6.4 Agricultural Development

6.4.1 Basic Concept

As for the formulation of agricultural development plan in the rehabilitation project, some agricultural constraints and development potentials in each scheme should be taken into consideration.

(1) Improvement of Paddy Cultivation

In the upstream, irrigation water supplied excessively reduces the effect of fertilizer application, while, in the downstream, inundation makes it difficult to use fertilizer effectively. For the effective usage of fertilizer on good timing, water management on-farm level as well as rehabilitation of irrigation and drainage systems are essential.

(2) Farmers intention to OFC cultivation in paddy land

Farmers in the irrigation schemes have some experience and intention of OFC in paddy land because in the schemes belong to dry zone, the irrigation water is insufficient in both Yala and Maha season.

In addition to the above, farmer intention to crop diversification is supposed to be based on the followings.

- Cost of production of paddy is increasing due rising input costs resulting in reduced income.
- There is an increasing awareness of the higher profit margins that can be realized from cultivation of OFCs.
- The land extent under OFCs will progressively increase.
- Paddy is necessary because it is the traditional crop, provides the staple food, gives a reasonable income and in some fields only paddy cultivation is possible.

(3) Extension support service

Generally speaking, agricultural extension is not enough in villages without KVS any more. Only in Badagiriya and Muruthawela L/B schemes, there are Project Offices which hold Institutional Organizers.

(4) Reeds cultivation in drainage schemes

Reeds can be seen everywhere at lowland in Hambantota. They use them mainly for roof materials. In Kalutara district, Benthara Ganga R/B scheme, farmers organization especially women's society has been eager in development for reeds cultivation and weaving industry. This plant can be introduced in drainage schemes supplementarily in a small scale.

6.4.2 Present and Proposed Cropping Pattern

Cropping pattern with Paddy and OFC or Reeds cultivation is planned based on the present condition. Paddy variety is planned by 3.5 months varieties as the same as those at present. The OFC is mainly designed for Chili cultivation which is preferred by famers. The proposed patterns are tabulated below.

Presented and Proposed Cropping Pattern in each Scheme

(1) Liyangastota Scheme

a) WLB Scheme

Command Area: 2,767 ha

Season	Present			Proposed		
	Crops	CI (%)	Benefitted Area (ha)	Crops	CI (%)	Benefitted Area (ha)
Yala	Paddy	60	1,660	Paddy	90	2,490
				OFC	10	277
Maha	Paddy	100	2,767	Paddy	100	2,767
Total		160	4,427		200	5,534

b) WRB Scheme

Command Area: 3,354 ha

Season	Present			Proposed		
	Crops	CI (%)	Benefitted Area (ha)	Crops	CI (%)	Benefitted Area (ha)
Yala	Paddy	60	2,012	Paddy	90	3,019
				OFC	10	335
Maha	Paddy	90	3,019	Paddy	100	3,354
Total		150	5,031		200	6,708

c) A total of Liyangastota Scheme Cropping Pattern is shown as follows:

Total Command Area: WLB+WRB= 6,121 ha

Season	Present			Proposed			
	Crops	CI (%)	Benefit Area (ha)	Crops	CI (%)	Benefit Area (ha)	
Yala	Paddy	60	3,672	Paddy	90	5,509	
				OFC	10	612	
Maha	Paddy	95	5,786	Paddy	100	6,121	
Total		155	9,458		200	12,242	*

Note: * Paddy = 11,630 ha (90%), OFC = 612 ha (10%)

(2) Muruthawela Reservoir Scheme

a) LB Main Scheme

Command Area: ∑=1,698 ha

Name of Scheme	Season	Present			Proposed		
		Crops	CI (%)	Benefit Area (ha)	Crops	CI (%)	Benefit Area (ha)
Tract I (415 ha)	Yala	Paddy	50	207	Paddy	70	290
					OFC	30	125
	Maha	Paddy	50	208	Paddy	70	290
					OFC	30	125
Tract II (669 ha)	Yala	Paddy	100	669	Paddy	100	669
	Maha	None	0	0	Paddy	70	468
					OFC	30	201
Tract III (614 ha)	Yala	None	0	0	Paddy	70	430
					OFC	30	184
	Maha	Paddy	100	614	Paddy	100	614
	Total		100	1,698		200	3,396

b) Urubokka Oya Scheme

Command Area: Σ=2,176 ha

Name of Scheme	Season	Present			Proposed		
		Crops	CI (%)	Benefit Area (ha)	Crops	CI (%)	Benefit Area (ha)
Ralwa Nawarathe - Udukiriwela (3 Anicuts, 391 ha)	Yala	Paddy	100	391	Paddy	90	352
					OFC	10	39
	Maha	Paddy	100	391	Paddy	100	391
Wakamulla - Rana (5 Anicuts, 1,380 ha)	Yala	Paddy	50	690	Paddy	90	1,242
					OFC	10	138
	Maha	Paddy	100	1,380	Paddy	100	1,380
High Level Canal (405 ha)	Yala	None	-	0	Paddy	90	365
					OFC	10	40
	Maha	Paddy	100	405	Paddy	100	405
	Total		150	3,257		200	4,352

c) Kirama Oya Scheme

Command Area: 2,276 ha

Season	Present			Proposed		
	Crops	CI (%)	Benefitted Area (ha)	Crops	CI (%)	Benefitted Area (ha)
Yala	Paddy	50	1,138	Paddy	50	1,138
				OFC	10	228
Maha	Paddy	90	2,048	Paddy	100	2,276
Total		140	3,186		160	3,642

d) A total of Muruthawela Reservoir Scheme Cropping Pattern is shown as follows

Command Area: ∑=6,149 ha

Name of Scheme	Season	Present			Proposed			
		Crops	CI (%)	Benefit Area (ha)	Crops	CI (%)	Benefit Area (ha)	
LB Main (1,698 ha)	Yala	Paddy	52	876	Paddy	82	1,389	
					OFC	18	309	
	Maha	Paddy	48	822	Paddy	81	1,372	
					OFC	19	326	
Urubokka Oya (2,176 ha)	Yala	Paddy	50	1,081	Paddy	90	1,959	
					OFC	10	217	
	Maha	Paddy	100	2,176	Paddy	100	2,176	
					OFC	0	0	
Kirama Oya (2,276 ha)	Yala	Paddy	50	1,138	Paddy	50	1,138	
					OFC	10	228	
	Maha	Paddy	90	2,048	Paddy	100	2,276	
Total			132	8,141		185	11,390	*

Note: * Paddy = 10,310 ha (91%), OFC = 1,080 ha (9%)

(3) Badagiriya Scheme

Command Area: 703 ha

Name of Season	Present			Proposed			
	Crops	CI (%)	Benefitted Area (ha)	Crops	CI (%)	Benefitted Area (ha)	
Yala	Paddy	34	239	Paddy	70	492	
	OFC	4	28	OFC	30	211	
Maha	Paddy	86	605	Paddy	70	492	
	OFC	2	14	OFC	30	211	
Total		126	886		200	1,406	*

Note: * Paddy = 984 ha (70%), OFC = 422 ha (30%)

(4) Kachigala Ara Scheme

Command Area: 516 ha

Name of Season	Present			Proposed		
	Crops	CI (%)	Benefit-ted Area (ha)	Crops	CI (%)	Benefit-ted Area (ha)
Yala	Paddy	20	103	None		
Maha	Paddy	15	77	None		
Total		35	180			

(5) Benthara Ganga RB Scheme

Command Area: 965 ha

Name of Season	Present			Proposed		
	Crops	CI(%)	Benefited Area (ha)	Crop	CI(%)	Benefited Area (ha)
Yala	Paddy	30	290	Paddy	60	579
	Reeds	2	20	Reeds	5	48
Maha	Paddy	35	340	Paddy	70	676
	Reeds	2	20	Reeds	5	48
Total		67	650		135	1,303

(6) Polwatte Ganga Scheme

Command Area: 560 ha

Name of Season	Present			Proposed		
	Crop	CI (%)	Benefited Area (ha)	Crop	CI (%)	Benefited Area (ha)
Yala	Paddy	40	224	Paddy	60	336
				Reeds	5	28
Maha	Paddy	60	336	Paddy	90	504
				Reeds	5	28
Total		100	560		155	868

(7) Thangalu Welyaya Scheme

Command Area: 395 ha

Name of Season	Present			Proposed		
	Crop	CI(%)	Benefited Area (ha)	Crop	CI(%)	Benefited Area (ha)
Yala	Paddy	70	276	Paddy	90	355
				Reeds	5	20
Maha	Paddy	50	198	Paddy	80	316
				Reeds	5	20
Total		120	474		175	691

6.4.3 Proposed Farming Practice

Seed paddy

Governmental seed paddy (Certificated Seeds) should be proposed in all the schemes since there are enough seeds of new varieties developed in Rice Research Station and produced in Seed Farm within the project area.

Fertilizer application

450kg/ ha of fertilizer application recommended by DOA is proposed for the expected yield of 5.0-5.5 t/ ha.

As an ineffective use of fertilizer due to difficulty of affective water management was observed at Liyangastota and Polwatte scheme, it is proposed that the improvement of on-farm water control on the application of fertilizer and the split application method should be instructed through the farmers organizations with help of DOA and DAS.

6.4.4 Expected Yields and Production

Irrigation schemes in Hambantota

In Liyangastota, Muruthawela and Badagiriya scheme located in Hambantota district, the paddy yields in the case of "with project" is expected at 5.5 t/ ha in both Maha and Yala. This yield has been already achieved by some farmers in well managed paddy lands.

Drainage schemes in Hambantota and Matara

In the Polwatte and Thangalu scheme, the future paddy yield in case of "with project" is expected at 5.0 t/ ha in both of Maha and Yala.

Benthara scheme in Kalutara

In Kalutara district data on paddy yields show relatively low ones (2.95t/ha in Maha and 1.53t/ha in Yala) even in major schemes due to small sizes of paddy cultivation without tractors. However yields in case of "with project" could be expected at 5.0 t/ ha.

OFC cultivation

Chili cultivation is mainly proposed as OFC. The expected yields in "with project" are planned at 1,000 kg/ ha in dry pods, and 450 kg/ ha in "without project".

Reeds has broadly grown in low lands, and the production yields will be as the same as "with and / or without-project" the present yields are about 4,000 kg/ ha in dry stalks.

Production

Total crop production plan in each scheme is summarized as follows:

	Irrigable Area	Without-Project Crop area	Without-Project Production	With-Project Crop area	With-Project Production
(1) Liyangastota					
Paddy	6,121 ha	8,985 ha	27,494 t	11,630 ha	63,965 t
OFC				612 ha	612 t
(2) Muruthawela					
Paddy	6,149 ha	7,734ha	24,362 t	10,310 ha	56,705 t
OFC				1,080 ha	1,080 t
(3) Badagiriya					
Paddy	703 ha	802ha	2,598 t	984 ha	5,412 t
OFC		40 ha	18 t	422 ha	422 t
(4) Kachigala					
Paddy	516 ha	None	None	None	None
Reeds					
(5) Benthara					
Paddy	965 ha	599 ha	1,378 t	1,255 ha	6,275 t
Reeds		20 ha	80 t	48 ha	192 t
(6) Polwatte					
Paddy	560 ha	532 ha	1,436 t	840 ha	4,200 t
Reeds		0	0	28 ha	112 t
(7) Thangalu					
Paddy	395 ha	450 ha	1,215 t	671 ha	3,355 t
Reeds		0	0	20 ha	80 t

6.4.5 Crop Budget

Crop budget at present is estimated from farmers interviews, and that for the Without-Project is planned as the same as the present cost of production with a reduced yield.

As for the crop budget for the With-Project, Governmental seed paddy and DOA recommended application of fertilizer were adopted in paddy and chili costs of production. The crop budget for reeds cultivation was estimated by hearing from farmers.

The detail tables of those crop budgets are shown in Appendix 1-2

6.5 Institutional Strengthening

In Sri Lanka at present there is a wide range of institutions - government, non-government and intermediate - associated with irrigation rehabilitation and management. The functions of related government agencies is given in Chapter 4.8 while the current status of FOs in the Study area is given in Chapter 5.x.3. Sustained interaction and cooperation of these agencies and institutions is vital to the proper management of the schemes and to improve the socio-economic conditions of the farming community.

