera project. Out of 135 manufacturing and processing units, 106 were rice mills. Of the 106 rice mills, 84 were established after the project.

Over 80 percent (305) of the Business and Trade activities were established after 1985. A majority of these business activities are groceries (224) and shops (67). Of this number, 52 shops and 189 groceries were established after the project. Supporting services has increased more than four fold after the project. Bicycle and motor repair shops were the most common businesses under this category. Personal services have also increased more than three fold after the project. Barber shops were the most common businesses under this category.

The major negative impact of the project has been identified as the losses in prawn fisheries in the adjacent lagoons. Prawn fishery has been almost wiped out in the Malala lagoon. The number of prawn fishermen has been reduced from 400 before the project to less than 10 at present. The losses have been estimated to be between 3-5 million rupees annually. Salinity has also cropped up in pockets of the old areas, due to salts being leached into this area from the newly irrigated area. The resulting losses have been estimated at Rs. 1 million annually.

10.7 Conclusion

The economic rate of return of this project is estimated at 6.22 percent and is just marginally above the economic discount rate of 6.0 percent worked out for Sri Lanka. The overall impact of the project in terms of, social and indirect benefits could be higher. The possibility of future improvement of the water regime is another factor that should be considered. The project area has experienced a prolonged period of water shortage, due apparently to changes in weather patterns. Experience over the last few years seem to suggest that this pattern is changing gradually with the possibility of improvement in water availability to the project over the next decade or so. Better use of the drainage water (estimates of drainage flows were much lower than currently measured quantities), reduction in the very high water duty for paddy in the new area (estimated at 8 acre feet/acre) and improved water management, as well as diversification to water saving crops are all likely to increase cropped area and thus enhance project benefits.

Annex 10.1 *Tables*

Table A-10.1 *Sectoral, aggregate and primary input conversion factors*

SECTORAL, AGGREGATE AND PRIMARY INPUT CONVERSION FACTORS

Aggregate Conversion Factors	
Average Conversion Factor	0.785
Investment Conversion Factor	0.906
Agriculture Conversion Factor	0.785
Infrastructure Conversion Factor	1.115
Consumption CF - Surplus	0.906
Consumption CF - Scarce	0.732

Primary Input Conversion Factors	
Foreign exchange	1.000
Transfers	0.000
Surplus labour	0.722
Scarce labour	0.785
Capital charges	0.906
Surplus profit	0.000

Economic Discount Rate	6%

Sectoral Conversion Factors	
Tea	1.080
Rubber products	1.294
Coconut products	1.100
Paddy	0.697
Other food crops	0.870
Livestock	0.774
Forestry	0.841
Firewood	0.787
Other Agriculture	0.723
Gems	1.002
Cement	0.746
Food processing	0.775
Textiles	0.665
Garments	1.004
Machinery & equipment	0.776
Chemicals & petroleum products	0.650
Metal products	0.717
Other Manufacture	0.791
Gas	0.598
Non-residential construction	1.050
Electricity	1.572
Road Transport	0.814
Rail Transport	4.534
Communications	0.924
Trade	0.579
Water & sewerage	2.517
Financial services	0.649
Other services	0.578

Source : Report on Shadow Prices for Sri Lanka, Development and Project Planning Centre, Bradford University UK, May 1991.

Table A-10.2 Rice prices

RICE PRICES

	1976	1977	1978	1979	1980	1981	1982	1983
Rice Price* (US$/MT)	250	265	360	340	435	478	295	265
Quality Adjustment 0.8	175	185.5	252	238	304.5	334.6	206.5	185.5
Freight / Insurance	20	20	20	20	21	21	21	21
CIF Colombo	195	205.5	272	258	325.5	355.6	227.5	206.5
Exchange Rate Rs=US$	8	9	14.95	15.45	18	21.55	21.32	25
In Country Costs Rs/MT	1560.00	1849.50	4066.40	3986.10	5859.00	7663.18	4850.30	5162.50
Port Charges	36.74	43.56	95.76	93.87	137.98	180.47	114.22	121.58
Handling	24.51	29.06	63.90	62.64	92.07	120.42	76.22	81.12
Transport to Warehouse	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00
Transport to Project Site	104.76	104.76	104.76	104.76	104.76	104.76	104.76	104.76
Storage	10.99	10.99	10.99	10.99	10.99	10.99	10.99	10.99
FG Rice Price Rs/MT	1700.26	1994.31	4246.05	4164.48	6066.82	7899.35	5042.26	5359.37
Processing Ratio 0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
FG Paddy Price Rs/MT	1156.18	1356.13	2887.31	2831.85	4125.43	5371.55	3428.74	3644.37
Economic FG Price Rs/Kg	1.16	1.36	2.89	2.83	4.13	5.37	3.43	3.64
Financial FG Price Rs/Kg	1.82	1.78	1.91	1.99	2.78	3.14	3.54	3.68

*Thai 5% broken , FOB Bangkok , FG - Farmgate , MT - Metric Tonne.

Sources: The Economist Book of Vital World Statistics - 1990.
World Bank , International Economic Dept. Int. Trade Div , Aug 1992
FAO Commodity Review 92/93 and 93/94

RICE PRICES

	1984	1985	1986	1987	1988	1989	1990	1991
Rice Price* (US$/MT)	250	216	205	240	301	320	287	314
Quality Adjustment 0.8	175	151.2	143.5	168	210.7	224	200.9	219.8
Freight / Insurance	21	21	21	20	22	21	22	21
CIF Colombo	196	172.2	164.5	188	232.7	245	222.9	240.8
Exchange Rate Rs=US$	26.28	27.41	28.52	30.76	33.03	40	40.24	42.58
In Country Costs Rs/MT	5150.88	4720.00	4691.54	5782.88	7686.08	9800.00	8969.50	10253.26
Port Charges	121.30	111.16	110.49	136.19	181.01	230.79	211.23	241.46
Handling	80.94	74.17	73.72	90.87	120.78	153.99	140.94	161.12
Transport to Warehouse	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00
Transport to Project Site	104.76	104.76	104.76	104.76	104.76	104.76	104.76	104.76
Storage	10.99	10.99	10.99	10.99	10.99	10.99	10.99	10.99
FG Rice Price Rs/MT	5347.57	4909.92	4881.01	5989.50	7922.61	10069.74	9226.19	10530.13
Processing Ratio 0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
FG Paddy Price Rs/MT	3636.35	3338.75	3319.09	4072.86	5387.37	6847.43	6273.81	7160.49
Economic FG Price Rs/Kg	3.64	3.34	3.32	4.07	5.39	6.85	6.27	7.16
Financial FG Price Rs/Kg	3.7	3.91	3.48	4.26	4.42	5.63	7.1	7.67

*Thai 5% broken , FOB Bangkok , FG - Farmgate , MT - Metric Tonne.

Sources: The Economist Book of Vital World Statistics - 1990.
World Bank , International Economic Dept. Int. Trade Div , Aug 1992
FAO Commodity Review 92/93 and 93/94

RICE PRICES

	1992	1993	1994	1995	1996	2000	2005
			---Projections---				
Rice Price* (US$/MT)	277	249	289	305	320	355	400
Quality Adjustment 0.8	193.9	174.3	202.3	213.5	224	248.5	280
Freight / Insurance	23	23	23	24	24	26	30
CIF Colombo	216.9	197.3	225.3	237.5	248	274.5	310
Exchange Rate Rs=US$	46	49.56	49.2	49.2	49.2	49.2	49.2
In Country Costs Rs/MT	9977.40	9778.19	11084.76	11685.00	12201.60	13505.40	15252.00
Port Charges	234.97	230.28	261.05	275.18	287.35	318.05	359.18
Handling	156.78	153.65	174.18	183.62	191.73	212.22	239.67
Transport to Warehouse	157.00	157.00	157.00	157.00	157.00	157.00	157.00
Transport to Project Site	104.76	104.76	104.76	104.76	104.76	104.76	104.76
Storage	10.99	10.99	10.99	10.99	10.99	10.99	10.99
FG Rice Price Rs/MT	10249.93	10047.59	11374.69	11984.36	12509.08	13833.37	15607.41
Processing Ratio 0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
FG Paddy Price Rs/MT	6969.95	6832.36	7734.79	8149.37	8506.18	9406.69	10613.04
Economic FG Price Rs/Kg	6.97	6.83	7.73	8.15	8.51	9.41	10.61
Financial FG Price Rs/Kg	7.43	7.5	7.5	7.5	7.5	7.5	7.5

*Thai 5% broken , FOB Bangkok , FG - Farmgate , MT - Metric Tonne.

Sources: The Economist Book of Vital World Statistics - 1990.
World Bank , International Economic Dept. Int. Trade Div , Aug 1992
FAO Commodity Review 92/93 and 93/94

Table A-10.3 Fertilizer prices

FERTILIZER PRICES

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Projections 1994	1995	2000	2005
Exchange Rate US $ = R	8.08	9.80	14.85	15.45	18.00	21.55	21.32	25.00	26.28	27.41	28.52	30.78	33.03	40.00	40.24	42.58	46.00	49.56	49.20	49.20	49.20	49.20
IMPORT PRICES CIF, Colombo																						
UREA (US $ / MT)	213.97	181.05	200.48	173.00	196.00	258.00	215.00	200.00	183.60	148.00	114.00	116.00	156.00	153.00	162.00	192.00	175.00	144.00	201	207	232	231
(Rs/Kg)	1.71	1.63	3.00	2.67	3.53	6.56	4.58	5.00	4.83	4.06	3.25	3.57	5.15	6.12	6.52	8.18	8.05	7.14	9.87	10.17	11.43	11.36
TSP (US $ / MT)	232.75	179.10	183.57	183.00	203.00	270.00	175.00	142.00	184.00	184.00	162.00	182.00	207.00	179.00	178.08	187.00	189.00	166.00	175	179	183	188
(Rs/Kg)	1.86	1.81	2.74	2.83	3.65	6.01	3.73	3.55	4.84	5.04	4.62	5.60	6.84	7.18	7.16	7.96	8.69	8.23	8.61	8.83	9.00	9.24
MOP (US $ / MT)	194.54	150.03	123.25	145.00	161.84	168.00	156.00	125.00	148.00	127.00	120.00	112.00	114.00	120.00	160.00	180.00	174.00	151.00	148	147	148	165
(Rs/Kg)	1.56	1.43	1.84	2.26	2.91	3.62	3.33	3.13	3.89	3.48	3.42	3.45	3.77	4.80	6.44	7.66	8.00	7.48	7.10	7.21	7.28	7.62
NPK (US $ / MT)	208.44	185.28	111.54	171.35	190.07	234.00	185.00	168.00	160.00	160.00	145.00	140.00	154.00	153.00	156.00	197.00	185.00	166.00				
(Rs/Kg)	1.67	1.67	1.67	2.65	3.42	5.04	3.94	4.20	4.20	4.39	4.14	4.31	5.09	6.12	6.28	8.39	8.51	8.23	0.00	0.00	0.00	0.00
V1 Mixture ($ / Kg)	0.22	0.18	0.17	0.17	0.19	0.25	0.17	0.14	0.18	0.17	0.15	0.16	0.18	0.16	0.17	0.19	0.18	0.16	0.17	0.17	0.18	0.18
V1 Mixture (Rs / Kg)	1.78	1.58	2.58	2.60	3.48	5.46	3.72	3.59	4.63	4.62	4.24	4.95	6.03	6.56	6.95	7.92	8.49	7.97	8.42	8.61	8.88	9.09
TDM Mixture ($ / Kg)	0.21	0.17	0.17	0.16	0.18	0.23	0.20	0.17	0.17	0.14	0.12	0.11	0.14	0.14	0.16	0.19	0.17	0.15	0.18	0.19	0.20	0.21
TDM Mixture (Rs/Kg)	1.66	1.56	2.61	2.63	3.32	4.91	4.16	4.37	4.51	3.86	3.31	3.53	4.69	5.66	6.49	8.00	8.03	7.25	8.97	9.18	10.04	10.16
GDP Deflator (Agric. Se	0.08	0.10	0.11	0.12	0.15	0.20	0.22	0.29	0.36	0.37	0.40	0.43	0.48	0.52	0.69	0.81	0.90	1.00	1.00	1.00	1.00	1.00
Local Costs Rs/Kg	0.22	0.25	0.29	0.31	0.40	0.51	0.58	0.75	0.94	0.96	1.04	1.12	1.25	1.37	1.79	2.11	2.34	2.61	2.61	2.61	2.61	2.61
Transport to Project Sit (Rs/Kg)	0.04	0.04	0.05	0.05	0.07	0.09	0.10	0.13	0.16	0.17	0.18	0.20	0.22	0.24	0.31	0.37	0.41	0.46	0.46	0.46	0.46	0.46
Economic/Financial Prices (Rs/Kg)																						
Urea Economic Price	1.91	1.88	3.26	2.86	3.90	6.04	5.13	5.70	5.70	4.85	4.21	4.01	6.31	7.30	8.18	10.13	10.22	9.54	[illegible]	[illegible]	[illegible]	[illegible]
Urea Financial Price	1.99	1.85	1.67	1.83	1.85	2.23	2.69	2.96	3.01	3.02	3.03	3.05	3.07	3.09	8.31	10.47	10.26	10.31				
TSP Economic Price	2.06	1.85	3.01	3.12	4.03	6.40	4.27	4.25	5.71	5.93	5.58	6.64	8.09	8.43	8.82	9.92	10.86	10.66	11.03	11.25	11.42	11.68
TSP Financial Price	1.38	1.29	2.03	1.39	1.41	2.15	2.79	2.88	3.01	3.02	3.03	3.05	2.87	3.89	10.06	10.87	10.71	10.78				
MOP Economic Price	1.76	1.66	2.11	2.55	3.29	4.10	3.87	3.82	4.76	4.37	4.38	4.48	4.83	6.07	8.10	9.62	10.17	9.90	9.61	9.63	9.70	10.04
MOP Financial Price	1.16	1.07	1.38	1.12	1.14	2.32	3.00	2.88	2.91	2.92	2.93	2.95	2.97	3.78	8.51	9.87	9.91	9.96				
NPK Economic Price	1.87	1.90	1.93	2.94	3.78	5.52	4.49	4.90	5.08	5.28	5.10	5.35	6.25	7.39	7.94	10.35	10.68	10.65	2.42	2.42	2.42	2.42
NPK Financial Price	1.24	1.24	1.25	1.39	1.32	2.23	2.89	3.83	3.46	3.47	3.48	3.50	3.72	4.54	8.51	10.77	10.81	10.86				
V1 Economic Price	1.98	1.81	2.84	2.68	3.86	5.94	4.29	4.29	5.50	5.51	5.20	5.99	7.19	7.83	8.91	9.88	10.66	10.39	10.84	11.03	11.28	11.51
V1 Financial Price	1.41	1.27	1.98	1.41	1.42	2.31	2.95	3.07	3.10	3.11	3.12	3.13	3.02	3.98	9.68	10.59	10.61	10.65				
TDM Economic Price	1.88	1.80	2.88	2.82	3.88	5.38	4.78	5.07	5.38	4.75	4.27	4.57	5.85	6.94	8.15	9.96	10.20	9.67	11.39	11.60	12.46	12.52
TDM Financial Price	1.22	1.16	1.81	1.17	1.18	2.37	3.04	3.08	3.09	3.08	3.11	3.12	3.15	3.97	8.49	10.38	10.25	10.30				

Sources : Sri Lanka Fertilizer Secretariat (1981-1993) ; World Bank , International Department (1977-1992) ;
Local and Transport Costs estimated using 1992 prices and deflated by GDP Agriculture Sector deflator.
Local Urea Plant closed October 1985 . Fertilizer subsidy removed completely in January 1990.
Projected Prices for 1994 - 2005 based on constant 1993 prices.
Local and Transport Costs adjusted by conversion factors of 0.785 and 0.914 respectively to estimate economic price.