Currently the flow of public resources and services, both human and financial, is determined almost exclusively by agencies of government and channeled through them; it is not sufficiently "demand driven". At the same time the roles and functions of these agencies are subject to frequent changes, arising from shifts in policies and strategies of the Government. Lack of continuity and stability prevents these agencies from functioning at optimum levels of efficiency. Since these involve several layers of administration from the national, provincial, district, divisional, field and village levels, it is unlikely that substantial changes in these structures could be anticipated or induced in the short run.

An attempt is made here therefore to examine how best the "receiving system" or the farming community could be energized to manage more efficiently the resources available to them and also mobilize their own resources with minimum dependence on agencies of government. This is a fundamental prerequisite to ensure the sustainability of the rehabilitated systems. Moreover, this is consistent with the declared policy of government to strengthen local level institutions and reduce government intervention.

Since the early 1980's, there have been several programs aimed at promoting interaction between government officials on the one hand and farmers on the other. The INMAS program launched in 1984 is the principal management initiative which fostered coordination among agencies and interaction with farmer groups in the management of irrigation systems. This was followed by the MANIS program for the medium scale irrigation schemes. The donor-funded rehabilitation projects over the past 15 years or so also provided opportunities either in the project design or during implementation to supplement resources and introduce increasingly more comprehensive institutional strengthening components to the irrigation management program of the government. Experience has clearly borne out that those projects which incorporated I.S. components were more cost effective and sustainable. The Irrigation Management Policy Support Activity (IMPSA) made a comprehensive set of recommendations about possible reforms in the management of irrigation systems.

The gains made over the past 15 years through these efforts include:

(i) Promotion and formation of FOs to be partners in the planning, design and implementation of irrigation rehabilitation and management.

(ii) Formation and strengthening of Project Management Committees (PMC) to prepare FOs for joint-management and self-management.

(iii) More systematic inter-agency coordination particularly in the provision of agricultural support services.

(iv) Introducing and facilitating the turnover of irrigation systems to FOs for operation and maintenance on mutually agreed terms.

(v) Encouraging the formation of independent system level farmer organizations to diversify the role of FOs.

(vi) Adoption of participatory management of irrigation systems as a policy of the Government.

(vii) Legal recognition of FOs and PMC through amendments to the Agrarian Services Act and to the Irrigation Ordinance.

(viii) Promoting farmer-farmer interaction through visits to other locations both local and foreign.

The above measures have enabled farmers to move from a passive, dependent role to that of an active responsible role for the management of irrigation systems. Furthermore, FOs have demonstrated their ability to undertake many economic development and social welfare programs for the benefit of the community. Apart form these direct activities, farmers participation in project management has resulted in improved relations among farmers, agency officials and the public. Where FOs are functioning well, the confrontational attitude that prevailed before has more or less disappeared; instead farmers now try to understand the constraints under which government agencies operate and endeavor to get their services through negotiation and persuasion. Agency officials too have become more responsive and accountable to farmers than before; this is a healthy development. It is now necessary to build on this accumulated experience and empower the PMC and FOs to accept a greater share of the responsibility in management.

In the Study area FOs and PMC are in varying stages of evolution (see Section 4.2). Several of the systems under study appear to be suitable for joint management. Participation at WLAC meetings during Phase I of the Study demonstrated very clearly:

(a) that farmers are very knowledgeable both about the deficiencies as well as the overall functioning and potential of the system, and

(b) that they are capable of articulating in a convincing manner rational proposals to overcome their problems.

Institutional strengthening, to be sustainable has to be planned for the long term, and should be a painstaking and interactive exercise. Results will not be visible overnight; therefore it is necessary that stakeholders fully understand from the outset, their roles duties, responsibilities and commitment to the program. The Study therefore will come up with a broad set of proposals aimed at preparing the ground for change and discuss these with the stakeholders before specific proposals are formulated.

Given the above background, it appears that the most rational strategy for I.S. would be:

(i) to streamline to the extent possible the functions of Government Agencies at the center and at the periphery to ensure closer interaction with PMC and FOs within the framework

of joint-management

(ii) to strengthen the scheme level institutions, viz. PMC and FOs, to progressively take over functions currently discharged by government agencies at project or sub-project levels and to generate resources to meet their needs.

Government Agencies particularly at the provincial and divisional levels have gone through frequent structural and organizational change in recent years seriously eroding their capacity to function effectively and leading to under utilization of resources and to general inertia. It is unlikely, therefore, that the proposed project could leverage a substantial rationalization of the functions of the concerned agencies. Also there are several ongoing other proposals for restructuring of agencies which will receive the attention of government; the response to these is not currently known. Hence, it is proposed that as an initial step the following assessments are made prior to commencement of the rehabilitation program.

They are:

(i) review the possibility of rationlizing the areas of operation at district and field levels of especially the agencies responsible for agricultural extension and output services in order that irrigation schemes receive focused attention.

(ii) review I.D. strategy for operation and maintenance of:

(a) the main system

(b) secondary and tertiary systems

together with their plans for mobilization and optimal use of resources, based on which firm proposals could be made to government to improve the situation and make their services more cost effective.

(iii) assess the capacity of INMAS and MANIS programs respectively for providing leadership and support to strengthen the PMC and FOs. This would include a review of how the two programs and the Agrarian Services Department could share and combine resources to provide the best service to the farmers. Based on the outcome a support package to strengthen the program could be formulated. (ii) and (iii) will include a review of the progress made in adopting the IMPSA recommendations relevant to these aspects.

(iv) examine how the activities of the Second Agricultural Extension Project in regard to farmer groups and problem census technique could be linked to the functions of the PMC and FOs. Given the absence of an agricultural extension network at the village level, supporting FOs to take on that role is an imperative.

(v) Examine the current roles of other public and private institutions in regard to enterprise development and environmental activities vis-à-vis the irrigation schemes.

Meanwhile, the current services arrangements will continue without disruption.

Scheme Level Institutions

The principal scheme level institutions are the PMC, DCO and FCO. Their current roles and functions are described in section 5.x.4. Since they are in different stages of evolution the main thrust of the rehabilitation plan would be:

(a) to ascertain the minimum level of capacity required, and develop them to reach that level prior to project initiation, and

(b) to develop them to take on higher levels of management responsibility, in the early stages of project implementation.

These would include:

(i) An in-depth assessment of the current status and capacity of existing PMC's and FO's in the proposed schemes to assume the desired levels of responsibility.

(ii) appointment of Institutional Organizers (IOs) to improve existing FO's and to catalyze new ones as required including redemarcation where necessary of the area of operation of each FO. The IOs should be well trained and their work should be supervised preferably by a specialist in institutional building working full time, rather than by regular agency staff.

(iii) develop or adapt a structured training program for PMC and FOs in areas such as social mobilization, organization, leadership skills, system management, financial management, support services and enterprise development. This could also include farmer exchange program and visits to other locations both local and foreign. The specific training needs of each scheme will be identified together with a review of any on-going training programs.

The support required to implement the training will be determined once the nature and extent of training required is known.

(iv) formation, structuring and/or strengthening of PMCs and FOs to take on planning and management responsibilities. The assessment referred to in (i) above will indicate the level of effort required in each case.

As part of this program all agencies which have or propose to have development activities in the scheme area will channel their programs through the PMC and participate actively in its deliberations. Equally, PMC will have representatives in all higher level committees that decide on development activities for the scheme area.

Mechanisms to realize these objectives have to be developed in consultation with the concerned agencies and at the higher levels of the administration.

(v) Proposals and mechanisms for channeling public sector expenditure beginning with O/M expenditure through the PMC once they reach a predetermined level of competence will be made.

(vi) Based on current government policy a program and time table will be developed for the formal turnover of rehabilitated systems to FOs for joint-management.

(vii) Private sector institutions including entrepreneurs should be encouraged to work with FOs based on mutual understanding, especially in such areas as trading and enterprise development. The state should develop mechanisms to facilitate this.

(viii) The current roles of other village level institutions and how they could strengthen their relationships with PMC and FOs should be examined.

If PMCs and FOs are to take on the above responsibilities, firstly the formation and strengthening of FOs should commence 18 to 24 months before the commencement of physical rehabilitation as they should participate actively in the planning and design of the rehabilitation program itself. Secondly they should be provided material support to function efficiently and takeover some of the functions currently performed by government agencies. This will be done in consultation with the FOs as they reach different levels of competence and to suit their specific needs. For planning purposes it is assumed that these could include the following.

- training and technical support
- basic office facilities and equipment
- transport facilities
- storage facilities
- facilities for input supplies and marketing
- facilities for enterprise development
- venture capital to start new enterprises

It is vital that the Institutional Strengthening Program be designed:

(a) to build on past experience and the considerable gains made in recent years, and

(b) with a view to developing fully the potential of the irrigation systems as dynamic agricultural enterprises.

The transfer of a higher level of responsibility and authority to PMC and FOs will require raising the competence and efficiency particularly of ID and IMD through better staffing and training to be responsive to farmer needs. Reduction of untrained and unskilled staff and substitution with more qualified staff over the long term has to be part of the plan.

6.6 Improvement of System Management

6.6.1 Government Policy of System Management

In January 1989, the participatory management of Irrigation Schemes was accepted by the government as a policy. With this policy commitment of participatory management, it was recommended that:

- Participatory management be accepted as a policy and systems based on these principles be developed and experimented with, with the objective of improving overall management and performance.

- Farmers be encouraged to manage an operation and maintenance system in which they contribute their labor and other resources rather than just paying O&M charges to a central authority.

- For some time to come, government funds should continue to be available to the irrigation agencies for main system management with appropriate provision for consultation with farmers' organizations in the execution of such work.

- The management principle of village tanks is adopted in larger systems with the turnout area, the field canal and the distributary canal respectively, in ascending order, they being treated as the respective management units.

- The institutions involved be strengthened providing for active farmer involvement.

- The water users' organizations be given legal recognition.

6.6.2 Program for Handing over to DCs

(1) Objectives

In response to the above recommendations, the IMD has initiated a program to hand over the management of DCs to farmers' organizations. This is a phased program depending upon the capabilities of farmers' organizations.

The objectives of the program are as follows:

- To provide for a system of joint management in major irrigation schemes with increased participation of the beneficiaries.

- To optimize the available funds.

- To afford an opportunity for farmers to supplement the available funds by contributing labor and other resources in lieu of payment of O&M rates.

- To insure better water distribution at DC and FC levels and mutual resolution of conflicts.

- To strengthen the planning, programming, and monitoring of O&M activities at the DC and FC levels.

(2) Maintenance Funds

Handing over of DCs means that their management will be handed over from the ID to the farmers' organizations. However the entire system will remain as a public property.

Handing over is essentially a matter between the ID and the farmers' organizations. The IMD will facilitate this process by strengthening farmers' organizations and training Farmer Representatives to handle those new responsibilities . The IMD will also closely monitor the O&M activities by the farmers' organizations after the handing over. It has been agreed that handing over can be done only on the following preconditions:

- The FC group and DC organizations should be stable and reasonably efficient.

- The farmers' organizations should have confidence and mutual understanding in the officers of the ID and vice versa.

- The DCs and FCs should be at least upto the standard which enables water to be regulated and sent down all the canals.

Funds available for maintenance of DCs and FCs will be turned over by the ID to the DC organization wherever the handing over process has been completed. It is intended to transfer the maintenance funds allocated by the government to the farmers' organizations in recognition of them taking over of responsibility for O&M. However until such time that farmers' organizations receive legal recognition their method of transfer is by means of contract agreement.

The maintenance funds available in respect of each DC organization area will be intimated by the ID to the Farmer Representatives at the beginning of each year. This agreement would help the farmers to plan maintenance activities and decide on local resource mobilization. The construction activities other than routine maintenance of DCs and FCs will also be given to the farmers' organizations on contract basis wherever possible.

(3) Achievement of the Program and Current Status

Since 1987 an informal program for transferring the responsibility for O&M of the system below the Secondary (D-Canal) level to FOs after rehabilitation where necessary has been initiated. This received government approval in 1988. In some systems farmers have taken them over on a formal agreement with the ID. According to IMD, 536 D Canals out of a total of 1160 have been informally handed over to FOs under the INMAS Program. In such schemes FOs are empowered to recover water charges from farmers where necessary. However most FOs prefer to obtain contributions by way of voluntary labor or cash to maintain the system. The ID provides technical advise for maintaining the system.

(4) Collection of O/M Rates

In 1983 the government decided that the beneficiaries of major irrigation schemes should bear the cost of operations and maintenance mainly due to the pressure extended by donor agencies. The estimated costs of O&M were Rs 200 per acre per annum. The rates were initially set to cover 50 percent of the cost (Rs 100) and would gradually increase over a 5-year period to reach full recovery cost. However, subsequently it was decided to freeze the rate at Rs 100 for some more time.

The responsibility of collection has been given to the IMD although such a "fee recovery system" conflicts with the INMAS policies. The INMAS policy depends heavily on farmer participation to improve the efficiency of the physical system. However, a system of fee recovery does not require farmer participation. A system of fee collection conflicts with the INMAS mainly on the following issues:

- The farmers will become fee payers and service receivers rather than equal partners.
- It works as an impediment to the development of a sense of ownership among the farmers.
- It also works as an impediment to develop a harmonious relationship with the government irrigation organization and the farmers.
- The charge had no relationship with the amount of water used. Hence, there was no incentive for the farmers to use water efficiently.

Thus, the IMD was given the responsibility of the implementation of two conflicting tasks simultaneously.

The amounts collected and the disbursement of collected funds are given in Table 6.6.2-1.

Table 6.6.2-1 Collection of O/M Rates and Disbursements

(Unit : Rs.)

Target for the year	1984		1985		1986		1987		1988		Total collection for the collection year
	37,621,900		47,954,660		37,023,502		33,084,240		33,166,260		
Collection during the year		%		%		%		%		%	
1984	7,493,366	19.92									7,493,366
1985	2,201,628	19.14	3,291,017	6.86							10,492,646
1986	788,692	7.41	3,724,352	7.76	3,263	0.51					9,776,515
1987	1,041,383	2.76	1,401,621	2.92	1,010,397	2.72	1,610,842	4.98			5,064,243
1988	427,218	1.13	129,471	0.26	100,892	0.27	1,764,543	5.33	1,079,543	3.26	3,501,669
Total	16,952,289	50.36	8,546,462	17.8	4,374,760	2.99	33,375,385	10.31	1,079,543	3.26	36,328,441

Source: IMD Progress Report (1984 - 1988)

As shown in the table, after some initial success the collections have progressively gone down. Several factors have contributed to the poor performance of the collection of O&M rates.

The ARTI has analyzed the following reasons:

- Fee is too high
- Others do not pay
- Crop failure and low income
- Method of mobilization unsatisfactory

On the other hand, a comparatively low percentage of farmers think that O&M is a duty of the government. This means that most of the farmers have realized that they have a greater responsibility towards the O&M of the system. In analyzing the perceptions of the farmers on the collection of O&M rates it could be concluded that the farmers are prepared to bear the cost of maintenance provided that there is a suitable system to insure that:

- All farmers share responsibility equitably.
- There is an equitable distribution of water.
- The rate is decided on the actual requirement.
- There is a proper system of utilization of collected funds to insure maximum output.

6.6.3 Basic Plan

(1) Approach

Programs for irrigation system management have already been implemented for a number of schemes. These programs are formulated to vigorously promote farmer participation, and effect efficient and sustainable system management. In the case of the schemes under the Project, the following 2 programs exist:

INMAS Program:	Badagiriya, Muruthawela Left Bank, Liyangastota (Walawe) Left Bank
MANIS Program:	Liyangastota (Walawe) Right Bank, Urubokka Oya, Kirima Oya, Benthara Ganga Right Bank (partial)

Under these programs, organization of farmers and system management by such farmer groups has been fostered. Nevertheless, it is considered imperative that a long-term, stage-wise development process be pursued with regards to system management mechanisms which are currently in various stages of evolution. Each scheme can be classified according to the present level of system management achieved, and under the envisioned development process measures would be taken on a stage-wise basis to enable the scheme to evolve to the next level of development until ultimately full and complete system management by the FOs is achieved.

Thus it is hoped that concerned government agencies will continue to promote the present programs through further strengthening of FOs, and continuation of management training for farmers.

(2) Classification of Farmer Organizations and System Management

Stages of development of farmer organizations and system management mechanisms can be grouped into the following 5 categories:

Category 1:

- Membership: over 90% of all farmers have joined FO
- FCG, DCO formed according to hydrological boundaries
- Registered under Agrarian Services Act and Irrigation Ordinance
- PMC, DCO and FO meet regularly and function fully
- FOs participate actively in project planning
- Independent System Level Farmer Organization formed
- D canals taken over formally and maintained well
- Engaged in input supplies marketing and other services
- Financial reserves: high
- Has membership in higher level organization

Category 2

- Membership: over 80% of all farmers have joined FO
- FCG, DCO formed according to hydrological boundaries
- Registered under Agrarian Services Act and Irrigation Ordinance
- PMC, DCO and FO meet regularly and function well
- D canals taken over informally and maintained well
- Engaged in input supplies marketing and/or ID contracts for maintenance
- Participate in planning at Project or DCO level
- Financial reserves: moderate

Category 3

- Membership: over 70% of all farmers have joined FO
- FCG, DCO formed according to hydrological boundaries
- Registered under Agrarian Services Act or Irrigation Ordinance
- PMC, DCO meet regularly
- Handling water distribution and organization maintenance at D canal level
- Organizes Shramadana(voluntary labor) or arranges input supplies or marketing
- Financial reserves: low

Category 4

- Membership: over 60% of all farmers have joined FO
- FOs formed according to hydrological boundaries
- Registered under Agrarian Services Act or Irrigation Ordinance
- No PMC
- Participate in water distribution at FC level and contribute labor for maintenance
- Regular meetings held
- Financial reserves: negligible

Category 5

- Membership: over 50% of all farmers have joined FO
- Registered under Agrarian Services Act
- FO formed according to Grama Niladiri Divisions, not according to hydrological boundaries
- No regular meetings held
- Participates in group activities (Shramadana, water distribution, other activities)

(3) Scheme Classification

Table 6.6.3-1 indicates a classification of the subject schemes according to the criteria in (2) above:

Table 6.6.3-1 Classification of Schemes

Classification	Scheme
1	-----
2	Badagiriya
3	Muruthawela LB Liyangastota LB
4	Liyangostota RB Urubokka Oya, Kirima Oya
5	Kachigala Ara, Polwatte Ganga Benthara Ganga RB, Tangalu Welyaya

Formal taking over of D canals and below has not occurred in any of the scheme areas. Furthermore, no scheme has sufficient diversification of activities to fall into class 1. Badagiriya (class 2), and Muruthawela LB and Liyangastota LB (both class 3) are in areas under the INMAS program, underscoring the effectivity of this program. Lagging behind are the drainage schemes in class 5, and it is desirable that a suitable program be inaugurated for these areas as well.

6.7 Environmental Conservation Plan

6.7.1 Basic Concept

One of the most serious environmental pressure in Sri Lanka is growth in population, which has increased from 8.1 million in 1953 to an estimated 17.4 million in 1992. This represents a twofold increase in 40 years. Population density is 260 persons/km^2 which is one of the highest in South Asia. Simultaneous increase in job opportunity and food supply by means of agricultural development should have accompanied population increase, but serious shortage of farmland has led the residents to various encroachment on natural forests such as "chena", illegal reclamation and so on. As a result, forested area has decreased almost by half, from 44% of total land area in 1950's to 24% in 1989.

Random reclamation and deforestation have caused erosion an deterioration of soil productivity and sedimentation in canals and tanks, thus diminishing the beneficial effects of agricultural development and forming the vicious circle in environmental impact. Decrease of natural forests deprived the wildlife of its habitat and resulted in the reduction of bio-diversity.

Under these circumstances, agricultural development plays and important role in coping with the population problem in southern region of Sri Lanka, where 83.1% of the population live in rural area.

Furthermore, about half of the whole household in southern area depend upon subsidies under food stamp and Janasaviya programmes. Lack of their own farmland and stable employment force them to migrate and consume excessively natural resources to obtain food or fuel. Poor conditions of education, health and sanitation caused high birth and mortality rate but even higher birth rate accelerated the population increase. However, nowadays the literacy rate in Sri Lanka, including the southern region, has reached 80% and population increase levels off, so it may be said Sri Lanka is getting out of serious educational problems. Further economic development, extending opportunity for employment and improvement of human resources should be aimed to overcome poverty. The subject project, aiming to rehabilitate the existing irrigation and drainage systems, would contribute to diminishing poverty which aggravates population increase and environmental pressures.

The subject Project aims to rehabilitate existing irrigation and drainage systems, and in this regard, it bears a close linkage with addressing to the issues of poverty and the population increase and environmental pressures. With this background, the basic concept includes the following.

(1) Alleviation of Poverty

Poverty is widespread in the southern region particularly among farmers.

Rehabilitation of irrigation and drainage systems under the Project will increase farmers' income, generate employment opportunities and thereby effectively raise living standard of the farmers. In view of the major impact which poverty has on the social and natural environments, alleviation of poverty will be the singlemost important factor in environmental conservation.

(2) Preservation of Bio-diversity

The southern region belongs climatically to three zones: Dry Zone, Intermediate Zone and Wet Zone. The natural forests of the region provide habitat for various indigenous and rare species of wildlife. Mangroves are abundant in wetland and along lagoons which are the habitats of various species of fish and birds. Preservation of these remaining natural resources is important from the standpoint of promoting local industries and conserving bio diversity.

To achieve this, conservation of habitats of rare species and reduction of influence on them should be noticed.

(3) Prevention of Environmental Degradation through Effective Use of Land Resources and Soil Conservation

Due to deterioration of irrigation and drainage systems, large portions of farm land have either decreased in productivity or been abandoned, aggravating poverty in the region and causing reduction of arable land and soil degradation (saline water intrusion, erosion).

Accordingly, rehabilitation of the systems with careful consideration for to environmental impacts will increase the farmers' income generated from benefit areas; thereby contributing to reduction of poverty, effective utilization of natural resources, and breaking the vicious cycle of poverty.

(4) Maximum Farmer's Participation in Project Implementation

In order to formulate effective rehabilitation plan, it is necessary to identify the specific characteristics and development issues in the areas, and thoroughly sound the needs of the farmers who actually work on farmlands in the benefit areas. Self-help mentality on the part of farmers is extremely important for effective operation and maintenance of the plan.

Accordingly, work shops were carried out under the Study three times for each scheme area with the participation of local farmer NGOs. Needs and demands of the farmers have been sorted out and taken notice of from the planning stage.

(5) Women in Development

The role of women in the process of alleviation of poverty and environmental conservation is extremely important. Women are important members of the household work force, responsible for cooking, laundry and other tasks which have direct influence on the health and welfare of the family. However, their socially low status and hard work prevent them from getting necessary education and training on health, sanitation and environmental issues.

Women in development contributes to alleviation of poverty and controlling population increase, and their active participation is necessary for effective agricultural development in rural areas.

Guidance to rural women concerning environmental protection (impacts of agro-chemicals, etc. on human health and the surrounding environment) and modern agricultural techniques is therefore recommended.

6.7.2 Related Legislation and National Action Plan

(1) Legislation

Various environmental related legislation is in effect in Sri Lanka.

Environmental conservation and management is described under the National Environmental Act No. 47, 1980 (NEA). Stipulations regarding the execution of IEE/EIA are supplemented and amended under the National Environmental Act No. 56 of 1988. EIA specifically is described in Part IVc (Approval of Projects) and submission of IEE/EIA report is stipulated in article 23 BB of the same.

Regulations on the procedure for execution of IEE/EIA, which supplement NEA article 23CC, were promulgated in June 1993. At the same time, an explanatory "Guidance for Implementing the Environmental Impact Assessment Process" was published by CEA.

On the basis of article 23Z of NEA, the range of projects requiring IEE/EIA are detailed in Government Notifications. Under these, the IEE/EIA is to be carried out for the following projects which are not subject to the Coast Conservation Act: "All river basin development and irrigation projects excluding minor irrigation works (as defined by Irrigation Ordinance, chapter 453)".