Table A-10.4 *Cost of production of paddy*

COST OF PRODUCTION OF PADDY

Paddy Cost of Production	Maha 76/77	Yala 77	Maha 77/78	Yala 86	Maha 86/87	Yala 87	Maha 92/93	Yala 93	Maha 93/94
Hired Labor (MD)	92.70	97.00	102.00	69.00	51.30	64.10	64.90	37.20	61.00
Family Labor (MD)	37.00	39.00	41.00	19.40	30.00	38.10	42.20	42.00	21.00
Total Labor (MD)	129.70	136.00	143.00	88.40	81.30	102.20	107.10	79.20	82.00
Wage Rate (Rs/MD)	9.50	10.00	11.00	44.45	49.54	46.36	121.92	122.00	122.00
Total Labor Cost (Rs)	1232.15	1360.00	1573.00	3929.38	4027.60	4737.99	13057.63	9662.40	10004.00
Economic Labor Cost (Rs)	889.61	981.92	1135.71	2637.01	2907.93	3420.83	9427.61	6976.25	7222.89
FW Tractor Cost (Rs)	306.00	336.00	360.00	334.00	0.00	599.00	1962.00	1119.00	1416.00
TW Tractor Cost (Rs)	299.00	328.00	370.00	1268.00	1906.80	1287.00	2292.00	2976.40	3537.00
Sprayer Hire Cost (Rs)	0.00	0.00	0.00	0.00	0.00	171.70	230.80	0.00	59.00
Total Machinery Cost (Rs)	605.00	664.00	730.00	1602.00	1906.80	2057.70	4484.80	4095.40	5012.00
Economic Machinery Cost (Rs)	469.48	515.26	566.48	1243.15	1479.68	1596.78	3480.20	3178.03	3889.31
Seed Rate (Kg)	103.00	104.00	114.00	114.00	132.30	146.30	126.60	216.30	120.00
Price (Rs/Kg)	2.14	2.14	2.15	4.45	4.60	4.52	11.10	11.71	11.50
Seed Cost (Rs)	220.42	222.56	245.10	507.30	608.58	661.28	1405.26	2532.87	1380.00
Economic Seed Cost (Rs)	191.77	193.63	213.24	441.35	529.46	575.31	1222.58	2203.60	1200.60
Basal Fertilizer (Kg/Ha)	126.00	124.00	120.00	138.00	139.60	150.90	123.50	121.00	120.50
Price (Rs/Kg)	1.26	1.24	1.34	3.03	2.97	3.00	10.36	10.58	11.00
Cost (Rs)	158.76	153.76	160.80	418.14	414.61	452.70	1279.46	1280.18	1325.50
Economic Price (Rs/Kg)	1.81	1.81	2.84	5.20	5.99	5.99	10.39	10.39	10.84
Urea (Kg/Ha)	126.00	112.00	130.00	152.00	120.71	150.90	88.90	215.00	118.00
Price (Rs/Kg)	1.04	1.00	0.98	2.93	2.94	2.92	10.27	10.24	10.28
Cost (Rs)	131.04	112.00	127.40	445.36	354.89	440.63	913.00	2201.60	1213.04
Economic Price (Rs/Kg)	1.86	1.86	3.26	4.21	4.61	4.61	9.56	9.56	12.29
TDM (Kg/Ha)	100.00	112.00	112.00	139.60	132.00	140.84	118.60	123.50	124.00
Price (Rs/Kg)	1.10	1.10	1.11	3.03	3.01	2.98	10.40	10.66	10.70
Cost (Rs)	110.00	123.20	124.32	422.99	397.32	419.70	1233.44	1316.51	1326.80
Economic Price (Rs/Kg)	1.80	1.80	2.88	4.27	4.57	4.57	9.67	9.67	11.38
Total Fertilizer Cost (Rs)	399.80	388.96	412.52	1286.49	1166.82	1313.03	3425.90	4798.29	3865.34
Economic Fertilizer Cost (Rs)	642.42	634.36	1087.16	1963.61	1996.92	2243.18	3279.91	4506.84	4167.56
Weedicides									
Cost (Rs)	49.00	54.00	74.00	648.80	742.20	653.30	1511.20	1514.00	1323.00
Pesticides									
Cost (Rs)	70.00	77.00	70.00	505.50	570.30	569.60	1490.00	830.00	1287.00
Total Chemical Cost (Rs)	119.00	131.00	144.00	276.00	347.68	346.91	3001.20	2344.00	2610.00
Total Economic Chemical Cost(Rs)	77.35	85.15	93.60	179.40	225.99	225.49	1950.78	1523.60	1696.50
Misc Input Cost (Rs)	106.00	116.00	119.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Material Inputs (Rs)	845.22	857.52	920.62	2948.09	3087.90	3197.21	7832.36	9675.16	7856.34
Economic Input Cost (Rs)	911.54	913.14	1394.00	3145.26	3378.51	3613.37	6453.27	8234.03	7064.66
Transport Costs (Rs)	0.00	0.00	0.00	0.00	196.70	240.00	0.00	210.00	353.00
Economic Transport Cost (Rs)	0.00	0.00	0.00	0.00	165.42	201.84	0.00	176.61	296.87
Total COP (Rs/Ha)	2682.37	2881.52	3223.62	8479.47	9219.00	10232.90	25374.80	23642.96	23224.34
Economic COP (Rs/Ha)	2270.63	2410.32	3096.18	7225.42	7931.54	8632.82	19381.06	18564.93	18473.73
Yield (Kg/Ha)	3113.00	2802.00	2910.00	4261.00	4295.00	4079.00	4423.00	4098.00	3800.00
Price(Rs/Kg)	1.78	1.84	1.88	3.45	3.72	3.78	7.40	7.29	7.50
Economic Price (Rs/Kg)	1.36	1.36	2.89	3.32	4.07	4.07	6.83	6.83	7.73
Gross Return (Rs/Ha)	5541.14	5155.68	5470.80	14700.45	15977.40	15418.62	32730.20	29874.42	28500.00
Gross Economic Return (Rs/Ha)	4221.64	3799.88	8402.08	14142.63	17492.93	16413.19	30219.53	27999.01	29392.20
Net Return (Rs/Ha)	2858.77	2274.16	2247.18	6220.98	6758.40	5185.72	7355.41	6231.46	5275.66
Net Economic Return (Rs/Ha)	1951.01	1389.56	5305.89	6917.21	9561.39	7780.37	10858.45	9434.08	10918.47

Sources : Department of Agriculture, Cost of Production Studies 1978 - 1993
Surveys, Ruhunu University, 1994
Study Estimates , IIMI , 1994

Table A-10.5 Economic and financial prices of selected commodities

Economic and Financial Prices of Selected Commodities								
		Maize		Sorghum		Soy Bean		
Year	Exchange Rate US$=SLRs	Economic Price Rs/Kg	Financial Price Rs/Kg	Economic Price Rs/Kg	Financial Price Rs/Kg	Economic Price Rs/Kg	Financial Price Rs/Kg	
1980	18	2.25	1.29	2.32	4.23	5.33	4.4	
1985	27.41	3.07	3.35	2.82	7.25	6.14	5.03	
1988	33.03	3.53	3.49	3.36	12.56	10.04	11.77	
1989	40	5.78	4.07	4.24	14	11.00	11.84	
1990	40.24	4.39	6.11	4.18	15.66	9.94	15.8	
1991	42.58	4.56	5.67	4.47	12.31	10.22	12.42	
1992	46	5.11	7.05	4.87	13.5	11.22	15.12	

Sources : Department of Census & Statistics 1980 - 1992
Central Bank Reports
AR&TI Data Bank 1983-1992
World Bank , International Economics Department , 1992

Table A-10.5 Economic and financial prices of selected commodities

Economic and Financial Prices of Selected Commodities

		Paddy		Urea		Basal V1		TDM Mixture	
Year	Exchange Rate US$=SLRs	Economic Price Rs/Kg	Financial Price Rs/Kg	Economic Price Rs/Kg	Financial Price Rs/Kg	Economic Price Rs/Kg	Financial Price Rs/Kg	Economic Price Rs/Kg	Financial Price Rs/Kg
1980	18	4.83	2.78	3.89	1.05	3.85	1.42	3.69	1.18
1985	27.41	3.97	3.91	4.94	3.01	5.5	3.1	4.75	3.09
1988	33.03	6.35	4.42	6.31	3.06	7.18	3.01	5.84	3.1
1989	40	8.02	5.63	7.38	3.88	7.82	3.97	6.94	3.96
1990	40.24	7.36	7.1	8.17	8.31	8.6	9.68	8.15	8.48
1991	42.58	8.39	7.67	10.13	10.46	9.87	10.58	9.96	10.37
1992	46	8.16	7.43	10.21	10.25	10.65	10.6	10.2	10.25

Sources : Department of Census & Statistics 1980 - 1992
Central Bank Reports
AR&TI Data Bank 1983-1992
World Bank , International Economics Department , 1992

Table A-10.6 Deflators and exchange rates

DEFLATORS AND EXCHANGE RATES			
Year	Sri Lanka GDP Agric. Deflator	Exch. Rate US$=SLRs	MUV Index
1978	0.11	14.95	1.954416
1979	0.12	15.45	1.725771
1980	0.15	18.00	1.573444
1981	0.20	21.55	1.567021
1982	0.22	21.32	1.591496
1983	0.29	25.00	1.628552
1984	0.36	26.28	1.664012
1985	0.37	27.41	1.650700
1986	0.40	28.52	1.399966
1987	0.43	30.76	1.274573
1988	0.48	33.03	1.188067
1989	0.52	40.00	1.196420
1990	0.69	40.24	1.132323
1991	0.81	42.58	1.109789
1992	0.90	46.00	1.079524
1993	1.00	49.56	1.039026
1994-2040	1.00	49.20	1.000000

Table A-10.7 Net benefit flow - base case - current prices (Rs. 000)

NET BENEFIT FLOW - BASE CASE - CURRENT PRICES (Rs. 000)						
Year	Net Fin. Ret. - OIA	Net Econ. Ret. - OIA	Net Fin. Ret. - NIA	Net Econ. Ret. - NIA	Net Total Fin. Ret.	Net Total Econ. Ret.
1978	(840)	(736)	(3,412)	(2,818)	(4,252)	(3,554)
1979	(6,383)	(5,154)	(12,044)	(9,719)	(18,427)	(14,873)
1980	(30,350)	(23,951)	(56,613)	(44,676)	(86,962)	(68,627)
1981	(29,272)	9,246	(89,526)	(71,886)	(118,797)	(62,640)
1982	(37,657)	(14,681)	(126,034)	(101,087)	(163,691)	(115,767)
1983	(69,742)	(43,110)	(171,978)	(137,815)	(241,720)	(180,925)
1984	(111,987)	(82,190)	(228,281)	(183,109)	(340,268)	(265,299)
1985	(136,087)	(98,506)	(283,162)	(225,363)	(419,249)	(323,869)
1986	(60,344)	(39,754)	(164,447)	(131,139)	(224,791)	(170,893)
1987	(29,570)	(11,426)	(98,772)	(73,311)	(128,342)	(84,737)
1988	(13,768)	21,244	(77,678)	(38,114)	(91,446)	(16,869)
1989	13,044	35,840	(16,897)	18,181	(3,854)	54,022
1990	37,959	41,597	(56,814)	(45,891)	(18,856)	(4,295)
1991	67,847	85,406	5,299	35,152	73,145	120,558
1992	15,969	22,859	(18,974)	(14,267)	(3,005)	8,592
1993	23,262	25,066	(53,697)	(34,272)	(30,435)	(9,206)
1994	33,129	43,587	4,428	31,887	37,556	75,475
1995	80,479	112,561	45,688	89,763	126,167	202,324
1996	94,631	136,700	54,614	108,676	149,245	245,376
1997	108,780	152,773	63,354	118,546	172,134	271,319
1998	122,925	168,843	72,309	128,594	195,234	297,438
1999	137,067	184,909	81,079	138,486	218,146	323,395
2000	151,205	226,894	90,066	174,273	241,271	401,167
2001	165,340	244,667	98,732	185,124	264,071	429,791
2002	179,471	262,435	107,601	196,145	287,072	458,580
2003	193,598	280,200	116,274	206,999	309,872	487,199
2004	207,722	297,960	125,150	218,024	332,872	515,984
2005	207,332	345,003	125,016	259,964	332,348	604,967
2006	206,937	344,546	125,086	259,932	332,023	604,479
2007	206,539	344,085	124,960	259,735	331,499	603,820
2008	206,137	343,619	125,038	259,708	331,176	603,327
2009	205,732	343,148	124,921	259,516	330,653	602,664
2010	205,704	343,107	125,240	259,758	330,945	602,865
2011	205,704	343,107	125,276	259,779	330,981	602,886
2012	205,704	343,107	125,514	259,970	331,218	603,077
2013	205,704	343,107	125,554	259,993	331,258	603,101
2014	205,704	343,107	125,795	260,187	331,499	603,294
2015	205,704	343,107	125,838	260,214	331,542	603,321
2016	205,704	343,107	143,983	275,464	349,687	618,571
2017	205,704	343,107	144,129	275,577	349,834	618,684
2018	205,704	343,107	144,278	275,692	349,982	618,799
2019	205,704	343,107	144,428	275,808	350,132	618,915
2020	205,704	343,107	144,580	275,926	350,285	619,033
2021	205,704	343,107	144,734	276,045	350,439	619,152
2022	205,704	343,107	144,890	276,166	350,594	619,273
2023	205,704	343,107	145,048	276,288	350,752	619,395
2024	205,704	343,107	145,208	276,412	350,912	619,519
2025	205,704	343,107	145,370	276,537	351,074	619,644
2026	205,704	343,107	145,533	276,664	351,238	619,771
2027	205,704	343,107	145,699	276,792	351,404	619,899
2028	205,704	343,107	145,867	276,922	351,571	620,029
2029	205,704	343,107	146,037	277,054	351,741	620,161
2030	205,704	343,107	146,209	277,187	351,913	620,294
2031	205,704	343,107	146,383	277,321	352,087	620,429
2032	205,704	343,107	146,559	277,458	352,264	620,565
2033	205,704	343,107	146,738	277,596	352,442	620,703
2034	205,704	343,107	146,918	277,736	352,623	620,843
2035	205,704	343,107	147,101	277,877	352,806	620,984
2036	205,704	343,107	129,286	262,883	334,991	605,990
2037	205,704	343,107	129,474	263,028	335,178	606,135
2038	205,704	343,107	129,663	263,174	335,368	606,281
2039	205,704	343,107	129,855	263,323	335,559	606,430
2040	205,704	343,107	130,049	263,473	335,754	606,580

Negative values in paranthesis

Table A-10.8 Net benefit flow - alternate case - current prices (Rs. 000)