Conservation of coastal areas falls under the Coast Conservation Act, No. 57 of 1981, in which article 16 pertains to EIA. Under this legislation, development activities in coastal zones require an EIA report. Definition of "coastal zone" is set out in article 42 of the same.

Conservation and management of national parks is addressed by the National Heritage Wilderness Areas Act, No. 3 of 1988. Forest conservation and logging/wood transport are regulated under the Forest Ordinance. Wildlife protection falls under the Fauna and Flora Protection Act No. 49 of 1993, which includes a list of species targeted for conservation efforts.

(2) Environmental Standards

Under revised legislation in 1988, the CEA is responsible for regulating and managing environmental related activities, and prevention of environmental contamination and deterioration. Without the relevant license from the CEA, discharge/disposal of waste materials is prohibited. Since January 1990, all industrial operations require a license which stipulates tolerance limits for discharge/disposal of waste materials. Standards for water use in this regard cover the following:

i) Tolerance limits for industrial effluents discharged into inland surface waters
ii) Tolerance limits for inland surface waters used as raw water for public water supply
iii) Tolerance limits for industrial effluents discharged on land for irrigation purposes
iv) Tolerance limits for inland surface waters for fish culture
v) Tolerance limits for effluents from rubber factories
vi) Sri Lanka Standard for potable water

Of the above, standards pertaining to irrigation and drainage water are given in the following table.

Table 6.7-1 Tolerance limits of Water Quality in Sri Lanka

Parameters	Maximum tolerance limit (1)	(2)
pH	5.5~9.0	6.0~8.5
Total dissolved solids(mg/l)	2,100	---
Suspended solid (mg/l)	---	50
Temperature (℃)	---	40
BOD (5 days at 20℃) (mg/l)	250	30
COD (mg/l)	---	250
Phenolic compounds(as C_6h_5OH)(mg/l)	---	1.0
Cyanides (mg/l)	---	0.2
Sulphate (as SO_4) (mg/l)	1,000	---
Sulphides (as S) (mg/l)	---	2.0
Choloride (as Cl) (mg/l)	600	---
Total residual Chlorine (mg/l)	---	1.0
Fluorides (as F) (mg/l)	---	2.0
Sodium absorbtion ratio (SAR)	10~15	---
Ammonical Nitrogen (as N) (mg/l)	---	50
Arsenic (as As) (mg/l)	0.2	0.2
Boron (as B) (mg/l)	2.0	---
Cadmium (as Cd) (mg/l)	2.0	0.1
Chromium (as Cr) (mg/l)	1.0	0.1
Copper (as Cu) (mg/l)	---	3.0
Lead (as Pb) (mg/l)	1.0	0.1
Mercury (as Hg) (mg/l)	0.01	0.0005
Nickel (as Ni) (mg/l)	---	3.0
Selenium (as Se) (mg/l)	---	0.05
Zinc (as Zn) (mg/l)	---	5.0
Residual Sodium Carbonate (mg/l)	2.5	---
Pesticides	---	Nil
Oil and grease (mg/l)	10	10.0
Radioactive materials	---	---
Alpha emitters (uc/ml	10^{-9}	10^{-7}
Beta emitters (uc/ml)	10^{-8}	10^{-6}
Odour	No obnoxious odour	---
Froatables	No visible large size solids	---

(mg/l = milligrams/litre; uc/l = microcries/millilitre

Remarks;
(1) Tolerance limits for industrial effluents discharged on land for irrigation purposes
(2) Tolerance limits for industrial waste water discharged into inland surface waters(after treatment)

6.7.3 IEE

(1) IEE Objective

The objective of IEE is to ensure the formulation of a project which is both sustainable and non-environmentally threatening. This study is carried out at the incipient stages of project planning and provides data on foreseeable environmental impacts as a result of project implementation, and provides a basis for formulating the most environmentally friendly alternative for a given project.

IEE is carried out in the case of projects with minimal anticipated impact on the environment, and is simpler, less costly and less time consuming than the full fledged EIA.

(2) Methodology

a) Schedule

Usually, the IEE/EIA is carried out during the project feasibility study with the objective of identifying both positive and negative impacts on the surrounding environment to be anticipated under the project, as well as the degree to which the economic/financial viability of the project is subject to influences from the surrounding environment. As indicated above, all basin development and irrigation/drainage projects in Sri Lanka require the execution of IEE/EIA.

Upon receipt of preliminary information on a project, the Project Approving Agency carries out "scoping" in collaboration with the CEA to determine whether an IEE or an EIA should be executed. The IEE option is selected in the case of projects with small anticipated environmental impact, and allows economizing on time and money.

The IEE/EIA is conventionally carried out at that point in time where the general project area has been delimited and specific project components are known. Under the subject Study, an IEE is carried out at the master plan stage (Phase I), and major environmental impacts to be expected under each scheme are identified. Measures to mitigate anticipated impacts are studied, and this data is reflected in selection of target schemes for feasibility study, and the formulation of facility and farm management planning which fully considers the relevant environmental issues.

The environmental examination was studied according to items listed below.

i. Material survey relating to the southern region and schemes,
ii. Field survey of watershed and schmes,
iii. Soil and Water quality investigation around schems (refer to Section 5.2.5),
iv. Meeting and workshop with related agencies and FOs, and
v. Interview and questionnair.

IEE/EIA procedure is shown in App.3-7.

b) Checklist Method

In the case of the IEE at the master plan study stage, full and precise identification of all environmental impacts under the project is constrained by the fact that the details of the project

have not yet been finalized. The IEE study is therefore carried out on the basis of a general understanding of specific project components. The checklist method rather than the matrix method is applied in light of the fact that the various construction work categories have not as yet been determined in detail. The said checklist was prepared based on ADB guidelines, with modifications to fit the requirements of an irrigation and drainage rehabilitation project.

c) Interview Survey

i. Interview to Farmers

To grasp farming environmental conditions, interviews were made to 57 Fermers (mainly FO leaders) at WALAC and other farmers meetings. Questionnaires to Fermers included daily life, conflicts among FOs, usage of farm inputs such as fertilizer and agro-chemicals, etc.(App.3-10 and 11).

ii. Interviews to Fishemen

Interviews to five fishermen were carried out on fishermen's living condition and fishery environment in estuaries, lagoons and tanks. Questionnaires to the fishermen included fishing yield, catching methods, catching area, income, etc. (App.3-5).

iii. Interviews to Women

Interviews to six women were done with questionnaires on women's incomes, roles and daily work, time schedule, women support agencies, etc..

Women are usually participate in harvesting work. They are in charge of all the house-keeping and sometimes work as a family labour. Usually, they get up at five o'clock in the mornig and cannot take a break at all untill nine o'clock at night. It is a hard routine work in particular to fetch drinking pot water several times a day and to bring fagots of fuelwoods (App.3-6).

(3) Study Area

The study areas for IEE will generally cover from the upstream portion of the study area to the river mouths or watersheds in the direction of the downstream, however, in the case that there exist large tanks at the upstream portion of the study area, the upper limit of the study area will be extended upto those tanks. Considering the nature of the project, it is anticipated that there will be no signidicant changes in land use, and also the impacts which will be caused by implementation of the project are judged to be less important at present.

Scheme	Study Area
1. Liyangastota Scheme	Downstream of Udawalawe Reservoir
2. Muruthawela Reservoir Scheme	Downstream of Muruthawela Reservoir
3. Badagiriya Scheme	Downstream of Lunugnwchera Tank
4. Kchigala Ara Scheme	Downstream of Chandrika Wewa
5. Benthara Ganga RB Scheme	Benthara Ganga watershed
6. Polwatte Ganga Scheme	Polwatte Ganga watershed
7. Tangalu Welyaya Scheme	(included in Muruthawela Reservoir Scheme)

(4) Results of IEE

According to the materials and field surveys, etc., the extracted environmental factors has been assessed with values, which are representing significance of environmental impact.

Table 6.7-2 Results of IEE

Items	Liy	Mur	Bad	Kch	Ben	Pol	Tha
a) Environmental Factors due to Site Situation							
1) Flooding problem by disruption of hydrology	ns	ns	ns	ns	-2	-2	-1
2) Watershed erosion	-1	-1	-1	-1	-1	-1	-1
3) Encroachment into wetlands	ns	-1	ns	-2	-2	ns	-1
4) Impacts on habitat and movement of wildlife	ns	ns	-2	-1	-1	ns	-1
5) Impacts on endangered species	ns	ns	-2	-1	-1	ns	-1
6) Impacts on fisheries and fish farmings	ns	ns	-1	-1	ns	ns	-3
7) Resettlement of families displaced by project	ns	ns	ns	ns	ns	ns	ns
8) Impacts on aesthetic values	ns	ns	ns	ns	-1	ns	ns
b) Environmental Factor from Oversights in Planning and Design							
1) Suitability of water quality for irrigation	-3	ns	-1	ns	ns	ns	ns
2) Suitability of soil for cultivation	ns	ns	-1	-1	-1	-1	-1
3) Excessive use of groundwater	ns	ns	ns	ns	ns	ns	ns
4) Use of agricultural chemicals	-1	-1	-1	-1	-1	-1	-1
5) Water-oriented disease hazards	-2	-2	-2	-2	-1	-1	-1
6) Feasibility of effective cooperatives	+1	+1	+1	+1	+1	+1	+1
7) Conflicts in land use	ns	ns	ns	ns	ns	ns	ns
8) Rights in water use	ns	-2	ns	ns	-2	-2	-2
9) Passageways of people and cattle	+1	+1	+1	+1	+1	+1	+1
10) Canal maintenance	+1	+1	+1	+1	+1	+1	+1
11) Influence from realization of other projects	ns	ns	ns	-3	-1	ns	-2
c) Problems During Construction Stage							
1) Erosion control	-1	-1	-1	-1	-1	-1	-1
2) Other construction stage impacts	ns	ns	ns	ns	ns	ns	ns
3) Monitoring during construction	+1	+1	+1	+1	+1	+1	+1
d) Problems in Operations							
1) Responsibility of O&M	+1	+1	+1	+1	+1	+1	+1
2) Operations monitoring	+1	+1	+1	+1	+1	+1	+1
e) Overall Environmental Review Criteria							
1) Land utilization	+2	+2	+2	+2	+2	+2	+2
2) Decrease of affluent/ poor income gap	+1	+1	+1	+1	+1	+1	+1

Legend

Liy ; Liyangastota Scheme
Mur ; Muruthawela Reservoir Scheme
Bad ; Badagiriya Scheme
Kch ; Kachigala Ara Scheme
Ben ; Benthara Ganga Right Bank Scheme
Pol ; Polwatte Ganga Scheme
Tha ; Thangalu Welyaya Scheme

ns ; No Significant
1 ; Small Significant
2 ; Moderate Significant
3 ; Major Significant
- ; Negative Impact
+ ; Positive Impact

(5) Positive and Negative Environmental Impacts

a) Environmental Factors due to Site Situation

1) Flooding Problem by Disruption of Hydrology

Lowland which is subject to inundation during flooding functions in a positive way to temporarily trap flood discharge and thereby relieving the pressure on areas further downstream. Areas of poor drainage under the drainage schemes of the Project, although rendered uncultivable in some cases by such poor drainage, serve the aforedescribed positive function of temporarily ponding flood discharge. This applies to lowland areas under irrigation schemes as well. The subsequent construction of embankments higher than the maximum flood water level in order to protect such areas from inundation has a potential negative effect of eliminating the ponding capacity of these areas and increasing flood damage downstream.

In the case of the Benthara Ganga (inundation in the scheme area is to 1 m depth according to interview survey) and Polwatte Ganga schemes, towns are located downstream. Particularly for the Benthara Ganga scheme, the downstream reaches of the river are an important tourist area and the potential impact on income from tourism as a result of flood damage cannot be ignored. Accordingly, upstream areas of these basins must be allowed to retain a certain degree of ponding capability during flooding. Similar conditions apply to the Tangalu Welyaya scheme as well; however, ponding scale is small and flooding relatively limited due to the fact that the river's headwaters are in Dry Zone. Accordingly, only a small impact is anticipated on downstream hydrology as a result of the scheme.