NET BENEFIT FLOW - ALTERNATE CASE - CURRENT PRICES (Rs. 000)						
Year	Net Fin. Ret. - OIA	Net Econ. Ret. - OIA	Net Fin. Ret. - NIA	Net Econ. Ret. - NIA	Net Total Fin. Ret.	Net Total Econ. Ret.
1978	(840)	(736)	(3,412)	(2,818)	(4,252)	(3,554)
1979	(6,383)	(5,154)	(12,044)	(9,719)	(18,427)	(14,873)
1980	(30,350)	(23,951)	(56,613)	(44,676)	(86,962)	(68,627)
1981	(29,272)	9,246	(89,526)	(71,886)	(118,797)	(62,640)
1982	(37,657)	(14,681)	(126,034)	(101,087)	(163,691)	(115,767)
1983	(69,742)	(43,110)	(171,978)	(137,815)	(241,720)	(180,925)
1984	(111,987)	(82,190)	(228,281)	(183,109)	(340,268)	(265,299)
1985	(136,087)	(98,506)	(283,162)	(225,363)	(419,249)	(323,869)
1986	(60,344)	(39,754)	(164,447)	(131,139)	(224,791)	(170,893)
1987	(29,570)	(11,426)	(98,772)	(73,311)	(128,342)	(84,737)
1988	(13,768)	21,244	(77,678)	(38,114)	(91,446)	(16,869)
1989	13,044	35,840	(16,897)	18,181	(3,854)	54,022
1990	37,959	41,597	(56,814)	(45,891)	(18,856)	(4,295)
1991	67,847	85,406	5,299	35,152	73,145	120,558
1992	15,969	22,859	(18,974)	(14,267)	(3,005)	8,592
1993	23,262	25,066	(53,697)	(34,272)	(30,435)	(9,206)
1994	33,129	43,587	4,428	31,887	37,556	75,475
1995	89,912	108,401	43,613	74,302	133,525	182,703
1996	101,941	127,935	50,195	88,128	152,136	216,063
1997	113,968	141,598	56,591	95,335	170,559	236,933
1998	125,991	155,257	63,203	102,721	189,194	257,978
1999	138,011	168,913	69,630	109,952	207,642	278,865
2000	150,029	202,139	76,275	136,065	226,304	338,203
2001	162,043	217,245	82,599	143,971	244,643	361,216
2002	174,055	232,349	89,127	152,048	263,182	384,397
2003	186,063	247,448	95,460	159,960	281,523	407,408
2004	198,069	262,545	101,996	168,042	300,065	430,587
2005	197,737	299,249	101,927	198,564	299,664	497,813
2006	197,401	298,860	102,062	198,608	299,464	497,469
2007	197,063	298,468	102,002	198,488	299,065	496,955
2008	196,722	298,072	102,147	198,538	298,869	496,610
2009	196,377	297,672	102,097	198,423	298,474	496,096
2010	196,353	297,637	102,421	198,672	298,774	496,309
2011	196,353	297,637	102,457	198,693	298,810	496,330
2012	196,353	297,637	102,695	198,884	299,048	496,521
2013	196,353	297,637	102,734	198,908	299,088	496,545
2014	196,353	297,637	102,976	199,101	299,329	496,739
2015	196,353	297,637	103,019	199,128	299,372	496,765
2016	196,353	297,637	121,163	214,378	317,517	512,015
2017	196,353	297,637	121,310	214,492	317,663	512,129
2018	196,353	297,637	121,458	214,606	317,812	512,244
2019	196,353	297,637	121,609	214,723	317,962	512,360
2020	196,353	297,637	121,761	214,840	318,114	512,478
2021	196,353	297,637	121,915	214,960	318,268	512,597
2022	196,353	297,637	122,071	215,080	318,424	512,718
2023	196,353	297,637	122,229	215,203	318,582	512,840
2024	196,353	297,637	122,388	215,326	318,742	512,963
2025	196,353	297,637	122,550	215,451	318,904	513,089
2026	196,353	297,637	122,714	215,578	319,067	513,215
2027	196,353	297,637	122,880	215,707	319,233	513,344
2028	196,353	297,637	123,048	215,836	319,401	513,474
2029	196,353	297,637	123,218	215,968	319,571	513,605
2030	196,353	297,637	123,390	216,101	319,743	513,738
2031	196,353	297,637	123,564	216,236	319,917	513,873
2032	196,353	297,637	123,740	216,372	320,093	514,009
2033	196,353	297,637	123,918	216,510	320,272	514,148
2034	196,353	297,637	124,099	216,650	320,452	514,287
2035	196,353	297,637	124,282	216,792	320,635	514,429
2036	196,353	297,637	106,467	201,797	302,820	499,434
2037	196,353	297,637	106,654	201,942	303,008	499,579
2038	196,353	297,637	106,844	202,089	303,197	499,726
2039	196,353	297,637	107,036	202,237	303,389	499,874
2040	196,353	297,637	107,230	202,388	303,583	500,025

Negative values in paranthesis

Table A-10.9 Net benefit flow - base case - constant 1994 prices (US$ 000)

NET BENEFIT FLOW - BASE CASE - CONSTANT 1994 PRICES (US$ 000)						
Year	Net Fin. Ret. - OIA	Net Econ. Ret. - OIA	Net Fin. Ret. - NIA	Net Econ. Ret. - NIA	Net Total Fin. Ret.	Net Total Econ. Ret.
1978	(110)	(96)	(446)	(368)	(556)	(465)
1979	(713)	(576)	(1,345)	(1,086)	(2,058)	(1,661)
1980	(2,653)	(2,094)	(4,949)	(3,905)	(7,602)	(5,999)
1981	(2,128)	672	(6,510)	(5,227)	(8,638)	(4,555)
1982	(2,811)	(1,096)	(9,408)	(7,546)	(12,219)	(8,642)
1983	(4,543)	(2,808)	(11,203)	(8,978)	(15,746)	(11,786)
1984	(7,091)	(5,204)	(14,454)	(11,594)	(21,545)	(16,798)
1985	(8,196)	(5,932)	(17,053)	(13,572)	(25,248)	(19,504)
1986	(2,962)	(1,951)	(8,072)	(6,437)	(11,034)	(8,389)
1987	(1,225)	(473)	(4,093)	(3,038)	(5,318)	(3,511)
1988	(495)	764	(2,794)	(1,371)	(3,289)	(607)
1989	390	1,072	(505)	544	(115)	1,616
1990	1,068	1,170	(1,599)	(1,291)	(531)	(121)
1991	1,768	2,226	138	916	1,906	3,142
1992	375	536	(445)	(335)	(71)	202
1993	488	526	(1,126)	(719)	(638)	(193)
1994	673	886	90	648	763	1,534
1995	1,636	2,288	929	1,824	2,564	4,112
1996	1,923	2,778	1,110	2,209	3,033	4,987
1997	2,211	3,105	1,288	2,409	3,499	5,515
1998	2,498	3,432	1,470	2,614	3,968	6,045
1999	2,786	3,758	1,648	2,815	4,434	6,573
2000	3,073	4,612	1,831	3,542	4,904	8,154
2001	3,361	4,973	2,007	3,763	5,367	8,736
2002	3,648	5,334	2,187	3,987	5,835	9,321
2003	3,935	5,695	2,363	4,207	6,298	9,902
2004	4,222	6,056	2,544	4,431	6,766	10,487
2005	4,214	7,012	2,541	5,284	6,755	12,296
2006	4,206	7,003	2,542	5,283	6,748	12,286
2007	4,198	6,994	2,540	5,279	6,738	12,273
2008	4,190	6,984	2,541	5,279	6,731	12,263
2009	4,182	6,975	2,539	5,275	6,721	12,249
2010	4,181	6,974	2,546	5,280	6,727	12,253
2011	4,181	6,974	2,546	5,280	6,727	12,254
2012	4,181	6,974	2,551	5,284	6,732	12,258
2013	4,181	6,974	2,552	5,284	6,733	12,258
2014	4,181	6,974	2,557	5,288	6,738	12,262
2015	4,181	6,974	2,558	5,289	6,739	12,263
2016	4,181	6,974	2,926	5,599	7,107	12,573
2017	4,181	6,974	2,929	5,601	7,110	12,575
2018	4,181	6,974	2,932	5,603	7,113	12,577
2019	4,181	6,974	2,936	5,606	7,117	12,580
2020	4,181	6,974	2,939	5,608	7,120	12,582
2021	4,181	6,974	2,942	5,611	7,123	12,584
2022	4,181	6,974	2,945	5,613	7,126	12,587
2023	4,181	6,974	2,948	5,616	7,129	12,589
2024	4,181	6,974	2,951	5,618	7,132	12,592
2025	4,181	6,974	2,955	5,621	7,136	12,594
2026	4,181	6,974	2,958	5,623	7,139	12,597
2027	4,181	6,974	2,961	5,626	7,142	12,600
2028	4,181	6,974	2,965	5,628	7,146	12,602
2029	4,181	6,974	2,968	5,631	7,149	12,605
2030	4,181	6,974	2,972	5,634	7,153	12,608
2031	4,181	6,974	2,975	5,637	7,156	12,610
2032	4,181	6,974	2,979	5,639	7,160	12,613
2033	4,181	6,974	2,982	5,642	7,163	12,616
2034	4,181	6,974	2,986	5,645	7,167	12,619
2035	4,181	6,974	2,990	5,648	7,171	12,622
2036	4,181	6,974	2,628	5,343	6,809	12,317
2037	4,181	6,974	2,632	5,346	6,813	12,320
2038	4,181	6,974	2,635	5,349	6,816	12,323
2039	4,181	6,974	2,639	5,352	6,820	12,326
2040	4,181	6,974	2,643	5,355	6,824	12,329

Negative values in paranthesis

Table A-10.10 Net benefit flow - alternate case - constant 1994 prices (US$ 000)

NET BENEFIT FLOW - ALTERNATE CASE - CONSTANT 1994 PRICES (US$ 000)						
Year	Net Fin. Ret. - OIA	Net Econ. Ret. - OIA	Net Fin. Ret. - NIA	Net Econ. Ret. - NIA	Net Total Fin. Ret.	Net Total Econ. Ret.
1978	(110)	(96)	(446)	(368)	(556)	(465)
1979	(713)	(576)	(1,345)	(1,086)	(2,058)	(1,661)
1980	(2,653)	(2,094)	(4,949)	(3,905)	(7,602)	(5,999)
1981	(2,128)	672	(6,510)	(5,227)	(8,638)	(4,555)
1982	(2,811)	(1,096)	(9,408)	(7,546)	(12,219)	(8,642)
1983	(4,543)	(2,808)	(11,203)	(8,978)	(15,746)	(11,786)
1984	(7,091)	(5,204)	(14,454)	(11,594)	(21,545)	(16,798)
1985	(8,196)	(5,932)	(17,053)	(13,572)	(25,248)	(19,504)
1986	(2,962)	(1,951)	(8,072)	(6,437)	(11,034)	(8,389)
1987	(1,225)	(473)	(4,093)	(3,038)	(5,318)	(3,511)
1988	(495)	764	(2,794)	(1,371)	(3,289)	(607)
1989	390	1,072	(505)	544	(115)	1,616
1990	1,068	1,170	(1,599)	(1,291)	(531)	(121)
1991	1,768	2,226	138	916	1,906	3,142
1992	375	536	(445)	(335)	(71)	202
1993	488	526	(1,126)	(719)	(638)	(193)
1994	673	886	90	648	763	1,534
1995	1,827	2,203	886	1,510	2,714	3,713
1996	2,072	2,600	1,020	1,791	3,092	4,392
1997	2,316	2,878	1,150	1,938	3,467	4,816
1998	2,561	3,156	1,285	2,088	3,845	5,243
1999	2,805	3,433	1,415	2,235	4,220	5,668
2000	3,049	4,109	1,550	2,766	4,600	6,874
2001	3,294	4,416	1,679	2,926	4,972	7,342
2002	3,538	4,723	1,812	3,090	5,349	7,813
2003	3,782	5,029	1,940	3,251	5,722	8,281
2004	4,026	5,336	2,073	3,415	6,099	8,752
2005	4,019	6,082	2,072	4,036	6,091	10,118
2006	4,012	6,074	2,074	4,037	6,087	10,111
2007	4,005	6,066	2,073	4,034	6,079	10,101
2008	3,998	6,058	2,076	4,035	6,075	10,094
2009	3,991	6,050	2,075	4,033	6,067	10,083
2010	3,991	6,050	2,082	4,038	6,073	10,088
2011	3,991	6,050	2,082	4,038	6,073	10,088
2012	3,991	6,050	2,087	4,042	6,078	10,092
2013	3,991	6,050	2,088	4,043	6,079	10,092
2014	3,991	6,050	2,093	4,047	6,084	10,096
2015	3,991	6,050	2,094	4,047	6,085	10,097
2016	3,991	6,050	2,463	4,357	6,454	10,407
2017	3,991	6,050	2,466	4,360	6,457	10,409
2018	3,991	6,050	2,469	4,362	6,460	10,411
2019	3,991	6,050	2,472	4,364	6,463	10,414
2020	3,991	6,050	2,475	4,367	6,466	10,416
2021	3,991	6,050	2,478	4,369	6,469	10,419
2022	3,991	6,050	2,481	4,372	6,472	10,421
2023	3,991	6,050	2,484	4,374	6,475	10,424
2024	3,991	6,050	2,488	4,377	6,478	10,426
2025	3,991	6,050	2,491	4,379	6,482	10,429
2026	3,991	6,050	2,494	4,382	6,485	10,431
2027	3,991	6,050	2,498	4,384	6,488	10,434
2028	3,991	6,050	2,501	4,387	6,492	10,436
2029	3,991	6,050	2,504	4,390	6,495	10,439
2030	3,991	6,050	2,508	4,392	6,499	10,442
2031	3,991	6,050	2,511	4,395	6,502	10,445
2032	3,991	6,050	2,515	4,398	6,506	10,447
2033	3,991	6,050	2,519	4,401	6,510	10,450
2034	3,991	6,050	2,522	4,403	6,513	10,453
2035	3,991	6,050	2,526	4,406	6,517	10,456
2036	3,991	6,050	2,164	4,102	6,155	10,151
2037	3,991	6,050	2,168	4,105	6,159	10,154
2038	3,991	6,050	2,172	4,107	6,163	10,157
2039	3,991	6,050	2,176	4,111	6,166	10,160
2040	3,991	6,050	2,179	4,114	6,170	10,163

Negative values in paranthesis

Table A-10.11 OFC-area, production, costs and benefits

OFC- AREA, PRODUCTION, COSTS AND BENEFITS								
	BASE CASE - NEW AREA (NIA) #						ALTERNATE CASE	
							NIA	OIA
	1989	1990	1991	1992	1993	1994	1995-2040	1995-2040
Area Cultivated (Ha)								
OFC - 1	294	203	435	296	472.0	590.0	214.0	435.0
OFC - 2	76	70	1,671	125	996.0	901.0	321.0	532.0
Yield (MT/ Hectare)								
OFC - 1	1.1	1.3	1.3	1.4	1.5	1.5	2.0	2.0
OFC - 2	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0
Total Production (MT)								
OFC - 1	333	264	585	414	708	885	428	870
OFC - 2	61	56	1,337	100	797	721	321	532
Prices (Rs/Kg)								
OFC - 1	15	18	20	20	22	24	30	30
OFC - 2	11	14	16	18	19	20	22	22
Gross Returns (Rs 000)								
OFC - 1	4,995	4,750	11,698	8,288	15,576	21,240	12,480	26,100
OFC - 2	670	782	21,452	1,800	15,139	14,416	7,062	11,704
Cost of Production (Rs/Ha)								
OFC - 1	11,050	13,000	15,134	16,900	18,400	19,490	22,670	22,670
OFC - 2	5,613	7,770	8,524	9,500	10,200	10,560	12,560	12,560
Gross Costs (Rs 000)								
OFC - 1	3,249	2,639	6,583	5,002	8,685	11,499	4,852	9,862
OFC - 2	427	544	14,243	1,188	10,159	9,515	4,032	6,682
Total Net Returns (Rs 000)								
OFC - 1	1,746	2,111	5,115	3,286	6,891	9,741	7,988	16,238
OFC - 2	244	238	7,209	613	5,995	4,901	3,030	5,022
Net Returns (Rs/Ha)								
OFC - 1	5,939	10,400	11,760	11,100	14,600	16,510	37,330	37,330
OFC - 2	3,208	3,396	4,314	4,900	6,020	5,440	9,440	9,440

- OFC cultivation began in 1989 in the NIA.