2) Watershed Erosion

Soil erosion occurs in the scheme basins depending on such factors as the type of land use and slope steepness. This erosion causes siltation in the scheme areas as well as further downstream. Siltation at weirs and gates as well as at the river mouth has a negative impact by causing deterioration in the function of river and irrigation facilities, and blocks discharge flow resulting in greater flood damage.

In the case of the Benthara Ganga scheme, land use in the upper basin is mainly for rubber plantation; in the case of the Polwatte Ganga scheme, upstream land use is chiefly for tea, rubber and coconut cultivation. The other dry zone schemes are in basins where the practice of chena is widespread, causing siltation of schemes due to soil erosion. At rubber plantations, soil is covered by undergrowth and erosion ratio is practically 0. At tea estates, however, the said ratio is much bigger. In areas where chena is practiced, erosion ratio is almost same as tea with no soil conservation. Accordingly, it can be seen that high erosion ratios exist in areas where land is used for tea estate and cultivation by chena. Nevertheless, large scale cutting and land preparation is carried out at rubber plantations every 20~25 years (the life of rubber tree) at which time erosion occurs on a par with that at tea estates (App.3-12, 13 and 14).

The expansion of cropped area as a result of the rehabilitation under the project will have

a positive impact on preventing erosion by reducing patches of waste land from which soil runoff occurs.

3) Encroachment into Wet Lands

Wetlands mark the boundary between areas of open water and dry land, comprising a valuable ecosystem as a habitat for both aquatic and terrain species. As a result, bio-diversity is high and the need to protect such areas also great. In the case of all schemes under the Project, lagoons and wetlands are found at the lower reaches near estuaries. Of these, areas for which CEA has formulated wetland conservation planning are considered as particularly meriting close attention.

These areas include Bundala national park downstream of Badagiriya Scheme, Dedduwa lagoon downstream of Benthara Ganga Scheme, Kalametiya lagoon (draft stage) downstream of the Kachigala Ara and the Liyangastota schemes. Mangrove forests are found at Kalamitya lagoon and the estuary of Benthara Ganga. The mangrove forest in the case of the mouth of the Benthara Ganga is on abandoned farm land, and the cutting of this forest would have a serious impact on habitat for aquatic species.

4) Impacts on Habitat and Movement of Wildlife

Bundala bird sanctuary is located downstream of Badagiriya Scheme, which is an important habitat not only for fowl but wild elephants and numerous other higher species of mammals, etc. In the case of wild elephants in particular, range of movement extends beyond the boundaries of the sanctuary, remaining near the water's edge during the day time and then emerging at night to forage for food in areas under the scheme. Although the full extent of movement patterns of these wild elephants is unclear at present, further development under the scheme has a potential negative impact on rest areas and trails utilized by them in and around the scheme area.

On the other hand, allowing wild elephant movement to continue within the scheme area will have a negative impact on the daily life of the farmers in the area as a result of crop damage.

The entire area around the mouth of the Benthara Ganga is jungle, serving as a habitat for numerous species of wildlife, and the area is an important source of income to local residents from the tourist trade. The scheme area extends at an elevation roughly equivalent to the average river water level along the Benthara and Welippene gangas. Mangrove grows in abundance along the river banks. Mangrove forest and uncultivated land along the water's edge is considered to be a route of movement for both aquatic and land wildlife, development of this area would have a negative impact on these movement routes and wildlife habitats in general. This concern for river edge areas applies to the other schemes to various degrees as well.

5) Impacts on Endangered Species

Under the Badagiriya Scheme, rare and endangered species include wild elephants and crocodiles, etc. in the vicinity of the estuary. The range of movement of wild elephants is wide, and these animals are seen as well in the Badagiriya, Muruthawela Reservoir and

Kachigala Ara scheme areas. Crocodiles live around the estuarys of almost all the major rivers; nevertheless, their intrusion into scheme canals appears to occur only very rarely, and rehabilitation of the schemes is not anticipated to affect their habitats or behavior with the exception of the Benthara scheme.

6) Impacts on Fisheries and Fish Farming

Impacts on fisheries and fish farming pertain to the tanks located upstream from the schemes, and the lagoons and estuary areas downstream of the schemes. Provided that the diversion amounts from the tanks and the drainage amounts into the downstream lagoons remain at present levels after rehabilitation of facilities under the Project, now new impact on existing fisheries and fish farming operations is envisioned. Nevertheless, the balance between inflow of salt water from the sea and the inflow of fresh water from upstream determines the saline concentration of downstream brackish water areas, and changes in this balance will cause concern for impact on catches of brackish fish varieties and shrimp.

Fishery in Malala, Kalametiya and Rekawa lagoons has already been affected by hydrological changes under past projects, resulting in lower saline concentration of the water and reduced catches of brackish water fish. If drainage amounts as a result of facility rehabilitation under the subject project further alter the saline concentration in these lagoons, the current situation will be further aggravated. Particularly in the case of Rekawa lagoon, fishermen are numerous and the potential negative impact from unmanaged discharge of freshwater into the lagoon under the Tangalu Welyaya Scheme is considered to be great. On the other hand, scheme implementation in coordination with the lagoon conservation policy of the Coast Conservation Department would result in a beneficial impact.

Fish farming relies on direct intake from the canal downstream of Muruthawela tank, and as long as this diversion is guaranteed no negative impact is seen as a result of the scheme rehabilitation.

7) Resettlement of Families Displaced by the Project

As resettlement will not occur under the envisioned rehabilitation of schemes, no impact in this regard will be generated by the Project.

8) Impact on Aesthetic Value

In the case of the Benthara Ganga Scheme area, tourist cruises ply the river to view the natural beauty of the area and its abundant wildlife. Changes to the natural environment including the construction of irrigation and drainage facilities which impair its aesthetic value will impact adversely on the present tourist value of the area.

Other schemes will not impact adversely on aesthetic value of the natural environment, particularly in light of the fact that already existing facilities are to be rehabilitated.

b) Environmental Factor from Oversights in Planning and Design

1) Suitability of Water Quality for Irrigation

Water quality for irrigation use was evaluated based on the analyses on the water samples collected during the phase-I field survey (Table 5.2.5-2). In the evaluation of pH of the collected water samples, reference was made to the Sri Lankan Standards (Table 6.7-1). And as for the evaluation for EC of the collected water samples, reference was made to the allowable values recommended by Sri Lankan standards as well as to the values given by IIMI (Table 5.2.-4).

Note : It is recommended in " Sri Lankan Standard Specification for Potable Water (SSPW) " that the desired level of EC is less than 750 uS/cm and permissible level should be below 3,500 uS/cm.

Impact	pH	EC (μS/cm)
ns	6.5 - 9.0	>750
-1		750 - 4000
-2		4000 - 6000
-3	<6.5 or >9.0	>6000

In the said evaluation, reference was also made to the following :

i. Benthara Ganga R.B Scheme is presently irrigated by rain-fed irrigation, accordingly this scheme was omitted from the evaluation ;
ii. Flood irrigation is being practiced in Polwatte Ganga Scheme by use of Ilwatta anicut where strong influence on the river water due to intrusion of saline water is observed. Accordingly, evaluation was made for this scheme based on the analyses of sampled water (Sample No.5) taken from the upstream of the existing Ilwatta Anict ; and
iii. Samples No.8 and No.9 taken both at Maha anicut and Danketiya anicut were used for water quality evaluation for Thangalu Welyaya.

Results of the evaluation have shown that the pH ranges of the sampled water are within the permissible level of SSPW and evaluated as " not significant (ns) ". As to the EC values of the sampled water, relatively high values of EC have been observed in Badagiriya, Polwatte and Thangalu Welyaya Schemes. This tendency is remarkable at Polwatte Ganga Scheme where flood irrigation is being practiced by Ilwatta Anicut. The reason for high values of EC in Badagiriya Scheme may be attributed to that the scheme is located in dry zone of Sri Lanka as well as to the meteorological condition of shortage of rainfalls and relatively high evapo-transpiration, which is commonly observed during dry season.

2) Suitability of Soil for Paddy and Crops

Soil suitability for cultivation has been evaluated based on the existing available data and survey results obtained during the phase-I field survey (Table 5.2.5-1). Evaluation for the whole target schemes has been made using the Soil Maps of Land Use Division in ID [1/] and the Land Suitability Evaluation [2/] which was prepared by Land Use Division of Irrigation Department.

Note 1/ : Soil Map of Kalutara District by Land Use Division of Irrigation Department.
Note 2/ : Land Suitability Evaluation & Land Use Study in Matara and Hambantota districts by Land Use Division of Irrigation department.

And in the evaluation of saline water affected-soil, the values of EC and NaCl contents in the said soil have been used In the said evaluation, reference has been made to the criteria by IIMI (Talbe 5.2.5-3).

Impact	Land Suitability Class	Influence of Sea Water Intrusion
ns	S1,S2,S3	Class0
-1		Class1
-2		Class2
-3	N	Class3

Results of the above-mentioned evaluation have revealed no serious problems in the soils in the areas under the target schemes which mostly consist of cultivated farmlands, except some areas affected by intrusion of saline water. Accordingly, the soil under the target schemes has been judged to be " ns " as a whole. However, bad influence on the soil by intrusion of saline water has been found in the schemes of Benthara Ganga Right Bank, Polwatte Ganga, Tangalu Welyaya and Kachigala Ara, giving negative impacts to the farmlands under the said schemes. Namely, as negative impacts, some water samples taken from the said 4 schemes have shown relatively high values of EC and NaCl contents. This may be attributed partially to concentration of saline water due to high evapo-transpiration during dry season. These negative impacts, however, would be mitigated through rehabilitation. Other than said 4 schemes, no serious problems in soil due to salinity have been found.

3) Excessive Use of Groundwater

As groundwater use is not planned under the rehabilitation of schemes, no impact in this regard will be generated by the Project.

4) Use of Agro-chemicals

Agro-chemicals and chemical fertilizers are widely utilized by farmers, with the quantity per farm fluctuating depending on availability of subsidies and changes in prices. Although implementation of the Project will not necessarily result in greatly increased use of these items, it can be assumed that amounts will proportionately rise in relation to extent of newly cropped land. Residue from agro-chemicals and chemical fertilizers will both reside in the soil and be carried off by drainage water to accumulate both at the bottom of lagoons and in solution in the lagoon water itself. This residue will be ingested by aquatic wildlife at the lagoon bottom and swimming species of lagoon wildlife, moving up the food chain in gradually more concentrated amounts to eventually impact adversely on the health of higher species including humans. In the case of chemical fertilizers, eutrophication in the lagoons is accelerated promoting algae blooms which give off unpleasant odor as well as impacting on water diversion upstream for domestic

and other purposes.

Thus utilization of these chemical substances upstream and within the scheme areas themselves impacts on both the scheme and downstream areas. In addition to the fact that farm households rely on rivers and canals for bathing and laundry, in many cases potable water is filtered from rivers and tanks. This poses a danger of ingestion of dissolved chemical residues. Impact on downstream ecosystems and fish catches is also a concern; however, present levels of these substances in river and lagoon water is not considered a major problem.

5) Water-oriented Disease Hazards

The dry zone area centering on Lunuganwehera is afflicted by malaria, spread by mosquitoes which breed in stagnant water bodies. Potential spread of this disease is a danger. Accordingly, increase of irrigated area through rehabilitation of facilities with resultant distribution of water to areas which were previously dry poses a potential negative impact of increase in incidences of malaria. Particularly in the case of the Badagiriya Scheme, a general absence of water to date in the area coupled with lack of awareness on the part of the local population about the malaria vector pose a potential negative impact should irrigation facilities not be operated and maintained properly. In the case of the Liyangastota Scheme as well, which not only being relatively proximate to Lunuganwehera is also an area of unmanaged gem mining which creates mosquito breeding grounds in trapped water of excavated shafts, the danger for spread of malaria via infected mine laborers is present.

6) Feasibility of Effective Cooperatives

Although farmer organizations exist in all the scheme areas, their activities vary from scheme to scheme. Under the subject Study, WLAC workshops were carried out to date three times for each scheme with the participation of representatives from the relevant farmer organizations. In the course of these workshops, the needs and aspirations of the concerned farmers were thoroughly sounded and this data is to be fully incorporated into project formulation. Problem issues put forth by farmers with regards to the operation and maintenance of facilities following rehabilitation are also under study. Heightening of farmer self-awareness about their role in the successful implementation and operation of the schemes through participation in workshops, etc. from the planning stage, and mutual understanding between the affected farmers and project executing agencies regarding project goals is anticipated to bring about a positive impact as a result of more effective and vigorous activity on the part of farmer organizations.