All values in current SL rupees

Table A-10.12 Paddy production, yields and returns - OIA - base case - with project

PADDY- PRODUCTION, YIELDS AND RETURNS - OIA -BASE CASE - WITH PROJECT										
Year	Cropped Area (Ha)	Cropping Intensity	Yield (Mt/Ha)	Production (Mt)	COP (Rs/Ha) Fin. Prices	COP (Rs/Ha) Econ. Prices	Paddy Price Fin.(Rs/Kg)	Paddy Price Econ.(Rs/Kg)	Net Returns Fin. (Rs/Ha)	Net Returns Econ. (Rs/Ha)
1978	6,487	1.43	2.99	19,418	3,274	3,141	1.90	2.89	2,414	5,502
1979	6,525	1.43	2.83	18,445	3,868	3,665	2.09	2.83	2,040	4,340
1980	6,563	1.44	3.21	21,093	4,119	3,991	2.64	4.13	4,365	9,267
1981	6,601	1.45	4.01	26,451	5,752	6,083	3.32	5.37	7,551	15,442
1982	6,639	1.46	4.50	29,888	6,758	6,165	3.20	3.43	7,648	9,271
1983	6,677	1.47	4.10	27,400	8,945	7,873	3.24	3.64	4,351	7,082
1984	6,715	1.48	3.52	23,668	10,147	8,896	3.24	3.64	1,273	3,921
1985	6,678	1.47	4.07	27,170	9,999	8,629	3.59	3.34	4,607	4,955
1986	7,416	1.53	4.12	30,528	10,154	8,491	3.45	3.32	4,047	5,171
1987	7,388	1.53	4.21	31,068	9,640	8,305	3.78	4.07	6,257	8,822
1988	8,563	1.77	4.14	35,444	11,029	9,916	4.42	5.39	7,265	12,363
1989	8,205	1.70	4.16	34,095	14,341	15,340	5.98	6.85	10,507	13,113
1990	8,369	1.73	4.30	36,010	17,647	13,333	7.10	6.27	12,904	13,663
1991	8,972	1.85	4.46	40,025	21,149	16,153	7.38	7.16	11,774	15,790
1992	5,181	1.07	4.47	23,152	22,891	17,801	8.51	6.97	15,138	13,347
1993	7,020	1.45	4.31	30,252	24,770	19,083	7.29	6.83	6,646	10,361
1994	7,449	1.54	3.84	28,596	23,228	18,478	7.50	7.73	5,562	11,213
1995	9,674	2.00	4.20	40,631	23,340	18,609	7.50	8.15	8,160	15,621
1996	9,674	2.00	4.40	42,566	23,377	18,649	7.50	8.51	9,623	18,795
1997	9,674	2.00	4.60	44,500	23,415	18,690	7.50	8.51	11,085	20,456
1998	9,674	2.00	4.80	46,435	23,453	18,731	7.50	8.51	12,547	22,117
1999	9,674	2.00	5.00	48,370	23,491	18,772	7.50	8.51	14,009	23,778
2000	9,674	2.00	5.20	50,305	23,529	19,118	7.50	9.41	15,471	29,814
2001	9,674	2.00	5.40	52,240	23,568	19,162	7.50	9.41	16,932	31,652
2002	9,674	2.00	5.60	54,174	23,607	19,208	7.50	9.41	18,393	33,488
2003	9,674	2.00	5.80	56,109	23,647	19,253	7.50	9.41	19,853	35,325
2004	9,674	2.00	6.00	58,044	23,687	19,299	7.50	9.41	21,313	37,161
2005	9,674	2.00	6.00	58,044	23,727	19,375	7.50	10.61	21,273	44,285
2006	9,674	2.00	6.00	58,044	23,768	19,422	7.50	10.61	21,232	44,238
2007	9,674	2.00	6.00	58,044	23,809	19,470	7.50	10.61	21,191	44,190
2008	9,674	2.00	6.00	58,044	23,851	19,518	7.50	10.61	21,149	44,142
2009	9,674	2.00	6.00	58,044	23,893	19,566	7.50	10.61	21,107	44,094
2010	9,674	2.00	6.00	58,044	23,896	19,571	7.50	10.61	21,104	44,089
2011-2040	9,674	2.00	6.00	58,044	23,896	19,571	7.50	10.61	21,104	44,089

Table A-10.13 Paddy production, yields and returns - OIA - alternate case - with project

PADDY- PRODUCTION, YIELD AND RETURNS - OIA - ALTERNATE CASE - WITH PROJECT

Year	Cropped Area (Ha)	Cropping Intensity	Yield (Mt/Ha)	Production (Mt)	COP (Rs/Ha) Fin. Prices	COP (Rs/Ha) Econ. Prices	Paddy Price Fin.(Rs/Kg)	Paddy Price Econ.(Rs/Kg)	Net Returns Fin. (Rs/Ha)	Net Returns Econ. (Rs/Ha)
1978	6,487	1.43	2.99	19,418	3,274	3,141	1.90	2.89	2,414	5,502
1979	6,525	1.43	2.83	18,445	3,868	3,665	2.09	2.83	2,040	4,340
1980	6,563	1.44	3.21	21,093	4,119	3,991	2.64	4.13	4,365	9,267
1981	6,601	1.45	4.01	26,451	5,752	6,083	3.32	5.37	7,551	15,442
1982	6,639	1.46	4.50	29,888	6,758	6,165	3.20	3.43	7,648	9,271
1983	6,677	1.47	4.10	27,400	8,945	7,873	3.24	3.64	4,351	7,082
1984	6,715	1.48	3.52	23,668	10,147	8,896	3.24	3.64	1,273	3,921
1985	6,678	1.47	4.07	27,170	9,999	8,629	3.59	3.34	4,607	4,955
1986	7,416	1.53	4.12	30,528	10,154	8,491	3.45	3.32	4,047	5,171
1987	7,388	1.53	4.21	31,068	9,640	8,305	3.78	4.07	6,257	8,822
1988	8,563	1.77	4.14	35,444	11,029	9,916	4.42	5.39	7,265	12,383
1989	8,205	1.70	4.16	34,095	14,341	15,340	5.98	6.85	10,507	13,113
1990	8,369	1.73	4.30	36,010	17,647	13,333	7.10	6.27	12,904	13,663
1991	8,972	1.85	4.46	40,025	21,149	16,153	7.38	7.16	11,774	15,790
1992	5,181	1.07	4.47	23,152	22,891	17,801	8.51	6.97	15,138	13,347
1993	7,020	1.45	4.31	30,252	24,770	19,083	7.29	6.83	6,646	10,361
1994	7,449	1.54	3.84	28,596	23,228	18,478	7.50	7.73	5,562	11,213
1995	8,223	1.70	4.20	34,536	23,340	18,609	7.50	8.15	8,160	15,621
1996	8,223	1.70	4.40	36,181	23,377	18,649	7.50	8.51	9,623	18,795
1997	8,223	1.70	4.60	37,825	23,415	18,690	7.50	8.51	11,085	20,456
1998	8,223	1.70	4.80	39,470	23,453	18,731	7.50	8.51	12,547	22,117
1999	8,223	1.70	5.00	41,115	23,491	18,772	7.50	8.51	14,009	23,778
2000	8,223	1.70	5.20	42,759	23,529	19,118	7.50	9.41	15,471	29,814
2001	8,223	1.70	5.40	44,404	23,568	19,162	7.50	9.41	16,932	31,652
2002	8,223	1.70	5.60	46,048	23,607	19,208	7.50	9.41	18,393	33,488
2003	8,223	1.70	5.80	47,693	23,647	19,253	7.50	9.41	19,853	35,325
2004	8,223	1.70	6.00	49,337	23,687	19,299	7.50	9.41	21,313	37,161
2005	8,223	1.70	6.00	49,337	23,727	19,375	7.50	10.61	21,273	44,285
2006	8,223	1.70	6.00	49,337	23,768	19,422	7.50	10.61	21,232	44,238
2007	8,223	1.70	6.00	49,337	23,809	19,470	7.50	10.61	21,191	44,190
2008	8,223	1.70	6.00	49,337	23,851	19,518	7.50	10.61	21,149	44,142
2009	8,223	1.70	6.00	49,337	23,893	19,566	7.50	10.61	21,107	44,094
2010	8,223	1.70	6.00	49,337	23,896	19,571	7.50	10.61	21,104	44,089
2011-2040	8,223	1.70	6.00	49,337	23,896	19,571	7.50	10.61	21,104	44,089

Table A-10.14 Paddy production, yields and returns - OIA - base / alternate case - without project

PADDY- PRODUCTION, YIELDS AND RETURNS - OIA - BASE/ALTERNATE CASE - WITHOUT PROJECT										
Year	Cropped Area (Ha)	Cropping Intensity	Yield (Mt/Ha)	Production (Mt)	COP (Rs/Ha) Fin. Prices	COP (Rs/Ha) Econ. Prices	Paddy Price Fin.(Rs/Kg)	Paddy Price Econ.(Rs/Kg)	Net Returns Fin. (Rs/Ha)	Net Returns Econ. (Rs/Ha)
1978	6,461	1.42	3.01	19,418	3,287	3,154	1.90	2.89	2,423	5,524
1979	6,525	1.43	2.83	18,445	3,868	3,665	2.09	2.83	2,040	4,340
1980	6,563	1.44	3.21	21,093	4,119	3,991	2.64	4.13	4,365	9,267
1981	5,915	1.30	2.83	16,744	5,727	6,064	3.32	5.37	3,671	9,142
1982	5,915	1.30	2.83	16,744	6,730	6,146	3.20	3.43	2,329	3,560
1983	5,915	1.30	2.83	16,744	8,982	7,903	3.24	3.64	190	2,413
1984	5,915	1.30	2.83	16,744	10,143	8,890	3.24	3.64	(971)	1,403
1985	5,915	1.30	2.83	16,744	10,012	8,642	3.59	3.34	151	809
1986	6,288	1.30	2.73	17,154	10,274	8,582	3.45	3.32	(862)	473
1987	6,288	1.30	2.83	17,800	9,166	7,897	3.78	4.07	1,535	3,632
1988	6,288	1.30	2.83	17,800	10,417	9,379	4.42	5.39	2,095	5,872
1989	6,288	1.30	2.83	17,800	13,689	14,746	5.98	6.85	3,239	4,637
1990	6,288	1.30	2.83	17,800	16,550	12,545	7.10	6.27	3,549	5,215
1991	6,288	1.30	2.83	17,800	20,074	15,330	7.38	7.16	817	4,939
1992	6,288	1.30	2.83	17,800	22,082	17,155	8.51	6.97	2,008	2,575
1993	6,288	1.30	2.83	17,800	23,410	18,073	7.29	6.83	(2,774)	1,268
1994	6,288	1.30	2.83	17,800	22,067	17,555	7.50	7.73	(837)	4,341
1995	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
1996	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
1997	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
1998	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
1999	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2000	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2001	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2002	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2003	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2004	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075
2005-2040	6,288	1.30	2.90	18,235	22,073	17,560	7.50	8.15	(323)	6,075

Table A-10.15 Cost and benefit stream - OIA - base case - In current financial prices (Rs. 000)

COST AND BENEFIT STREAM - OIA - BASE CASE - In Current Financial Prices (Rs.000)												
	WITH PROJECT								WITHOUT PROJECT			
Year	Gross Returns	Gross COP	Total O&M Costs	Rehab. Costs	Investment Costs	Indir.Costs & Benefits	Total Net Returns	Net Inc. Returns	Gross Returns	Gross COP	Total O&M Costs	Total Net Returns
1978	36,682	21,237	350	26	814	0	14,255	(840)	36,682	21,237	350	15,095
1979	36,620	25,242	377	22	6,362	0	4,618	(6,383)	36,620	25,242	377	11,001
1980	53,758	27,036	485	0	30,350	0	(4,112)	(30,350)	53,758	27,036	485	26,238
1981	78,494	37,972	620	44	48,035	0	(8,176)	(29,272)	55,590	33,875	620	21,095
1982	89,728	44,863	700	1,104	67,644	0	(24,584)	(37,657)	53,581	39,808	700	13,073
1983	85,996	59,725	902	2,536	92,354	0	(69,521)	(69,742)	54,251	53,127	902	221
1984	75,258	68,135	1,131	2,254	122,598	0	(118,861)	(111,987)	54,251	59,993	1,131	(6,874)
1985	90,608	66,772	1,158	6,811	152,222	0	(136,355)	(136,087)	60,111	59,221	1,158	(268)
1986	103,088	75,308	1,332	5,840	87,708	0	(67,098)	(60,344)	59,183	64,605	1,332	(6,754)
1987	116,325	71,216	1,432	5,794	59,234	0	(21,351)	(29,570)	67,285	57,634	1,432	8,219
1988	149,306	94,449	1,403	1,444	54,010	0	(2,000)	(13,768)	78,677	65,506	1,403	11,768
1989	197,363	117,674	1,258	989	45,290	0	32,153	13,044	106,445	86,078	1,258	19,109
1990	252,274	147,685	1,403	0	43,977	(338)	58,871	37,959	126,381	104,066	1,403	20,912
1991	290,590	189,748	1,528	0	27,462	(397)	71,455	67,847	131,365	126,229	1,528	3,608
1992	181.271	118.596	1.040	0	33.638	(441)	27.556	15.969	151.479	138.852	1,040	11,587
1993	222,762	173,883	1,451	0	42,567	(490)	4,370	23,262	129,763	147,204	1,451	(18,892)
1994	214,466	173,036	1,451	0	13,073	(490)	26,417	33,129	133,501	138,762	1,451	(6,712)
1995	304,731	225,793	1,451	0	0	(490)	76,997	80,479	136,766	138,797	1,451	(3,482)
1996	319,242	226,152	1,451	0	0	(490)	91,149	94,631	136,766	138,797	1,451	(3,482)
1997	333,753	226,514	1,451	0	0	(490)	105,298	108,780	136,766	138,797	1,451	(3,482)
1998	348,264	226,880	1,451	0	0	(490)	119,443	122,925	136,766	138,797	1,451	(3,482)
1999	362,775	227,249	1,451	0	0	(490)	133,585	137,067	136,766	138,797	1,451	(3,482)
2000	377,286	227,622	1,451	0	0	(490)	147,723	151,205	136,766	138,797	1,451	(3,482)
2001	391,797	227,998	1,451	0	0	(490)	161,858	165,340	136,766	138,797	1,451	(3,482)
2002	406,308	228,378	1,451	0	0	(490)	175,989	179,471	136,766	138,797	1,451	(3,482)
2003	420,819	228,762	1,451	0	0	(490)	190,116	193,598	136,766	138,797	1,451	(3,482)
2004	435,330	229,149	1,451	0	0	(490)	204,240	207,722	136,766	138,797	1,451	(3,482)
2005	435,330	229,539	1,451	0	0	(490)	203,850	207,332	136,766	138,797	1,451	(3,482)
2006	435,330	229,934	1,451	0	0	(490)	203,455	206,937	136,766	138,797	1,451	(3,482)
2007	435,330	230,332	1,451	0	0	(490)	203,057	206,539	136,766	138,797	1,451	(3,482)
2008	435,330	230,734	1,451	0	0	(490)	202,655	206,137	136,766	138,797	1,451	(3,482)
2009	435,330	231,139	1,451	0	0	(490)	202,250	205,732	136,766	138,797	1,451	(3,482)
2010	435,330	231,167	1,451	0	0	(490)	202,222	205,704	136,766	138,797	1,451	(3,482)
2011-2040	435,330	231,167	1,451	0	0	(490)	202,222	205,704	136,766	138,797	1,451	(3,482)

Negative values in paranthesis

Table A-10.16 Cost and benefit stream - OIA - base case - In current economic prices (Rs. 000)

COST AND BENEFIT STREAM - OIA - BASE CASE - In Current Economic Prices (Rs.000)												
	WITH PROJECT								WITHOUT PROJECT			
Year	Gross Returns	Gross COP	Total O&M Costs	Rehab. Costs	Investment Costs	Indir.Costs & Benefits	Total Net Returns	Net Inc. Returns	Gross Returns	Gross COP	Total O&M Costs	Total Net Returns
1978	56,065	20,375	337	22	714	0	34,617	(736)	56,065	20,375	337	35,353
1979	52,234	23,913	363	18	5,137	0	22,804	(5,154)	52,234	23,913	363	27,959
1980	87,016	26,195	466	0	23,951	0	36,403	(23,951)	87,016	26,195	466	60,354
1981	142,085	40,153	596	37	38,573	0	62,726	9,246	89,941	35,866	596	53,479
1982	102,477	40,927	674	917	54,259	0	5,701	(14,681)	57,411	36,356	674	20,381
1983	99,854	52,571	868	2,106	74,012	0	(29,703)	(43,110)	61,021	46,746	868	13,407
1984	86,064	59,737	1,088	1,872	98,344	0	(74,977)	(82,190)	60,887	52,586	1,088	7,213
1985	90,712	57,624	1,114	5,656	121,152	0	(94,834)	(98,506)	55,904	51,117	1,114	3,673
1986	101,324	62,975	1,281	4,850	70,281	0	(38,062)	(39,754)	56,937	53,964	1,281	1,692
1987	126,537	61,359	1,377	4,812	48,953	0	10,036	(11,426)	72,498	49,658	1,377	21,462
1988	190,950	84,915	1,349	1,199	46,670	0	56,816	21,244	95,896	58,973	1,349	35,573
1989	233,464	125,865	1,210	821	41,778	0	63,790	35,840	121,885	92,726	1,210	27,950
1990	225,919	111,580	1,349	0	39,709	(244)	73,037	41,597	111,675	78,885	1,349	31,441
1991	286,595	144,923	1,470	0	24,921	(287)	114,994	85,406	127,458	96,399	1,470	29,588
1992	161,369	92,221	1,000	0	29,779	(318)	38,050	22,859	124,066	107,874	1,000	15,192
1993	206,695	133,962	1,396	0	39,341	(354)	31,642	25,066	121,617	113,645	1,396	6,576
1994	221,180	137,649	1,396	0	12,295	(354)	69,487	43,587	137,681	110,385	1,396	25,900
1995	331,141	180,026	1,396	0	0	(354)	149,365	112,561	148,619	110,419	1,396	36,804
1996	362,233	180,414	1,396	0	0	(354)	180,069	136,700	155,184	110,419	1,396	43,369
1997	378,698	180,806	1,396	0	0	(354)	196,143	152,773	155,184	110,419	1,396	43,369
1998	395,164	181,201	1,396	0	0	(354)	212,212	168,843	155,184	110,419	1,396	43,369
1999	411,629	181,601	1,396	0	0	(354)	228,278	184,909	155,184	110,419	1,396	43,369
2000	473,368	184,943	1,396	0	0	(354)	286,675	226,894	171,596	110,419	1,396	59,781
2001	491,575	185,377	1,396	0	0	(354)	304,448	244,667	171,596	110,419	1,396	59,781
2002	509,781	185,815	1,396	0	0	(354)	322,217	262,435	171,596	110,419	1,396	59,781
2003	527,988	186,257	1,396	0	0	(354)	339,981	280,200	171,596	110,419	1,396	59,781
2004	546,194	186,703	1,396	0	0	(354)	357,741	297,960	171,596	110,419	1,396	59,781
2005	615,847	187,430	1,396	0	0	(354)	426,667	345,003	193,479	110,419	1,396	81,664
2006	615,847	187,887	1,396	0	0	(354)	426,210	344,546	193,479	110,419	1,396	81,664
2007	615,847	188,349	1,396	0	0	(354)	425,748	344,085	193,479	110,419	1,396	81,664
2008	615,847	188,815	1,396	0	0	(354)	425,282	343,619	193,479	110,419	1,396	81,664
2009	615,847	189,285	1,396	0	0	(354)	424,812	343,148	193,479	110,419	1,396	81,664
2010	615,847	189,326	1,396	0	0	(354)	424,771	343,107	193,479	110,419	1,396	81,664
2011-2040	615,847	189,326	1,396	0	0	(354)	424,771	343,107	193,479	110,419	1,396	81,664

Negative values in paranthesis

Table A-10.17 Cost and benefit stream - OIA - alternate case - In current financial prices (Rs. 000)

COST AND BENEFIT STREAM - OIA - ALTERNATE CASE - In Current Financial Prices (Rs.000)													
	WITH PROJECT									WITHOUT PROJECT			
Year	Gross Returns	Gross COP	Total O&M Costs	Rehab. Costs	Investment Costs	Indir.Costs & Benefits	Net Returns OFC	Total Net Returns	Net Inc. Returns	Gross Returns	Gross COP	Total O&M Costs	Total Net Returns
1978	36,682	21,237	350	26	814	0	0	14,255	(840)	36,682	21,237	350	15,095
1979	36,620	25,242	377	22	6,362	0	0	4,618	(6,383)	36,620	25,242	377	11,001
1980	53,758	27,036	485	0	30,350	0	0	(4,112)	(30,350)	53,758	27,036	485	26,238
1981	78,494	37,972	620	44	48,035	0	0	(8,176)	(29,272)	55,590	33,875	620	21,095
1982	89,728	44,863	700	1,104	67,644	0	0	(24,584)	(37,657)	53,581	39,808	700	13,073
1983	85,996	59,725	902	2,536	92,354	0	0	(69,521)	(69,742)	54,251	53,127	902	221
1984	75,258	68,135	1,131	2,254	122,598	0	0	(118,861)	(111,987)	54,251	59,993	1,131	(6,874)
1985	90,608	66,772	1,158	6,811	152,222	0	0	(136,355)	(136,087)	60,111	59,221	1,158	(268)
1986	103,088	75,308	1,332	5,840	87,708	0	0	(67,098)	(60,344)	59,183	64,605	1,332	(6,754)
1987	116,325	71,216	1,432	5,794	59,234	0	0	(21,351)	(29,570)	67,285	57,634	1,432	8,219
1988	149,306	94,449	1,403	1,444	54,010	0	0	(2,000)	(13,768)	78,677	65,506	1,403	11,768
1989	197,363	117,674	1,258	989	45,290	0	0	32,153	13,044	106,445	86,078	1,258	19,109
1990	252,274	147,685	1,403	0	43,977	(338)	0	58,871	37,959	126,381	104,066	1,403	20,912
1991	290,590	189,748	1,528	0	27,462	(397)	0	71,455	67,847	131,365	126,229	1,528	3,608
1992	181,271	118,596	1,040	0	33,638	(441)	0	27,556	15,969	151,479	138,852	1,040	11,587
1993	222,762	173,883	1,451	0	42,567	(490)	0	4,370	23,262	129,763	147,204	1,451	(18,892)
1994	214,466	173,036	1,451	0	13,073	(490)	0	26,417	33,129	133,501	138,762	1,451	(6,712)
1995	259,021	191,924	1,451	0	0	(490)	21,274	86,430	89,912	136,766	138,797	1,451	(3,482)
1996	271,356	192,229	1,451	0	0	(490)	21,274	98,459	101,941	136,766	138,797	1,451	(3,482)
1997	283,690	192,537	1,451	0	0	(490)	21,274	110,485	113,968	136,766	138,797	1,451	(3,482)
1998	296,024	192,848	1,451	0	0	(490)	21,274	122,509	125,991	136,766	138,797	1,451	(3,482)
1999	308,359	193,162	1,451	0	0	(490)	21,274	134,529	138,011	136,766	138,797	1,451	(3,482)
2000	320,693	193,479	1,451	0	0	(490)	21,274	146,547	150,029	136,766	138,797	1,451	(3,482)
2001	333,027	193,799	1,451	0	0	(490)	21,274	158,561	162,043	136,766	138,797	1,451	(3,482)
2002	345,362	194,122	1,451	0	0	(490)	21,274	170,573	174,055	136,766	138,797	1,451	(3,482)
2003	357,696	194,447	1,451	0	0	(490)	21,274	182,581	186,063	136,766	138,797	1,451	(3,482)
2004	370,031	194,776	1,451	0	0	(490)	21,274	194,587	198,069	136,766	138,797	1,451	(3,482)
2005	370,031	195,108	1,451	0	0	(490)	21,274	194,255	197,737	136,766	138,797	1,451	(3,482)
2006	370,031	195,444	1,451	0	0	(490)	21,274	193,919	197,401	136,766	138,797	1,451	(3,482)
2007	370,031	195,782	1,451	0	0	(490)	21,274	193,581	197,063	136,766	138,797	1,451	(3,482)
2008	370,031	196,124	1,451	0	0	(490)	21,274	193,239	196,722	136,766	138,797	1,451	(3,482)
2009	370,031	196,468	1,451	0	0	(490)	21,274	192,895	196,377	136,766	138,797	1,451	(3,482)
2010	370,031	196,492	1,451	0	0	(490)	21,274	192,871	196,353	136,766	138,797	1,451	(3,482)
2011-2040	370,031	196,492	1,451	0	0	(490)	21,274	192,871	196,353	136,766	138,797	1,451	(3,482)

Negative values in paranthesis

Table A-10.18 Cost and benefit stream - OIA - alternate case - In current economic prices (Rs. 000)

COST AND BENEFIT STREAM - OIA - ALTERNATE CASE - In Current Economic Prices (Rs.000)													
	WITH PROJECT									WITHOUT PROJECT			
Year	Gross Returns	Gross COP	Total O&M Costs	Rehab. Costs	Investment Costs	Indir.Costs & Benefits	Net Returns OFC	Total Net Returns	Net Inc. Returns	Gross Returns	Gross COP	Total O&M Costs	Total Net Returns
1978	56,065	20,375	337	22	714	0	0	34,617	(736)	56,065	20,375	337	35,353
1979	52,234	23,913	363	18	5,137	0	0	22,804	(5,154)	52,234	23,913	363	27,959
1980	87,016	26,195	466	0	23,951	0	0	36,403	(23,951)	87,016	26,195	466	60,354
1981	142,085	40,153	596	37	38,573	0	0	62,726	9,246	89,941	35,866	596	53,479
1982	102,477	40,927	674	917	54,259	0	0	5,701	(14,681)	57,411	36,356	674	20,381
1983	99,854	52,571	868	2,106	74,012	0	0	(29,703)	(43,110)	61,021	46,746	868	13,407
1984	86,064	59,737	1,088	1,872	98,344	0	0	(74,977)	(82,190)	60,887	52,586	1,088	7,213
1985	90,712	57,624	1,114	5,656	121,152	0	0	(94,834)	(98,506)	55,904	51,117	1,114	3,673
1986	101,324	62,975	1,281	4,850	70,281	0	0	(38,062)	(39,754)	56,937	53,964	1,281	1,692
1987	126,537	61,359	1,377	4,812	48,953	0	0	10,036	(11,426)	72,498	49,658	1,377	21,462
1988	190,950	84,915	1,349	1,199	46,670	0	0	56,818	21,244	95,896	58,973	1,349	35,573
1989	233,464	125,865	1,210	821	41,778	0	0	63,790	35,840	121,885	92,726	1,210	27,950
1990	225,919	111,580	1,349	0	39,709	(244)	0	73,037	41,597	111,675	78,885	1,349	31,441
1991	286,595	144,923	1,470	0	24,921	(287)	0	114,994	85,406	127,458	96,399	1,470	29,588
1992	161,369	92,221	1,000	0	29,779	(318)	0	38,050	22,859	124,066	107,874	1,000	15,192
1993	206,695	133,962	1,396	0	39,341	(354)	0	31,642	25,066	121,617	113,645	1,396	6,576
1994	221,180	137,649	1,396	0	12,295	(354)	0	69,487	43,587	137,681	110,385	1,396	25,900
1995	281,470	153,022	1,396	0	0	(354)	18,508	145,206	108,401	148,619	110,419	1,396	36,804
1996	307,898	153,352	1,396	0	0	(354)	18,508	171,304	127,935	155,184	110,419	1,396	43,369
1997	321,894	153,685	1,396	0	0	(354)	18,508	184,967	141,598	155,184	110,419	1,396	43,369
1998	335,889	154,021	1,396	0	0	(354)	18,508	198,626	155,257	155,184	110,419	1,396	43,369
1999	349,884	154,360	1,396	0	0	(354)	18,508	212,282	168,913	155,184	110,419	1,396	43,369
2000	402,363	157,202	1,396	0	0	(354)	18,508	261,920	202,139	171,596	110,419	1,396	59,781
2001	417,838	157,570	1,396	0	0	(354)	18,508	277,026	217,245	171,596	110,419	1,396	59,781
2002	433,314	157,943	1,396	0	0	(354)	18,508	292,130	232,349	171,596	110,419	1,396	59,781
2003	448,789	158,318	1,396	0	0	(354)	18,508	307,229	247,448	171,596	110,419	1,396	59,781
2004	464,265	158,698	1,396	0	0	(354)	18,508	322,326	262,545	171,596	110,419	1,396	59,781
2005	523,470	159,316	1,396	0	0	(354)	18,508	380,913	299,249	193,479	110,419	1,396	81,664
2006	523,470	159,704	1,396	0	0	(354)	18,508	380,524	298,860	193,479	110,419	1,396	81,664
2007	523,470	160,097	1,396	0	0	(354)	18,508	380,132	298,468	193,479	110,419	1,396	81,664
2008	523,470	160,493	1,396	0	0	(354)	18,508	379,736	298,072	193,479	110,419	1,396	81,664
2009	523,470	160,892	1,396	0	0	(354)	18,508	379,336	297,672	193,479	110,419	1,396	81,664
2010	523,470	160,927	1,396	0	0	(354)	18,508	379,301	297,637	193,479	110,419	1,396	81,664
2011-2040	523,470	160,927	1,396	0	0	(354)	18,508	379,301	297,637	193,479	110,419	1,396	81,664

Negative values in paranthesis

Table A-10.19 Area, production and yields of paddy in NIA, with project

'AREA , PRODUCTION AND YIELDS OF PADDY IN NIA , WITH PROJECT								
	BASE CASE				ALTERNATE CASE			
Year	Cropped Area (Ha)	Cropping Intensity	Yield (Mt/Ha)	Production (Mt)	Cropped Area (Ha)	Cropping Intensity	Yield (Mt/Ha)	Production (Mt)
1986	879	0.21	2.40	2,110	879	0.21	2.40	2,110
1987	2,406	0.57	4.10	9,865	2,406	0.57	4.10	9,865
1988	5,316	1.25	3.66	19,478	5,316	1.25	3.66	19,478
1989	5,631	1.20	4.13	23,271	5,631	1.20	4.13	23,271
1990	2,256	0.45	4.20	9,475	2,256	0.45	4.20	9,475
1991	6,362	1.25	3.86	24,583	6,362	1.25	3.86	24,583
1992	5.038	0.94	3.80	19,144	5,038	0.94	3.80	19,144
1993	4,290	0.80	3.80	16,302	4,290	0.80	3.80	16,302
1994	4,861	0.91	3.60	17,500	4,861	0.91	3.60	17,500
1995	5,876	1.10	4.20	24,680	4,274	0.80	4.20	17,949
1996	5,876	1.10	4.40	25,855	4,274	0.80	4.40	18,804
1997	5,876	1.10	4.60	27,031	4,274	0.80	4.60	19,659
1998	5,876	1.10	4.80	28,206	4,274	0.80	4.80	20,513
1999	5,876	1.10	5.00	29,381	4,274	0.80	5.00	21,368
2000	5,876	1.10	5.20	30,556	4,274	0.80	5.20	22,223
2001	5,876	1.10	5.40	31,731	4,274	0.80	5.40	23,077
2002	5,876	1.10	5.60	32,907	4,274	0.80	5.60	23,932
2003	5,876	1.10	5.80	34,082	4,274	0.80	5.80	24,787
2004	5,876	1.10	6.00	35,257	4,274	0.80	6.00	25,642
2005-2040	5,876	1.10	6.00	35,257	4,274	0.80	6.00	25,642

Table A-10.20 *Cost and benefit stream - NIA - alternate case - with project - In current financial prices (Rs. 000)*