7) Conflicts in Land Use

Conflicts over land use that affect feasibility of this project are not envisioned under any of the schemes.

8) Rights in Water Use

In the case of the Muruthawela Reservoir Scheme, illegal diversion of irrigation water from Muruthawela tank to Tract I (operation commenced in 1971) has been tacitly

tolerated. The benefit area under this diversion is estimated at around 415 ha. As a result of diversion in Tract I, irrigation water shortages are experienced in the downstream Tract II and III areas with a negative impact for the overall scheme.

Under the Benthara Ganga Scheme, leaving flap gates open in the course of fish harvesting in the scheme canals has resulted in many cases of deformation and other damage to the said facilities. The possibility of this occurring after rehabilitation under the Project remains high, and poses a negative impact to the said scheme.

Water is diverted in scheme benefit areas for drinking and other domestic purposes, and it is necessary to ensure that such diversion is not affected under the Project. Particularly in the cases of the Polwatte and Thangalu Welyaya schemes, river discharge is small with diversion sites for domestic use water located in tidal zone, posing a potential danger that excessive diversion of fresh water for irrigation will raise the saline content of drinking water.

9) Passageways of People and Cattle

Although roads exist along embankments (O/M roads) in the scheme areas, in some cases these are unsurfaced, lack sufficient width, and do not extend along the entire length of embankment. Improvement of these roads in the course of rehabilitation of facilities will have a beneficial impact.

10) Canal Maintenance

Canals are unlined (earthen) and in some cases water passage is blocked by plant growth and canal walls damaged by foraging water buffalo. Should canals be earthen following rehabilitation works as well, these phenomena can be expected to continue posing a negative impact under the schemes.

11) Influence from Realization of Other Projects

Impact on other projects includes that to already completed projects and that to projects currently either under planning or under implementation.

Among large scale, already completed projects are the Uda Walawe Development Project and the Kirindi Oya Irrigation Settlement Project. Discharge from the Uda Walawe WB Scheme passes via the Kachigala Ara Scheme to empty into Kalametiya lagoon. In this regard, the hydrological boundary between the Kachigala and Walawe basins has in effect disappeared, with a large increase in the discharge emptying into Kalametiya lagoon. As a result, areas at the lower reaches of the Kachigala Ara suffer from poor drainage and chronic flood damage, and excessive inflow of fresh water into Kalametiya lagoon has reduced the saline concentration causing smaller catches of brackish water fish and shrimp. Under this situation, rehabilitation of the Kachigala Ara Scheme will neither fully correct the problem of poor drainage in the scheme area, nor resolve the issue of conserving the lagoon eco-system at Kalametiya. Without the establishment of serious measures to regulate discharge from Uda Walawe, the full beneficial effect of rehabilitation under the Kachigala Ara Scheme is constrained.

In the case of Badagiriya Scheme, diversion is from Lunuganwehera tank. Furthermore, the Kirindi Oya scheme has an independent drainage mechanism meaning that the existence of the Kirindi scheme has no bearing on the impact to be expected from rehabilitation under the Badagiriya Scheme.

Among projects at the design and implementation stage are the Benthara LB scheme and the SAM at Rekawa lagoon. In the case of the Benthara LB, study of an irrigation and drainage system is ongoing, and given natural topographical features of the area conducive to frequent flooding, the specific content of the LB scheme will have a certain bearing on the Benthara RB Scheme. For example, if the LB scheme completely eliminates flooding from its scheme area, flood pressure will potentially increase on the right bank.

SAM is an integrated environmental conservation program aimed at protecting the lagoon's ecosystem by stabilizing saline concentration of lagoon waters, and fostering a managed fisheries industry. Amount and method of drainage of fresh water into Rekawa lagoon will impact on SAM, and conversely, SAM will be a constraint on components under the relevant scheme.

c) Problems during Construction Stage

1) Erosion Control

Construction work categories envisioned under rehabilitation of the irrigation and drainage schemes are: embankment works (cutting, embanking, excavation, bank protection works, covering), canal works (excavation, bank protection works, step works) bridge and gate works (excavation, concrete works, backfilling), road works (cutting, embanking, compaction, asphalt surfacing works), finishing works (land leveling, soil dressing), electrical facility works (building construction, manufacture, installation), temporary facilities, etc.

Of the above, work categories particularly relevant to soil erosion are cutting, embanking and excavation. Nevertheless, these are done only on a small scale and impact on erosion control is considered very little provided construction works are done during periods of no rain.

2) Other Construction Stage Impacts

Other environmental issues at the construction stage include safety of workers; worker health and sanitation including the prevention of malaria outbreak; prevention of frictions among construction workers and the local population; protection of personnel from toxic substances; odor, dust and noise pollution; contamination of groundwater, localized instances of flood damage, unintentional alteration of hydrology (landfill into lagoons, rivers, estuaries, etc., dredging).

In light of the fact that scheme areas area flat farmland away from urban areas, and the nature of the schemes themselves as rehabilitation of existing structures as opposed to new construction, no particular problems with regards to safety, labor conditions, sanitation, etc. are not envisioned. Attention is necessary, however, to prevention of

malaria outbreak at construction sites.

3) Monitoring during Construction

Environmental monitoring during the construction stage is important in addressing the issues cited in c-2) above. A careful monitoring program will track impacts to the environment as they arise, and allow for prompt response where conditions fall below stipulated standards.

d) Problems in Operations

1) Responsibility of O/M

Establishment of an effective O/M system will have a major bearing on the success of the Project. Responsibilities in this regard must be clearly delineated, with maximum participation in O/M by the farmers themselves promoted.

Farmer participation is to be encouraged from the design stage in order to fully grasp farmer needs and aspirations and reflect these project formulation including the operation and maintenance plan for the system after constuction. In this way, the Project will have a beneficial impact on the sharing of O/M responsibilities by the farmers.

2) Operations Monitoring

As with the construction phase of the Project, the carrying out of an appropriate environmental monitoring program will have a positive impact by preventing or minimizing to the extent possible impacts to the environment at their incipient stages.

e) Overall Environmental Review Criteria

1) Land Utilization

Land use under the target schemes is almost totally for farming. However, salt buildup in the soils of the scheme areas has led to soil degradation, causing some of this land to become uncultivable. Regeneration of this land as productive farm land is a target of the Project, and from the standpoint of effective use of natural resources, productive utilization of abandoned waste land and the prevention of soil degradation are positive impacts to be realized under the Project.

The Project will also have a beneficial impact in the preservation of wetland and promotion of greening. Long-term, unmanaged use of paddy field, which will continue without implementation of the Project, results in gradual silt buildup, eventually turning such areas into dry land and causing soil degradation which inhibits plant growth.

2) Decrease of Affluent / Poor Income Gap

Farmers in Sri Lanka are largely poor, and the rural population comprises a large proportion of the whole in the southern region. Rehabilitation of facilities under the Project will increase land productivity, resulting in a positive impact of increased and

stabilized farm income which will contribute to closing the income gap between the affluent and the poor.

6.7.4 Alleviation and Conservation Plan

(1) General Part of the Plan

a) Watershed erosion

Negative impacts by soil erosion from watersheds may be related to every scheme, and they will be different from each other by land use, rainfall, geology and topography in watersheds. Especially since land use is artificially affected, the improvement toward land use with less erosion should be necessary, and in addition, to grasp quantitative sedimentation rate in schemes and exclusion of soil may be necessary, if judged so.

Such improvements will include the following:

- Weirs and other structures across rivers are to be equipped with sand flushways to prevent siltation in order to keep hydrological functions of the structures.
- To monitor quantities in tanks periodically, and to dredge there if necessary.
- Where tea plantation is done on inclined lands, farmers will be given guidance in contour planting of tea trees.
- Contour farming on revitalization of rubber plantations as well will be encouraged as well to suppress soil erosion.
- To divert from erosive crops and plantations to no erosive one.
- To encourage chena farmers to cultivate in the designated lands.
- To improve those in the above totally through FOs, and subsidy for farmers of small scale.

b) Biodiversity

A lower part of every scheme belongs to a National Park, a Sanctuary or wetlands. Therefore, it is necessary that discharges and agro-chemicals from schemes should not impact the habitats and movements of wildlife such as endangered species.

- Purchase or to barter of land on which mangrove forests are located, and the designation of the same as special reserves in order to protect mangroves.
- Designation of sanctuaries and inter-scheme buffer zones to preserve natural vegetation.
- Conduct survey on the natural habitats and movements of larger wildlife including elephants and crocodiles, etc., and reflect the findings of such study in Project planning.
- To consider close liaison between this Rehabilitation Plan and the other conservation plans about such as National parks and wetlands listed below.
    - Bundala National Park
    - Kalametiya & Lunama Kalapuwa Sanctuary
    - Rekawa Lagoon
    - Bentota Estuary

c) Soil Salinity

Every scheme has soil salinity problem by sea water intrusion especially in lower lands, in which improvement including not only planning and design but maintenance of the structure rehabilitated is necessary.

- Improvement of SWE and systems, and studying adequate operation methods in order to restrain the impacts by sea water intrusion.
- Daily careful O&M of irrigation structures with consideration of handing over them to farmers and FOs.
- Considering the profitability, surrounding environment and farmer's needs, counterplans given below will be considered in lands with soil salinity problems.
  - Removal of soil salinity by leaching,etc..
  - Introducing of crops and vegitations with saline tolerance.
  - Land use diversion in lands with much soil salinity

d) Use of agro-chemicals

Although soil and water pollution induced by agro-chemicals and fertilizers is getting worse, enough observations have not been carried out in most rivers yet. First to collect basic data to guide adequate use methods, which also include the following will be necessary.

- Periodical observation of water quality in the designated points in channels, tanks and rivers.
- Periodical observation of soils and groundwater.
- Drafting of manuals on the correct use of agro-chemicals and chemical fertilizers, and dissemination of this information to farmers.
- Settlement of organizations for water use and water management including water quality protection on the basis of FOs.
- Instruction to the public about harmful effects of agro-chemical contamination.
- Extension of organic farming methods.

e) Water-oriented disease hazards

Disease hazards of Malaria mainly centering around the Hambantota district and Filaliyasis mainly in the western part rather than the Matara district become problems. To prevent to occur mosquitoes carrying these diseases is necessary.

- Spraying of insecticides such as Malathion against larvae over stagnant water bodies in pits, etc. and extermination by releasing fish into channels and tanks.
- Strict enforcement of penalties and fines for illegal gem mining
- Filling of pits excavated during construction.
- To avoid a channel structure which may provide dead water place.
- Strict Maintenance of channels by weeding and cleaning.
- Strengthening of medical services and facilities in affected areas.

f) Infrastructure improvement

Improvement of agricultural infrastructure will be necessary such as improvement of farm roads, bridges and channels, etc. and in addition, comfortable bathing and washing places in channels for local people are also necessary.

g) Construction Stage

During construction, to prevent soil erosion caused by construction work is necessary, besides, prevention of water-oriented diseases to avoid excessive soil compaction in agricultural lands by construction machines and to avoid discharge and abandonment of wastes are also necessary.

In addition the following are also to be taken into account.

- Cut and fill planning to minimize soil erosion and consideration for construction work avoiding Southwest Monsoon and Northeast Monsoon.
- Provision of sedimentation tank, and quick recovery of bare lands by provision of natural vegitation.

h) O&M Stage

In examining maintenance and operation rule in O&M stage including responsabilities and methods of daily maintenance of channels,etc., FOs will take partial charge of maintenance and management work also. And to examine the adequate water management and to promote FOs will be executed through periodical meeting between government and FOs.

i) Environmental Monitoring

Monitoring should be carried out in 3 stages, i.e., before construction, during construction stage and O&M stage after construction in order to grasp an extent of environmental impacts. The monitoring items will be, run-off water and groundwater quality, soil, sedimentation,etc. In the monitoring, number of testing items and frequency of testing should be carefully decided considering costs required.

The said monitoring will include the following:

- Monitoring of water quality of injurious materials and contamination by wastes and agro-chemicals during and after construction. The monitoring will be periodically executed according to the Sri Lankan Tolerance Limits relating to run-off water quality.
- In addition, monitoring of soil characteristics and groundwater quality of farm lands, sedimentation quantity in tanks and flora and fauna species around schemes, investigation of environmental changes by this rehabilitation project and execution of the measures against outstanding problems, etc. will also be included in the monitoring.

(2) Scheme-wise plan

In addition to the plan already mentioned, scheme-wise alleviation and conservation plan will be considered as below.

a) Liyangastota Scheme

IEE results of the Liyangastota scheme are given below.

Suitability of water quality for irrigation	:	-2

- The problem is river water pollution by discharged effluent from the Paper mill in the upper basin. According to make clear about stipulation of procedures for communications and to establish gate management rule in the event of discharge of so called black liquor are necessary. A guidance, education and information to farmers relating to the injurious effluent from the Paper mill will be definitely necessary and checking of water quality on discharged effluent is also necessary.
- As a basic policy, either enforcement of more strict standards for waste water from the pater mill, or checking the achievement of drainage criteria required in the scheme are necessary.

b) Muruthawela Reservoir Scheme

IEE results of the Muruthawela Reservoir scheme are given below.

- Rights in water use	:	-2
- Encroachment into wetlands	:	-1

- As a result, it is necessary in planning to take into account of the intake water amount in tract 1 considering discharge distribution to tracts 1, 2 and 3, and exclusion of illegal intakes by superintendence of FOs is also required.
- Further, mangrove forests in Kirama Oya estuary should be protected same as in the SAM project.

c) Badagiriya Scheme

IEE results of the Badagiriya scheme are given below.

- Impacts on habitat and movement of wildlife	:	-2
- Impacts on endangered species	:	-2
- Impacts on fisheries and fish farmings	:	-1
- Suitability of water quality for irrigation	:	-1

- Impacts on the Bundala National Park as the Ramsar site must be alleviated in particular, and monitoring of water quality of discharges from the scheme and biotic indicators representing ecological degradation will be executed. It is necessary to plan with consideration of setting buffer zone of green belt for grazing livestock and collecting fuel woods surrounding the Park.
- Continuous observation of salinity concentration in the Badagiriya Reservoir.

Introduction of crops and plants with tolerance for salin.

- Water management rule relating to the adequate discharge from the Scheme will be defined in order to alleviate impacts on fisheries which is regarded as "small significant" due to discharge flowing into the Embilikal Kalapuwa and Malala Leweya.

d) Kachigala Ara Scheme

IEE results of the Kachigala Ara scheme are given below.

- Influence from realization of other projects	:	-3
- Encroachment into wetlands	:	-2
- Impacts on habitat and movement of wildlife	:	-1
- Impacts on endangered species	:	-1
- Impacts on fisheries and fish farmings	:	-1

Floods in the lower part of Kachigala Ara scheme may result from the excessive discharge from the Udawalawe right bank scheme, and the counterplans listed below will be considered in order to assure the effects of this Rehabilitation Plan.

- Execution of the cooperative study with the Mahaweli Authority concerning the adequate water management of both Udawalawe right bank scheme and Kachigala Ara scheme, and of the discharge from the Udawalawe right bank scheme also.
- Or diversion of discharge directly into the Walawe Ganga from the Udawalawe right bank scheme.
- Widening of the estuary at Kalametiya lagoon, and flood mitigation by the connection between Kalametiya and Lunama Kalapuwa.

In order to conserve wetlands and wildlife and maintain fisheries, the following are required.

- Purchase and barter of lands in order to conserve mangrove forests in the Scheme.
- Farming of fresh water fish and brackish water fish, and subsidy for releasing those small young fish to tanks and lagoons.

e) Benthara Ganga Scheme

IEE results of the Benthara Ganga scheme are given below.

- Flooding problem by disruption of hydrology	:	-2
- Rights in water use	:	-2
- Encroachment into wetlands	:	-2
- Impacts on habitat and movement of wildlife	:	-1
- Impacts on endangered species	:	-1
- Influence from realization of other projects	:	-1

Accordingly, the following are required.

- To estimate a ponding capacity and a discharge flux, etc. during flooding in the Scheme, and to prevent more strict flooding around there.
- Consideration of the counterplan to discharge the floods quickly as possible, assuming of waterlogging within the Scheme due to flooding.

- In order to avoid troubles with fishermen in channels, more vigorous cautioning and instruction against fishing in canals, to examine possibility of establishing water bodies solely for fishing and replacement of flap gates with a stronger type of gate will be considered.
- Diversion from paddy to sedge cultivation and instruction, propagation and marketing of sedge crafts in order to conserve the Bentota estuary wetland.
- Conservation of natural vegetation such as mangroves along the rivers and design of structure so as to minimize their "stand-out" from the surrounding site environment for cruising along the river.
- Adjustments with rehabilitation plan for Benthara ganga left bank scheme

f) Polwatte Ganga Scheme

IEE results of the Polwatte Ganga scheme are given below.

- Flooding problem by disruption of hydrology	:	-2
- Rights in water use	:	-2

As a result, the following are required.

- The drainage plan of the Scheme will be studied after grasping flood discharge of Polwatte Ganga. However, flood damages by the Polwatte ganga is expected as smaller rather than that by the Benthara ganga. Improvement of Ilwatta anicut which was constructed for flood irrigation is necessary.
- To avoid impacts on tap-water supply system caused by the excessive taking of river water for irrigation and degradation of sea water intrusion.

g) Thangalu Welyaya Scheme

IEE results of the Thangalu Welyaya scheme are given below.

- Impacts on fisheries and fish farmings	:	-3
- Influence from realization of other projects	:	-2
- Rights in water use	:	-2
- Flooding problem by disruption of hydrology	:	-1
- Encroachment into wetlands	:	-1
- Impacts on habitat and movement of wildlife	:	-1
- Impacts on endangered species	:	-1

As a result, the following are required.

- To maintain discharge into the Rekawa lagoon, to monitor water quality of the discharge and to exchange information between the subject Project and SAM Project in order to alleviate impacts on the lagoon fisheries.
- As countermeasures against siltation, planting of mangrove in boundary areas between the Scheme and the lagoon.
- Farming of brackish water fish and prawns, and release of fingerlings into water bodies in order to promote the lagoon fishery.
- Conservation of mangrove forests and biotic diversity of the Rekawa lagoon.

6.7.5 Participation of Farmers

Since participation of FOs will be necessary in daily maintenance after rehabilitation, so the Plan intends promotion of FOs from the view point of the middle years, and measures such as carrying out of work shop with FOs from planning stage, grasping of farmers' demands against the irrigation rehabilitation project and making relation closer between government and FOs must be taken. Continuation of periodic workshops and other efforts to increase self-awareness and a mentality of self-help among farmers will assure effects of the Project.

6.7.6 Elevation of Women's Situation

Women might play important roles concerning directly with family income increase by agricultural work, natural resources conservation and control of population increase. In order to raise the situation and role of women in the rehabilitation project, collection of basic data, guidance and subsidy,etc. for women in agriculture will become necessary.

- Presenting of information, training and instructing and offering of subsidy against women's agricultural work, home gardening, labour and self-employment work,etc.
- Promotion of market for productions by women.
- Offering and lending of a working places and instruments for women
- Examining of women's workshop.
- Reflection of women's requests to the Project relating to agricultural works and facilities,etc.

6.7.7 Education and Subsidy for Farmers

To examine the issues listed below and assure the effects of the Project will be important.

- Technical instruction for farmers
  - Policy and measures of daily maintenance and management
  - Cooperation work and responsabilities of government and FOs
- Environmental instruction
  - Natural resources conservation such as soil and natural forest,etc.
  - Wildlife and biodiversity conservation
  - Water pollution and impacts by use of agro-chemicals and fertilizers
- Subsidy to farmers for an initial investment of crop diversion,etc.

6.8 Project Evaluation

6.8.1 Objective of Project Evaluation

Evaluation of a project includes both financial and economic evaluation. Financial evaluation assesses the profitability of a project from an individual economy standpoint, whereas economic evaluation assesses the same from a national economic viewpoint.

6.8.2 Methodology

By computing and comparing benefit and cost for both the case in which the project is not implemented (hereinafter referred to as "future-without-project") and the case in which the project is implemented (hereinafter referred to as "future-with-project"), the profitability of the project is examined in terms of 3 criteria, i.e. net present value, benefit/cost ratio and internal rate of return. It should also be noted that financial evaluation centers on farm economy.

6.8.3 Financial Evaluation and Economic Evaluation

(1) Base Conditions of Project Evaluation

Project evaluation is carried out based on the following conditions.

a) Interpretation of Future-without-Project Case

Under the future-without-project case, it is assumed that operational condition of existing irrigation facilities will progressively decline, resulting in increased deterioration of the facilities and increased irrigation conveyance losses in turn causing a decrease in cropped area and unit yield.

b) Project Life

Project life, based on the estimated duration of rehabilitated irrigation facilities, is considered at 25 years, including the 5 year construction period.

c) Cost and Benefit

Cost and benefit are computed in terms of market prices (financial terms) under financial evaluation, and in terms of shadow price (economic terms) under economic evaluation.

d) Inputs and Outputs

i. Traded Goods

Financial prices of traded goods are based on 1994 domestic market prices, while 2,000 international market prices (1994 constant prices) are adopted for economic prices. As a result, inflation is not considered.

Farmgate prices of agricultural products and fertilizer (in economic terms) are based on FOB/CIF prices also taking into account tariffs, port charges, distributor's margin, and transport costs, after which tariffs and taxes are then eliminated and the conversion factor applied (see App. 2.3-1 ~ 5). However, the farmgate prices (in economic terms) for chillies and reeds have been converted to border prices applying the standard conversion factor (SCF).

ii. Non-traded Goods

In the case of non-traded goods, domestic market prices have been applied for financial prices and the SCF has been applied to estimate economic prices. The SCF is also applied in the case of estimating labor cost, and evaluation made based on opportunity cost.

iii. Capital

The World Bank's estimated value of 10% for Sri Lanka is applied as the opportunity cost of capital.

iv. Foreign Exchange

Foreign currency value is generally determined under national policy with regards to tariffs and trade constraints, and there often exists a gap between this and the official exchange rate. Under such conditions, some form of adjustment of border price is necessary when computing economic cost and benefit. Nevertheless, the present administration emphasizes a flexible foreign exchange policy and as a result the official exchange rate approximates the actual rate of foreign exchange. Accordingly, the official exchange rate as of December 1994 of US$ 1 = Rs 50 is adopted under both financial and economic evaluation.

v. Labor

The economic cost of labor is interpreted not as the nominal wage rate within the labor market, but rather it is considered equivalent to the wage rate of the best alternative employment opportunity inside the country or the marginal productivity of labor. Chronic under-employment is present in the Study region and the labor absorption rate of the agricultural sector is considered to be at a saturated level. Accordingly, the nominal wage rate is applied under financial evaluation. Under economic evaluation, the opportunity cost of skilled labor is assumed at 1.0, and the SFC applied. In the case of unskilled labor, an opportunity cost of 0.5 is assumed, and theSFC applied.

vi. Conversion Factors

A gap exists between international market prices and domestic market prices in the case of Sri Lanka as a result of government trade policies which apply various import/export duties on goods moving in and out of the country. In order to compensate for this in project evaluation, a certain portion of the benefit and cost of the project, calculated on the basis of the domestic prices for non-traded goods, is converted to border prices by applying the SCF. The SCF is an expression of the ratio of domestic prices to border prices, and is set at 0.85 (from World Bank Report, "National Irrigation Rehabilitation Project", May 9, 1991).

In order to eliminate the gap between international and domestic price levels, the Government is pursuing a policy of step-wise reduction of import/export tariffs in order to promote the development of robust domestic economic activity fully competitive at the international level, including domestically produced agricultural products as well.