COST AND BENEFIT STREAM - NIA - ALTERNATE CASE - WITH PROJECT In Current Financial Prices (Rs.000)										
Year	Gross Returns	Net Ret. Forestry	Net Ret. Livestock	Net Ret. OFC	Gross COP	Benefits Foregone	Investment Costs	Total O&M Costs	Indir. Costs & Benefits	Net Returns NIA
1978	0	0	0	0	0	1,900	1,512	0	0	(3,412)
1979	0	0	0	0	0	229	11,815	0	0	(12,044)
1980	0	0	0	0	0	249	56,363	0	0	(56,613)
1981	0	0	0	0	0	319	89,207	0	0	(89,526)
1982	0	0	0	0	0	408	125,825	0	0	(126,034)
1983	0	0	0	0	0	464	171,514	0	0	(171,978)
1984	0	0	0	0	0	598	227,683	0	0	(228,281)
1985	0	0	283	0	0	746	282,698	0	0	(283,162)
1986	7,278	0	373	0	7,453	763	162,886	995	0	(164,447)
1987	37,288	(36)	496	0	24,620	824	110,005	1,070	0	(98,772)
1988	86,092	(46)	501	0	61,983	891	100,303	1,049	0	(77,878)
1989	139,162	(51)	497	1,990	72,355	996	64,110	1,035	0	(18,897)
1990	67,274	(67)	410	2,349	42,160	1,086	81,671	1,236	(628)	(56,814)
1991	181,421	(82)	1,510	12,324	135,348	1,421	51,001	1,367	(737)	5,299
1992	162,919	(92)	1,208	3,898	120,964	1,677	62,470	976	(819)	(18,974)
1993	118,642	(94)	298	11,871	101,428	1,860	79,054	1,362	(910)	(53,697)
1994	131,247	(94)	203	14,642	112,945	2,075	24,278	1,362	(910)	4,428
1995	134,616	0	2,326	11,002	99,747	2,075	0	1,603	(910)	43,613
1996	141,029	100	2,557	11,002	99,906	2,075	0	1,603	(910)	50,195
1997	147,439	0	2,803	11,002	100,065	2,075	0	1,603	(910)	56,591
1998	153,850	100	3,065	11,002	100,227	2,075	0	1,603	(910)	63,203
1999	160,260	0	3,346	11,002	100,390	2,075	0	1,603	(910)	69,630
2000	166,670	100	3,645	11,002	100,555	2,075	0	1,603	(910)	76,275
2001	173,081	0	3,825	11,002	100,721	2,075	0	1,603	(910)	82,599
2002	179,491	100	4,010	11,002	100,889	2,075	0	1,603	(910)	89,127
2003	185,902	0	4,202	11,002	101,058	2,075	0	1,603	(910)	95,460
2004	192,312	100	4,399	11,002	101,229	2,075	0	1,603	(910)	101,996
2005	192,312	0	4,602	11,002	101,402	2,075	0	1,603	(910)	101,927
2006	192,312	100	4,811	11,002	101,576	2,075	0	1,603	(910)	102,062
2007	192,312	0	5,027	11,002	101,752	2,075	0	1,603	(910)	102,002
2008	192,312	100	5,250	11,002	101,929	2,075	0	1,603	(910)	102,147
2009	192,312	0	5,479	11,002	102,108	2,075	0	1,603	(910)	102,097
2010	192,312	100	5,716	11,002	102,121	2,075	0	1,603	(910)	102,421
2011	192,312	0	5,851	11,002	102,121	2,075	0	1,603	(910)	102,457
2012	192,312	100	5,989	11,002	102,121	2,075	0	1,603	(910)	102,695
2013	192,312	0	6,128	11,002	102,121	2,075	0	1,603	(910)	102,734
2014	192,312	100	6,269	11,002	102,121	2,075	0	1,603	(910)	102,976
2015	192,312	0	6,412	11,002	102,121	2,075	0	1,603	(910)	103,019
2016	192,312	18,000	6,557	11,002	102,121	2,075	0	1,603	(910)	121,163
2017	192,312	18,000	6,704	11,002	102,121	2,075	0	1,603	(910)	121,310
2018	192,312	18,000	6,852	11,002	102,121	2,075	0	1,603	(910)	121,458
2019	192,312	18,000	7,003	11,002	102,121	2,075	0	1,603	(910)	121,609
2020	192,312	18,000	7,155	11,002	102,121	2,075	0	1,603	(910)	121,761
2021	192,312	18,000	7,309	11,002	102,121	2,075	0	1,603	(910)	121,915
2022	192,312	18,000	7,465	11,002	102,121	2,075	0	1,603	(910)	122,071
2023	192,312	18,000	7,623	11,002	102,121	2,075	0	1,603	(910)	122,229
2024	192,312	18,000	7,782	11,002	102,121	2,075	0	1,603	(910)	122,386
2025	192,312	18,000	7,944	11,002	102,121	2,075	0	1,603	(910)	122,550
2026	192,312	18,000	8,108	11,002	102,121	2,075	0	1,603	(910)	122,714
2027	192,312	18,000	8,274	11,002	102,121	2,075	0	1,603	(910)	122,880
2028	192,312	18,000	8,442	11,002	102,121	2,075	0	1,603	(910)	123,048
2029	192,312	18,000	8,611	11,002	102,121	2,075	0	1,603	(910)	123,218
2030	192,312	18,000	8,783	11,002	102,121	2,075	0	1,603	(910)	123,390
2031	192,312	18,000	8,958	11,002	102,121	2,075	0	1,603	(910)	123,564
2032	192,312	18,000	9,134	11,002	102,121	2,075	0	1,603	(910)	123,740
2033	192,312	18,000	9,312	11,002	102,121	2,075	0	1,603	(910)	123,918
2034	192,312	18,000	9,493	11,002	102,121	2,075	0	1,603	(910)	124,099
2035	192,312	18,000	9,676	11,002	102,121	2,075	0	1,603	(910)	124,282
2036	192,312	0	9,861	11,002	102,121	2,075	0	1,603	(910)	106,467
2037	192,312	0	10,048	11,002	102,121	2,075	0	1,603	(910)	106,654
2038	192,312	0	10,238	11,002	102,121	2,075	0	1,603	(910)	106,844
2039	192,312	0	10,430	11,002	102,121	2,075	0	1,603	(910)	107,036
2040	192,312	0	10,624	11,002	102,121	2,075	0	1,603	(910)	107,230

Table A-10.21 Cost and benefit stream - NIA - alternate case - with project - In current economic prices (Rs. 000)

COST AND BENEFIT STREAM - NIA - ALTERNATE CASE - WITH PROJECT

In Current Economic Prices (Rs.000)

Year	Gross Returns	Net Ret. Forestry	Net Ret. Livestock	Net Ret OFC	Gross COP	Benefits Foregone	Investment Costs	Total O&M Costs	Indir. Costs & Benefits	Net Returns NIA
1978	0	0	0	0	0	1,492	1,327	0	0	(2,818)
1979	0	0	0	0	0	180	9,539	0	0	(9,719)
1980	0	0	0	0	0	196	44,480	0	0	(44,676)
1981	0	0	0	0	0	250	71,636	0	0	(71,886)
1982	0	0	0	0	0	321	100,766	0	0	(101,087)
1983	0	0	0	0	0	364	137,451	0	0	(137,815)
1984	0	0	0	0	0	469	182,640	0	0	(183,109)
1985	0	0	219	0	0	586	224,996	0	0	(225,363)
1986	7,002	0	289	0	6,351	599	130,522	957	0	(131,139)
1987	40,177	(30)	384	0	21,252	647	90,913	1,030	0	(73,311)
1988	104,934	(38)	388	0	55,017	699	86,673	1,009	0	(38,114)
1989	159,348	(43)	385	1,731	63,876	782	77,587	996	0	18,181
1990	59,446	(56)	317	2,044	31,401	853	73,745	1,189	(453)	(45,891)
1991	176,025	(69)	1,169	10,722	103,449	1,116	46,283	1,315	(532)	35,152
1992	133,436	(78)	935	3,391	93,801	1,317	55,304	939	(591)	(14,267)
1993	111,381	(79)	231	10,328	79,644	1,460	73,062	1,310	(657)	(34,272)
1994	135,356	(79)	157	12,739	89,856	1,629	22,833	1,310	(657)	31,887
1995	146,285	0	1,801	9,572	79,529	1,629	0	1,542	(657)	74,302
1996	160,021	84	1,979	9,572	79,700	1,629	0	1,542	(657)	88,128
1997	167,294	0	2,169	9,572	79,873	1,629	0	1,542	(657)	95,335
1998	174,568	84	2,373	9,572	80,048	1,629	0	1,542	(657)	102,721
1999	181,842	0	2,590	9,572	80,224	1,629	0	1,542	(657)	109,952
2000	209,116	84	2,821	9,572	81,701	1,629	0	1,542	(657)	136,065
2001	217,159	0	2,960	9,572	81,892	1,629	0	1,542	(657)	143,971
2002	225,202	84	3,104	9,572	82,086	1,629	0	1,542	(657)	152,048
2003	233,245	0	3,252	9,572	82,281	1,629	0	1,542	(657)	159,960
2004	241,287	84	3,405	9,572	82,478	1,629	0	1,542	(657)	168,042
2005	272,057	0	3,562	9,572	82,799	1,629	0	1,542	(657)	198,564
2006	272,057	84	3,724	9,572	83,001	1,629	0	1,542	(657)	198,608
2007	272,057	0	3,891	9,572	83,205	1,629	0	1,542	(657)	198,488
2008	272,057	84	4,063	9,572	83,411	1,629	0	1,542	(657)	198,538
2009	272,057	0	4,240	9,572	83,619	1,629	0	1,542	(657)	198,423
2010	272,057	84	4,423	9,572	83,637	1,629	0	1,542	(657)	198,672
2011	272,057	0	4,529	9,572	83,637	1,629	0	1,542	(657)	198,693
2012	272,057	84	4,635	9,572	83,637	1,629	0	1,542	(657)	198,884
2013	272,057	0	4,743	9,572	83,637	1,629	0	1,542	(657)	198,908
2014	272,057	84	4,853	9,572	83,637	1,629	0	1,542	(657)	199,101
2015	272,057	0	4,963	9,572	83,637	1,629	0	1,542	(657)	199,128
2016	272,057	15,138	5,075	9,572	83,637	1,629	0	1,542	(657)	214,378
2017	272,057	15,138	5,189	9,572	83,637	1,629	0	1,542	(657)	214,492
2018	272,057	15,138	5,304	9,572	83,637	1,629	0	1,542	(657)	214,606
2019	272,057	15,138	5,420	9,572	83,637	1,629	0	1,542	(657)	214,723
2020	272,057	15,138	5,538	9,572	83,637	1,629	0	1,542	(657)	214,840
2021	272,057	15,138	5,657	9,572	83,637	1,629	0	1,542	(657)	214,960
2022	272,057	15,138	5,778	9,572	83,637	1,629	0	1,542	(657)	215,080
2023	272,057	15,138	5,900	9,572	83,637	1,629	0	1,542	(657)	215,203
2024	272,057	15,138	6,024	9,572	83,637	1,629	0	1,542	(657)	215,326
2025	272,057	15,138	6,149	9,572	83,637	1,629	0	1,542	(657)	215,451
2026	272,057	15,138	6,276	9,572	83,637	1,629	0	1,542	(657)	215,578
2027	272,057	15,138	6,404	9,572	83,637	1,629	0	1,542	(657)	215,707
2028	272,057	15,138	6,534	9,572	83,637	1,629	0	1,542	(657)	215,836
2029	272,057	15,138	6,665	9,572	83,637	1,629	0	1,542	(657)	215,968
2030	272,057	15,138	6,798	9,572	83,637	1,629	0	1,542	(657)	216,101
2031	272,057	15,138	6,933	9,572	83,637	1,629	0	1,542	(657)	216,236
2032	272,057	15,138	7,070	9,572	83,637	1,629	0	1,542	(657)	216,372
2033	272,057	15,138	7,208	9,572	83,637	1,629	0	1,542	(657)	216,510
2034	272,057	15,138	7,347	9,572	83,637	1,629	0	1,542	(657)	216,650
2035	272,057	15,138	7,489	9,572	83,637	1,629	0	1,542	(657)	216,792
2036	272,057	0	7,632	9,572	83,637	1,629	0	1,542	(657)	201,797
2037	272,057	0	7,777	9,572	83,637	1,629	0	1,542	(657)	201,942
2038	272,057	0	7,924	9,572	83,637	1,629	0	1,542	(657)	202,089
2039	272,057	0	8,073	9,572	83,637	1,629	0	1,542	(657)	202,237
2040	272,057	0	8,223	9,572	83,637	1,629	0	1,542	(657)	202,388

Table A-10.22 *Cost and benefit stream - NIA - base case - with project - In current financial prices (Rs. 000)*

COST AND BENEFIT STREAM - NIA - BASE CASE - WITH PROJECT

In Current Financial Prices (Rs.000)

Year	Gross Returns	Net Ret. Forestry	Net Ret. Livestock	Net Ret. OFC	Gross COP	Benefits Foregone	Investment Costs	Total O&M Costs	Indir. Costs & Benefits	Net Returns NIA
1978	0	0	0	0	0	1,900	1,512	0	0	(3,412)
1979	0	0	0	0	0	229	11,815	0	0	(12,044)
1980	0	0	0	0	0	249	56,363	0	0	(56,613)
1981	0	0	0	0	0	319	89,207	0	0	(89,526)
1982	0	0	0	0	0	408	125,625	0	0	(126,034)
1983	0	0	0	0	0	464	171,514	0	0	(171,978)
1984	0	0	0	0	0	598	227,683	0	0	(228,281)
1985	0	0	283	0	0	746	282,698	0	0	(283,162)
1986	7,278	0	373	0	7,453	763	162,886	995	0	(164,447)
1987	37,288	(36)	496	0	24,620	824	110,005	1,070	0	(98,772)
1988	86,092	(46)	501	0	61,983	891	100,303	1,049	0	(77,678)
1989	139,162	(51)	497	1,990	72,355	996	84,110	1,035	0	(16,897)
1990	67,274	(67)	410	2,349	42,160	1,086	81,671	1,236	(628)	(56,814)
1991	181,421	(82)	1,510	12,324	135,348	1,421	51,001	1,367	(737)	5,299
1992	162,919	(92)	1,208	3,898	120,964	1,677	62,470	976	(819)	(18,974)
1993	118,842	(94)	298	11,871	101,428	1,860	79,054	1,362	(910)	(53,697)
1994	131,247	(94)	203	14,642	112,945	2,075	24,278	1,362	(910)	4,428
1995	185,100	0	2,326	0	137,151	2,075	0	1,603	(910)	45,688
1996	193,915	100	2,557	0	137,370	2,075	0	1,603	(910)	54,614
1997	202,729	0	2,803	0	137,590	2,075	0	1,603	(910)	63,354
1998	211,543	100	3,065	0	137,812	2,075	0	1,603	(910)	72,309
1999	220,358	0	3,346	0	138,036	2,075	0	1,603	(910)	81,079
2000	229,172	100	3,645	0	138,263	2,075	0	1,603	(910)	90,066
2001	237,986	0	3,825	0	138,491	2,075	0	1,603	(910)	98,732
2002	246,800	100	4,010	0	138,722	2,075	0	1,603	(910)	107,601
2003	255,615	0	4,202	0	138,955	2,075	0	1,603	(910)	116,274
2004	264,429	100	4,399	0	139,190	2,075	0	1,603	(910)	125,150
2005	264,429	0	4,602	0	139,427	2,075	0	1,603	(910)	125,016
2006	264,429	100	4,811	0	139,667	2,075	0	1,603	(910)	125,086
2007	264,429	0	5,027	0	139,909	2,075	0	1,603	(910)	124,960
2008	264,429	100	5,250	0	140,153	2,075	0	1,603	(910)	125,038
2009	264,429	0	5,479	0	140,399	2,075	0	1,603	(910)	124,921
2010	264,429	100	5,715	0	140,416	2,075	0	1,603	(910)	125,240
2011	264,429	0	5,851	0	140,416	2,075	0	1,603	(910)	125,276
2012	264,429	100	5,989	0	140,416	2,075	0	1,603	(910)	125,514
2013	264,429	0	6,128	0	140,416	2,075	0	1,603	(910)	125,554
2014	264,429	100	6,269	0	140,416	2,075	0	1,603	(910)	125,795
2015	264,429	0	6,412	0	140,416	2,075	0	1,603	(910)	125,838
2016	264,429	18,000	6,557	0	140,416	2,075	0	1,603	(910)	143,983
2017	264,429	18,000	6,704	0	140,416	2,075	0	1,603	(910)	144,129
2018	264,429	18,000	6,852	0	140,416	2,075	0	1,603	(910)	144,278
2019	264,429	18,000	7,003	0	140,416	2,075	0	1,603	(910)	144,428
2020	264,429	18,000	7,155	0	140,416	2,075	0	1,603	(910)	144,580
2021	264,429	18,000	7,309	0	140,416	2,075	0	1,603	(910)	144,734
2022	264,429	18,000	7,465	0	140,416	2,075	0	1,603	(910)	144,890
2023	264,429	18,000	7,623	0	140,416	2,075	0	1,603	(910)	145,048
2024	264,429	18,000	7,782	0	140,416	2,075	0	1,603	(910)	145,208
2025	264,429	18,000	7,944	0	140,416	2,075	0	1,603	(910)	145,370
2026	264,429	18,000	8,108	0	140,416	2,075	0	1,603	(910)	145,533
2027	264,429	18,000	8,274	0	140,416	2,075	0	1,603	(910)	145,699
2028	264,429	18,000	8,442	0	140,416	2,075	0	1,603	(910)	145,867
2029	264,429	18,000	8,611	0	140,416	2,075	0	1,603	(910)	146,037
2030	264,429	18,000	8,783	0	140,416	2,075	0	1,603	(910)	146,209
2031	264,429	18,000	8,958	0	140,416	2,075	0	1,603	(910)	146,383
2032	264,429	18,000	9,134	0	140,416	2,075	0	1,603	(910)	146,559
2033	264,429	18,000	9,312	0	140,416	2,075	0	1,603	(910)	146,738
2034	264,429	18,000	9,493	0	140,416	2,075	0	1,603	(910)	146,918
2035	264,429	18,000	9,676	0	140,416	2,075	0	1,603	(910)	147,101
2036	264,429	0	9,861	0	140,416	2,075	0	1,603	(910)	129,286
2037	264,429	0	10,048	0	140,416	2,075	0	1,603	(910)	129,474
2038	264,429	0	10,238	0	140,416	2,075	0	1,603	(910)	129,663
2039	264,429	0	10,430	0	140,416	2,075	0	1,603	(910)	129,855
2040	264,429	0	10,624	0	140,416	2,075	0	1,603	(910)	130,049

Table A-10.23 Cost and benefit stream - NIA - base case - with project - In current economic prices (Rs. 000)

COST AND BENEFIT STREAM - NIA - BASE CASE - WITH PROJECT In Current Economic Prices (Rs.000)										
Year	Gross Returns	Net Ret. Forestry	Net Ret. Livestock	Net Ret. OFC	Gross COP	Benefits Foregone	Investment Costs	Total O&M Costs	Indir. Costs & Benefits	Net Returns NIA
1978	0	0	0	0	0	1,492	1,327	0	0	(2,818)
1979	0	0	0	0	0	180	9,539	0	0	(9,719)
1980	0	0	0	0	0	196	44,480	0	0	(44,676)
1981	0	0	0	0	0	250	71,636	0	0	(71,886)
1982	0	0	0	0	0	321	100,766	0	0	(101,087)
1983	0	0	0	0	0	364	137,451	0	0	(137,815)
1984	0	0	0	0	0	469	182,640	0	0	(183,109)
1985	0	0	219	0	0	586	224,996	0	0	(225,363)
1986	7,002	0	289	0	6,351	599	130,522	957	0	(131,139)
1987	40,177	(30)	384	0	21,252	647	90,913	1,030	0	(73,311)
1988	104,934	(38)	388	0	55,017	699	86,673	1,009	0	(38,114)
1989	159,348	(43)	385	1,731	63,876	782	77,587	996	0	18,181
1990	59,446	(56)	317	2,044	31,401	853	73,745	1,189	(453)	(45,891)
1991	176,025	(69)	1,169	10,722	103,449	1,116	46,283	1,315	(532)	35,152
1992	133,436	(78)	935	3,391	93,801	1,317	55,304	939	(591)	(14,267)
1993	111,381	(79)	231	10,328	79,644	1,460	73,062	1,310	(657)	(34,272)
1994	135,356	(79)	157	12,739	89,856	1,629	22,833	1,310	(657)	31,887
1995	201,142	0	1,801	0	109,352	1,629	0	1,542	(657)	89,763
1996	220,028	84	1,979	0	109,588	1,629	0	1,542	(657)	108,676
1997	230,030	0	2,169	0	109,826	1,629	0	1,542	(657)	118,546
1998	240,031	84	2,373	0	110,066	1,629	0	1,542	(657)	128,594
1999	250,032	0	2,590	0	110,308	1,629	0	1,542	(657)	138,486
2000	287,534	84	2,821	0	112,339	1,629	0	1,542	(657)	174,273
2001	298,593	0	2,960	0	112,602	1,629	0	1,542	(657)	185,124
2002	309,652	84	3,104	0	112,868	1,629	0	1,542	(657)	196,145
2003	320,711	0	3,252	0	113,137	1,629	0	1,542	(657)	206,999
2004	331,770	84	3,405	0	113,408	1,629	0	1,542	(657)	218,024
2005	374,079	0	3,562	0	113,849	1,629	0	1,542	(657)	259,964
2006	374,079	84	3,724	0	114,127	1,629	0	1,542	(657)	259,932
2007	374,079	0	3,891	0	114,407	1,629	0	1,542	(657)	259,735
2008	374,079	84	4,063	0	114,690	1,629	0	1,542	(657)	259,708
2009	374,079	0	4,240	0	114,976	1,629	0	1,542	(657)	259,516
2010	374,079	84	4,423	0	115,001	1,629	0	1,542	(657)	259,758
2011	374,079	0	4,529	0	115,001	1,629	0	1,542	(657)	259,779
2012	374,079	84	4,635	0	115,001	1,629	0	1,542	(657)	259,970
2013	374,079	0	4,743	0	115,001	1,629	0	1,542	(657)	259,993
2014	374,079	84	4,853	0	115,001	1,629	0	1,542	(657)	260,187
2015	374,079	0	4,963	0	115,001	1,629	0	1,542	(657)	260,214
2016	374,079	15,138	5,075	0	115,001	1,629	0	1,542	(657)	275,464
2017	374,079	15,138	5,189	0	115,001	1,629	0	1,542	(657)	275,577
2018	374,079	15,138	5,304	0	115,001	1,629	0	1,542	(657)	275,692
2019	374,079	15,138	5,420	0	115,001	1,629	0	1,542	(657)	275,808
2020	374,079	15,138	5,538	0	115,001	1,629	0	1,542	(657)	275,926
2021	374,079	15,138	5,657	0	115,001	1,629	0	1,542	(657)	276,045
2022	374,079	15,138	5,778	0	115,001	1,629	0	1,542	(657)	276,166
2023	374,079	15,138	5,900	0	115,001	1,629	0	1,542	(657)	276,288
2024	374,079	15,138	6,024	0	115,001	1,629	0	1,542	(657)	276,412
2025	374,079	15,138	6,149	0	115,001	1,629	0	1,542	(657)	276,537
2026	374,079	15,138	6,276	0	115,001	1,629	0	1,542	(657)	276,664
2027	374,079	15,138	6,404	0	115,001	1,629	0	1,542	(657)	276,792
2028	374,079	15,138	6,534	0	115,001	1,629	0	1,542	(657)	276,922
2029	374,079	15,138	6,665	0	115,001	1,629	0	1,542	(657)	277,054
2030	374,079	15,138	6,798	0	115,001	1,629	0	1,542	(657)	277,187
2031	374,079	15,138	6,933	0	115,001	1,629	0	1,542	(657)	277,321
2032	374,079	15,138	7,070	0	115,001	1,629	0	1,542	(657)	277,458
2033	374,079	15,138	7,208	0	115,001	1,629	0	1,542	(657)	277,596
2034	374,079	15,138	7,347	0	115,001	1,629	0	1,542	(657)	277,736
2035	374,079	15,138	7,489	0	115,001	1,629	0	1,542	(657)	277,877
2036	374,079	0	7,632	0	115,001	1,629	0	1,542	(657)	262,883
2037	374,079	0	7,777	0	115,001	1,629	0	1,542	(657)	263,028
2038	374,079	0	7,924	0	115,001	1,629	0	1,542	(657)	263,174
2039	374,079	0	8,073	0	115,001	1,629	0	1,542	(657)	263,323
2040	374,079	0	8,223	0	115,001	1,629	0	1,542	(657)	263,473

Table A-10.24 Milk production, yields, costs and returns (current financial prices)

MILK PRODUCTION, YIELDS , COSTS AND RETURNS (Current Financial Prices)

Year	Total No. Animals	No.Milked	Yield (Lt/Day)	Lactn. Period	Prodn. (000 Lt)	Price (Rs / Lt)	Gross Ret. (Rs 000)	Other Prods. Val. (Rs 000)	Gross COP (Rs000)	Net Returns (Rs000)
1985	15,553	4,417	1.05	78	361	4.32	1,559	201	1,478	283
1986	14,986	4,371	1.06	80	370	4.58	1,693	218	1,538	373
1987	14,574	4,368	1.07	82	382	4.90	1,871	241	1,616	496
1988	14,313	4,410	1.02	84	378	5.33	2,016	260	1,775	501
1989	12,831	4,080	0.94	86	329	6.02	1,978	255	1,736	497
1990	12,821	4,147	0.85	87	309	7.69	2,373	306	2,269	410
1991	15,513	5,018	1.17	87	511	8.23	4,207	542	3,239	1,510
1992	18,771	6,071	1.06	87	562	8.75	4,921	634	4,346	1,208
1993	22,713	7,346	0.97	87	619	8.83	5,462	704	5,868	298
1994	26,862	8,817	0.88	88	684	9.25	6,327	815	6,939	203
1995	32,503	10,669	1.09	88	1,027	9.25	9,499	1,224	8,397	2,326
1996	33,717	11,118	1.10	88	1,079	9.25	9,981	1,286	8,710	2,557
1997	34,982	11,589	1.10	89	1,134	9.25	10,488	1,351	9,037	2,803
1998	36,303	12,082	1.11	89	1,192	9.25	11,023	1,420	9,378	3,065
1999	37,682	12,598	1.12	89	1,253	9.25	11,587	1,493	9,734	3,346
2000	39,120	13,138	1.12	89	1,317	9.25	12,181	1,570	10,106	3,645
2001	39,675	13,362	1.13	89	1,348	9.25	12,468	1,606	10,249	3,825
2002	40,240	13,590	1.13	90	1,380	9.25	12,761	1,644	10,395	4,010
2003	40,816	13,822	1.14	90	1,412	9.25	13,062	1,683	10,544	4,202
2004	41,401	14,059	1.15	90	1,446	9.25	13,371	1,723	10,695	4,399
2005	41,998	14,301	1.15	90	1,480	9.25	13,688	1,764	10,849	4,602
2006	42,605	14,547	1.16	90	1,515	9.25	14,012	1,805	11,006	4,811
2007	43,223	14,799	1.16	90	1,551	9.25	14,345	1,848	11,166	5,027
2008	43,852	15,055	1.17	90	1,588	9.25	14,686	1,892	11,328	5,250
2009	44,492	15,316	1.17	90	1,625	9.25	15,035	1,937	11,494	5,479
2010	45,144	15,582	1.18	90	1,664	9.25	15,394	1,983	11,662	5,715
2011	45,306	15,661	1.19	90	1,681	9.25	15,551	2,004	11,704	5,851
2012	45,469	15,740	1.19	91	1,698	9.25	15,711	2,024	11,746	5,989
2013	45,633	15,820	1.20	91	1,716	9.25	15,872	2,045	11,788	6,128
2014	45,797	15,900	1.20	91	1,733	9.25	16,034	2,066	11,831	6,269
2015	45,962	15,980	1.21	91	1,751	9.25	16,199	2,087	11,874	6,412
2016	46,128	16,061	1.22	91	1,769	9.25	16,365	2,109	11,916	6,557
2017	46,294	16,143	1.22	91	1,787	9.25	16,533	2,130	11,959	6,704
2018	46,462	16,225	1.23	91	1,806	9.25	16,703	2,152	12,003	6,852
2019	46,630	16,307	1.23	91	1,824	9.25	16,874	2,174	12,046	7,003
2020	46,799	16,390	1.24	91	1,843	9.25	17,048	2,197	12,090	7,156
2021	46,968	16,473	1.25	91	1,862	9.25	17,223	2,219	12,133	7,309
2022	47,139	16,557	1.25	91	1,881	9.25	17,400	2,242	12,178	7,465
2023	47,310	16,641	1.26	91	1,900	9.25	17,579	2,265	12,222	7,623
2024	47,482	16,725	1.26	91	1,920	9.25	17,760	2,288	12,266	7,782
2025	47,655	16,810	1.27	91	1,940	9.25	17,943	2,312	12,311	7,944
2026	47,828	16,896	1.28	91	1,960	9.25	18,128	2,336	12,356	8,108
2027	48,003	16,982	1.28	91	1,980	9.25	18,315	2,360	12,401	8,274
2028	48,178	17,069	1.29	91	2,000	9.25	18,503	2,384	12,446	8,442
2029	48,354	17,156	1.29	91	2,021	9.25	18,694	2,409	12,491	8,611
2030	48,531	17,243	1.30	91	2,042	9.25	18,887	2,434	12,537	8,783
2031	48,709	17,331	1.31	91	2,063	9.25	19,082	2,459	12,583	8,958
2032	48,887	17,420	1.31	91	2,084	9.25	19,279	2,484	12,629	9,134
2033	49,066	17,509	1.32	91	2,106	9.25	19,478	2,510	12,675	9,312
2034	49,247	17,599	1.33	91	2,127	9.25	19,679	2,536	12,722	9,493
2035	49,428	17,689	1.33	91	2,149	9.25	19,883	2,562	12,769	9,676
2036	49,609	17,779	1.34	91	2,172	9.25	20,088	2,588	12,816	9,861
2037	49,792	17,870	1.35	91	2,194	9.25	20,296	2,615	12,863	10,048
2038	49,976	17,962	1.35	91	2,217	9.25	20,506	2,642	12,910	10,238
2039	50,160	18,054	1.36	91	2,240	9.25	20,718	2,670	12,958	10,430
2040	50,345	18,147	1.37	91	2,263	9.25	20,933	2,697	13,006	10,624

Annex 10.2 *Figures*

Figure 10.1 *Non-agricultural business activities in Kirindi Oya - Manufacturing and processing*

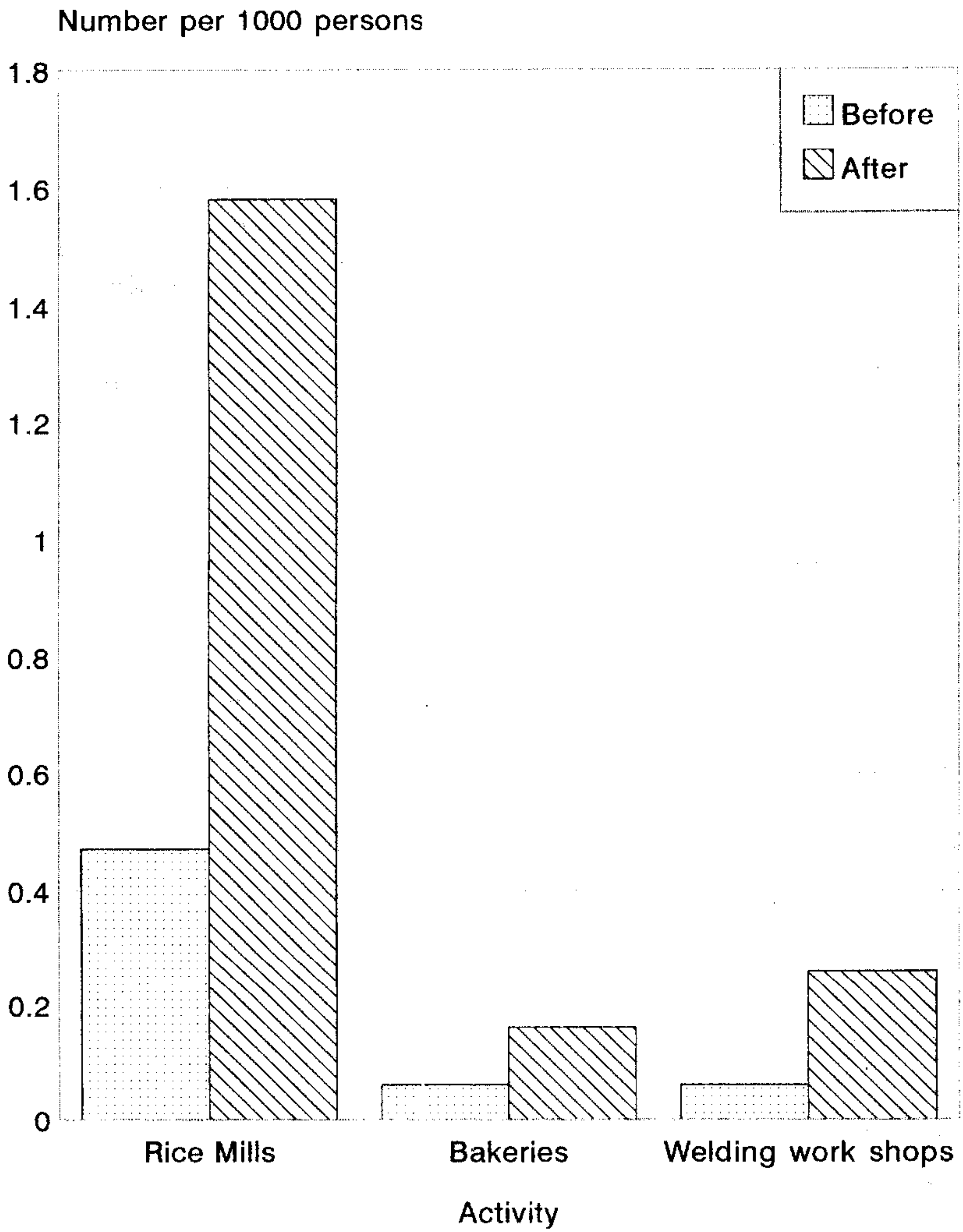


Figure 10.2 *Non-agricultural business activities in Kirindi Oya - Business and trade*

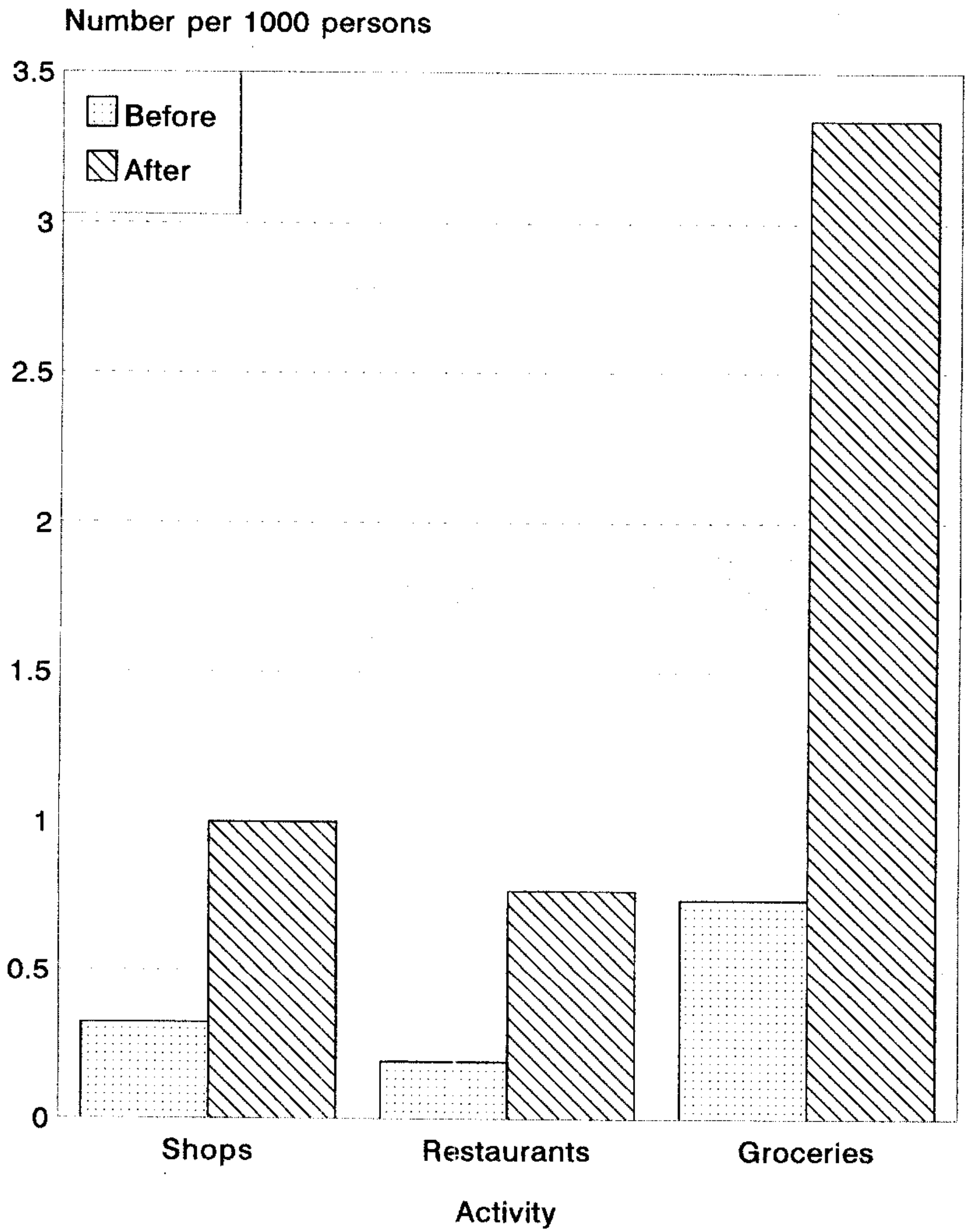
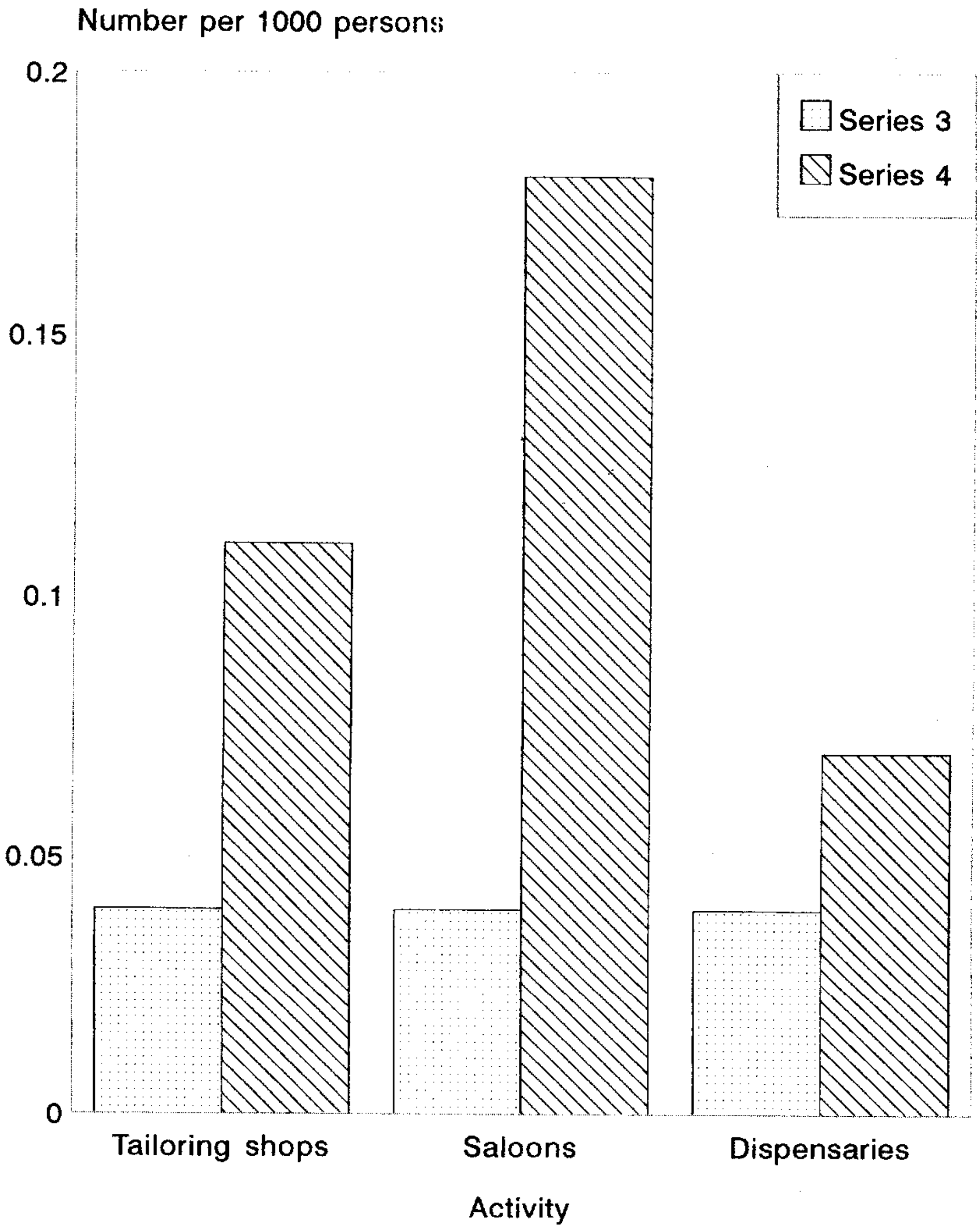


Figure 10.3 *Non-agricultural business activities in Kirindi Oya - Personal services*



Agrarian Research and Training Institute (ARTI). 1992. Proceedings of the seminar on South-East dry Zone Development. Sri Lanka, Colombo: ARTI.

Agrarian Research and Training Institute (ARTI). 1994. Farming systems of Kirindi Oya Irrigation and Settlement Project. Sri Lanka, Colombo: ARTI.

Asian Development Bank (ADB). 1977. Appraisal of Kirindi Oya Irrigation and Settlement Project in the Republic of Sri Lanka. ADB.

Asian Development Bank. 1982. Appraisal of reformulated Kirindi Oya Irrigation and Settlement Project (Phase I) in Sri Lanka.

Asian Development Bank. 1986. Preparation Report of Kirindi Oya Irrigation and Settlement Project in Sri Lanka.

Asian Development Bank. 1990. Kirindi Oya Irrigation and Settlement Project, Phase II. Memorandum of Understanding, ADB Review Mission (3-18 September 1990).

Asian Development Bank. 1991. Kirindi Oya Irrigation and Settlement Project, Phase II. Memorandum of Understanding, ADB Review Mission (6-23 May 1991).

Asian Development Bank. 1992. Kirindi Oya Irrigation and Settlement Project, Phase II. Memorandum of Understanding, ADB Review Mission (8-25 June 1992).

Atapattu, D. 1986. Construction and Project Management Kirindi Oya Experience, pp 133-143 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

Brewer, J.D.; Sakthivadivel; and P.G. Somaratne. 1993. Developing a Seasonal Strategy in a Water-short System: The Case of Kirindi Oya. Paper presented at IIMI's Internal Program Review, 1993.

Central Bank of Sri Lanka. 1981. Annual report.
--- 1986. Annual report.
--- 1993. Annual report.

Department of Census Statistics. 1981. Population Census Survey. Sri Lanka, Colombo: Dept. of Census.

Department of Wildlife. Record on Elephant Damage in the KOISP Area. Sri Lanka, Kataragama: Dept. of Wildlife.

de Silva, A.S. 1986. Kirindi Oya Irrigation and Settlement Project: Some Aspects of Construction, pp 126-131 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

Dissanayake, R.W.A. 1993. Inspiring Farmers to Stay on Their Allotments and The Problem of Crop Damage Caused by Cattle. Paper presented at Workshop on Participatory Action Research at Kirindi Oya, 11 December 1993, Hambantota, Sri Lanka.

Dunham, D. 1986. Interpreting the Politics of Settlement Policy: a Back Ground of the Mahaweli Development Scheme. The Netherlands, The Hague: Institute of Social Studies (ISS). (ISS working paper)

Economic Review. 1986. Land Settlement in Sri Lanka. Economic Review, September, 1986, pp. 3-19.

Esman, Milton J.; and Uphoff, Norman T. 1984. Local Organizations: Intermediaries in Rural Development. USA, Ithaca: Cornell University Press.

Forest Department. 1993. Nursery Records. Sri Lanka: Tissa Range Office.

Forest Department. 1993. Homelot Records. Sri Lanka: Tissa Range Office.

Forest Department. 1993. Woodlot Records. Sri Lanka: Tissa Range Office.

Gamage, D.; Wanigaratne, R.D.; Wijetunga, L.D.I.; and Tudawe, I. 1988. Kirindi Oya Irrigation and Settlement Project: Mid-Project Evaluation. Colombo, Sri Lanka: Agrarian Research and Training Institute. (Research study no. 85)

Gunarathne, L. 1987. The poorest of the poor in Sri Lanka, The Alleviation of Poverty in Sri Lanka. Sri Lanka, Colombo: Central Bank of Sri Lanka.

International Irrigation Management Institute (IIMI). 1990. Final Report, Irrigation Management and Crop Diversification (Sri Lanka), Volume II, Kirindi Oya Project. Sri Lanka, Colombo: IIMI.

International Irrigation Management Institute (IIMI). 1992. Seasonal Report, Kirindi Oya maha 1991/92. Sri Lanka, Colombo: IIMI.

International Irrigation Management Institute (IIMI). 1993. Seasonal Report, Kirindi Oya yala 1992. Sri Lanka, Colombo: IIMI.

International Irrigation Management Institute (IIMI). 1994. Draft Final Report, Irrigation Management and Crop Diversification Phase II. Sri Lanka, Colombo: IIMI.

International Irrigation Management Institute (IIMI). 1991. Irrigation Management and Crop Diversification (Sri Lanka). Inception Report on the Phase II Technical Assistance Study T.A. 1480 SRI. Sri Lanka, Colombo: IIMI.

Land Commissioner's Department (LCD). 1980. Socio Economic Survey of the Kirindi Oya Irrigation and Settlement Project. Sri Lanka, Colombo: LCD.

Merrey, D.J.; and Somaratne, P.G. 1988. Institutions under Stress and People in Distress: Institution-Building and Drought in a New Settlement Scheme in Sri Lanka. Sri Lanka, Colombo: International Irrigation Management Institute.

Munesinghe, R.L. de S. 1986. Kirindi Oya Project Dam and Spillway Engineering Geological Aspects, pp 57-77 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

Nijman, C. 1992. Irrigation Decision-Making Processes and Conditions: A Case Study of Sri Lanka's Kirindi Oya Irrigation and Settlement Project. Sri Lanka, Colombo: International Irrigation Management Institute.

Pingali, P.L.; Moya, P.F.; and Velasco, L.E. 1990. The Post-Green Revolution Blues In Asian Rice Production. Philippines, Manila: Social Science Division, International Rice Research Institute.

Razaak, M.G.M.; and Wijetunga, L.D.I. 1994. The Beneficiary Participation in the Development Program of Kirindi Oya and Settlement Project, draft report. Sri Lanka, Colombo: Agrarian Research and Training Institute.

Selvarajah, S.; and Manoharan, S. 1986. Domestic Water Supply to New Towns and Settlement Areas under Kirindi Oya Irrigation and Settlement Project, pp 185-189 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

Senanayake, S.M.P.; and Wijetunga, L.D.I. 1987. The Employment Generation in Kirindi Oya Irrigation and Settlement Area. Sri Lanka, Colombo: Agrarian Research and Training Institute. (Research study no. 79)

Seneviratne, S.N. de S. 1993. Kirindi Oya and the Development of the South-East dry Zone, pp. 191-200 in The South-East Dry Zone of Sri Lanka. Sri Lanka, Colombo: Agrarian Research and Training Institute.

Sivapatham, T. 1986. Some Soils Aspects of the Kirindi Oya Embankment Dam, pp 41-54 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

Stanbury, Pamela. 1989. Land Settlement Planning for Improved Irrigation Management: A Case Study of the Kirindi Oya Irrigation and Settlement Project. Sri Lanka, Colombo: International Irrigation Management Institute.

Tudawe, I. 1986. Kirindi Oya Irrigation and Settlement Project: Dietary Intake and Nutrition Status Survey. Sri Lanka, Colombo: Agrarian Research and Training Institute. (Research study no. 70)

Uluwishewa, R.; and Jayasuriya, M.R.T. 1991. Study of Cattle and Buffalo Husbandry in the Kirindi Oya Irrigation and Land Settlement Project. Sri Lanka, Colombo: Agrarian Research and Training Institute.

Vermillion, D.L. 1991. The Turnover and Self Management of Irrigation Institutions in Developing Countries. Sri Lanka, Colombo: International Irrigation Management Institute.

Wanasinghe, A.; Sumanasekera, H.D.; Wijetunga, D.M.A.; and Tennekoon, D. 1984. Pre-Project Socio-Economic Conditions - Kirindi Oya Irrigation and Settlement Project. Sri Lanka, Colombo: Agrarian Research and Training Institute. (Research study no. 59)

Wickramarachchi, M.S. 1993. The Land Settlement Programme. In The South-East Dry Zone of Sri Lanka, pp. 131-145. Agrarian Research and Training Institute, Documentation Series no. 13, July 1993.

Wickramasekara, P. 1985. An Evaluation of Policies and Programmes for Alleviation of Poverty in Sri Lanka. In Rizanul, (Ed.), Strategies for alleviating Poverty in Rural Asia. Thailand, Bangkok: International Labour Organization/ARTEP.

Wimalabandu, E.P. 1986. Kirindi Oya Irrigation and Settlement Project Phase 1: Main Features of the Project and Contracting Arrangements, pp 146-165 in Proceedings of the Seminar on Kirindi Oya Project Technical and Human Aspects. Sri Lanka, Colombo: Irrigation Department.

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