(2) Project Cost

Project cost comprises construction cost and O/M cost.

a) Construction Cost

Construction cost includes irrigation facility rehabilitation cost, administrative cost, engineering service fee, and contingencies (both physical contingency to cover changes in construction quantities and price contingency to cover price fluctuations). Since the sunk value of irrigation facility rehabilitation is a small portion of total project cost, it is not considered here. In order to convert financial cost into economic cost, transfer payments are eliminated and conversion factor applied. Results are indicated in App.2.3-6.

b) O/M Cost

Required costs for operation and maintenance of rehabilitated irrigation facilities are estimated on the assumption that the O/M cost under the present case amounts to Rs.300/ha and remains unchanged under the future-with-project case.

(3) Project Benefit

Benefit generated under the project is multifaceted, including external economic benefit (secondary benefit). Agricultural product quantities and the incremental production benefit for by-products are calculated under benefit.

a) Cropped Area and Crop Yield

Year-wise changes in cropped areas and crop yields under the present case, the future-without-project case and the future-with-project case are shown in App.2.3-7. As can be seen from the table, decline in the operational and maintenance status of existing irrigation facilities results in deterioration of structures and increased conveyance losses, thereby impacting on cropped areas and crop yields.

b) Production Value of By-Products

Bran and chaff are included in project benefit as by-products. Yields for these are calculated at 280 kg and 40 kg, respectively, for 1 ton of paddy.

c) Net Production Value of Farm Products

Net production value of farm products is computed by subtracting production cost from gross production value, on the basis of the present case, the future-without-project case and the future-with-project case. (see App. 2.3-8)

(4) Annual Net Incremental Benefit

Flow of annual net incremental benefit based on project cost and project benefit is as shown in App. 2.3-9.

(5) Project Profitability Indicators

On the basis of the criteria set out in section 6.8.2, project profitability indicators under economic evaluation are as shown in the table below:

Project Evaluation Indicators

Scheme	NPV (Rs. 1,000)	B/C ratio	EIRR (%)
Liyangastota Scheme	781,079	3.62	24.24
Muruthawela Reservoir Scheme	702,026	3.30	22.22
Badagiriya Scheme	166,936	6.02	32.76
Benthara Ganga Right Bank Scheme	7,004	1.06	10.69
Polwatte Ganga Scheme	-35,496	0.65	5.89
Thangalu Welyaya Scheme	-22,817	0.69	6.46

Note: NPV and B/C ratio are computed at a discount factor of 10%.

Implementation of three schemes of Liyangastota, Muruthawela Reservoir and Badagiriya is determined to have an extremely high economic justification from a national economic stand point as well as general criteria for project profitability (EIRR over 15%). Profitability becomes even greater when socio-economic ripple effect of the schemes is considered.

(6) Sensitivity Analysis

Case 1: Project cost increases 10% due to rise in unit costs for construction materials and equipment, etc.

Case 2: Achieving of target unit yield becomes impossible, and project benefit drops by 10%

Case 3: Simultaneous occurrence of Case 1 and Case 2.

Results of sensitivity analysis on the basis of the above 3 cases are indicated in the table below:

Sensitivity Analysis for EIRR (%)

Scheme	Case No.1	Case No.2	Case No.3
Liyangastota Scheme	23.14	23.02	21.91
Muruthawela Reservoir Scheme	21.24	21.13	20.16
Badagiriya Scheme	31.48	31.34	30.05
Benthara Ganga Right Bank Scheme	9.65	9.54	8.53
Polwatte Ganga Scheme	5.01	4.93	4.08
Thangalu Welyaya Scheme	5.57	5.48	4.61

Although there is a general sensitivity of all schemes regarding decrease in project benefit and increase in project cost, no significant effect on economic justifiability is anticipated.

(7) Analysis of Farm Economy

Farm economy analysis aims to calculate the annual income increase for both land owner cultivators and tenant cultivators in the case of project implementation. Under the assumption that off-farm income is not considered, the cost amounting to Rs100/ha for O/M of irrigation facilities after rehabilitation are taken into consideration in computing farm income. Results of calculation are indicated in App. 2.3-10. Accordingly, incremental incomes for owner cultivators are estimated to range between 2.3 and 7.5 fold over present levels, of which those for paddy cultivation differ from 1.5 and 3.5 fold except Benthara Ganga Right Bank Scheme. In the case of tenant cultivators, there are two types of tenancy contract: (i) where the tenant turns over 25% of total rice production to the land owner, and (ii) where the tenant turns over 10 bushels/ac (Kalutara, Galle and Matara districts) or 14 bushels/ac (Hambantota) of rice to the land owner, based on the Agrarian Services Act ("Gazette Extraordinary of the Democratic Socialist Republic of Sri Lanka, April 8, 1992"). Applying the latter type as analysis criterion, annual incremental income of the tenant cultivators is also anticipated to increase significantly from the present situation.

CHAPTER SEVEN :
SELECTION OF THE SCHEMES

CHAPTER SEVEN : SELECTION OF REHABILITATION PLAN

7.1 Criteria for Selection of the Schemes

In selecting target schemes for feasibility study, first screening will emphasize the dual criteria of (i) level of farmer organization, and (ii) economic viability.

Viability of the schemes will be judged based on the following conditions.

(1) Farmer Organizations

The results of much research to date show clearly that active participation by farmer organizations at both planning and construction stages and the establishment of efficient and sustainable system management by the farmer organizations are the corner stones in effectively implementing a participatory type rehabilitation project and achieving the desired goals thereby. Accordingly, scheme screening will strongly emphasize this point. In this regard it would normally be considered that the relevant farmer organization must have achieved at least a class 3 level of development (classifications as set out in the previous section 6.6.3) in order for it to effectively carry out system management. Nevertheless, on the assumption that strengthening of farmers organizations will be carried out simultaneous to the facility rehabilitation under the Project, and that this will upgrade the development level of a class 4 FO to a class 3 organization, the class 4 level is accordingly considered the minimum when considering effective system management under the farmer organizations. FOs at class 5 level need to be targeted for an organizational strengthening program; however, judging from the current status of such groups it is concluded that this would take a long period of time.

(2) Economic Viability

The economic Internal Rate of Return (EIRR) of a scheme under rehabilitation works is at least 15%.

(3) Benefit Area

The combination of benefit areas of the schemes satisfying the above criteria (1) and (2) is at least 10,000 ha.

7.2 Ranking of the Schemes

Based on criteria for selection of schemes, ranking of each scheme is summarized below.

(1) Farmer Organization (F.O.)

The level of F.O. is ranked as follows. (refer to Section 6.6.3)

Ranking	Name of the Schemes
1	None
2	Badagiriya
3	Muruthawela LB, Liyangastota LB
4	Liyangastota RB, Urubokka Oya, Kirama Oya
5	Polwatte Ganga, Benthara Ganga RB, Tangalu Welyaya

In view of the criteria for selection of schemes, the schemes with ranking No.5, i.e, Polwatte Ganga, Benthara Ganga RB and Tangalu Welyaya, would be eliminated.

(2) Economic Viability

As a result of economic evaluation, EIRR of each scheme ranked as follows.

Ranking	Name of the Schemes	Cost (Mil. Rs.)	EIRR (%)
1	Badagiriya	57	32.76
2	Liyangastota LB and RB	473	24.24
3	Muruthawela	484	22.22
4	Benthara Ganga RB	174	10.69
5	Tangalu Welyaya	118	6.63
6	Polwatte Ganga	163	5.89

Note: Muruthawela Scheme includes MLB, Urubokka Oya and Kirama Oya Schemes

Based on the criteria, three schemes of Benthara Ganga RB, Tangalu Welyaya and Polwatte Ganga are eliminated.

(3) Benefit Area

The combination of benefit areas of the schemes satisfying criteria (1) and (2) is determined as follows.

Name of Scheme	Benefit Area (Ha)	Ranking of (1) Farmer Organization	Ranking of (2) EIRR (%)	Estimated Cost (Mil. Rs.)
Badagiriya	703	2	1 (32.76)	53
Liyangastota	6,121	3 (LB scheme) 4 (RB scheme)	2 (24.24)	473
Muruthawela	6,149	4 (Urubokka and Kirama Oya scheme)	3 (22.22)	484
Total	12,973 ha		Ave. 23.74 %	1,010

7.3 Schemes Proposed for Feasibility Study

On the basis of ranking result, following three schemes would be recommended for the Feasibility Study.

i. Badagiriya Scheme
ii. Liyangastota Schemes
iii. Muruthawela Schemes

ANNEX-1
AGRICULTURE

LIST OF ANNEX-1

App.1-1 Result Table of Farmers Leaders Survey (1/3)

(Livangastota Scheme)

	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15		
A. LABOUR SURVEY																Total	Average
1.Nos. of family members	5	6	5	4	4	9	3	6	6	7	7	10	7	5	10	94	6
2.Age of house- owner	46	58	50	37	42	77	62	45	45	47	58	72	45	45	55	784	52
3.Nos. of children	2	4	3	2	1	3	1	3	4	4	4	4	4	3	4	46	3
4.Age of the eldest child	18	40	12	9	8	37	32	14	20	20	24	38	18	9	30	329	22
5.Age of the youngest child	14	26	7	7	8	27	32	9	12	15	18	26	12	3	25	241	16
6.Workable nos. in family	3	6	2	2	3	3	3	3	3	5	7	5	4	1	4	54	3.5
7.Unhealthy family member																	
8.Sick name																	
9.Sick days																	
10.Farm Worked days / yr.	210	910	280	nd	nd	nd	nd	nd	450	nd	nd	330	nd	nd	nd	2180/5	436
11.Outside Worked days/yr.	510	400	150	nd	nd	nd	nd	nd	0	nd	nd	684	nd	nd	nd	1744/5	349
12.Husband main work																	
13.Commuting time(minutes)																	
14.Feeling on working	usual	hard	hard	hard	hard	hard	hard	usual	hard		hard	hard	hard		hard		
15.Income satisfaction	no	no	no	no	no	no	no	no	no		no	no	no		no		
16.Farm land acreage(ha)	1.2	1.2	0.8	0.4	0.4	1.2	1.4	0.4	0.6	1.2	0.8	1.2	2	0.8	0.8	14.4	0.88
17.Farming difficulty	WMC	LMC	LTC	TMC	WTC	C		LWC	TC		C	WMC	LMC	L	LTMC		
18.Crop knowledge source	A	A	Nei	A	Ne,A	A	A	A	Nei		D	A	D	D	Nei		
19.Will for irrigation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y15	
20.Will for group farming	Y	N	Y	Y	Y		U	N	Y	Y	Y		Y	Y	Y	Y10,N2	
21.Farmer's successor	U	Y	Y	N	Y	N	N	N	N	N	N	N	Y	N	N	Y4,N10	
B. PADDY CULTIVATION																Total	per ha
1.Paddy cropped area (ha)	2.5	0.9	1.6	0.8	0.8	2.4	2.8	0.8	0.8	1.6	1.6	2.4	2.9	1.6	1.5	Av.=1.8	
2.Machinery cost (Rs)	31000		12400	7200	7480	13600		7480	4900			10700		21100		115860	8460
3.Agro-chemical cost (Rs)	12000		1000	4000	4250	10000		4250	3800			10000		4800		54100	3950
4.Fertilizer (kg) / (Rs)	18000		8000	5000	5850	14000		5850	3825			12000		9920		82445	6020
5.Seeds paddy (Rs)	3750		1120	1590	1250	1680		1250	1075			3000		1120		15835	1160
6.Hired labours cost (Rs)	5000		5000	0	0	10000		0	0			16000		0		36000	2630
7. Total Cost	69750	nd	27520	17790	18830	49280	nd	18830	13600	nd	nd	51700	nd	36940	nd	304240	22220
8.Family working days																	
9.Total yield (kg)	13970	nd	7500	4800	3650	11430	12000	3650	3175	7840	nd	11430	10800	nd	4540	94785	4540
10.Paddy G. income (Rs)	97790		52500	33600	25550	80010	84000	25550	22225	54880		80010	75600		31780	663495	31780
11.Paddy N.income (Rs)	28040		24980	15810	6720	30730		15810	8625			29310					9560
C. FARMER'S INCOME																	Average
1.Main source of Income	out-job						out-job	out-job						out-job			
2.Share of Farm Income(%)	40%	60%	80%	70%	60%	nd	40%	20%	100%	nd	100%	100%	60%	20%	50%		62%
3.Loans or Debts(default)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y100%	
4.Self-provided food	RV	RVFr	RFr	R	R	R	R	RV	RV	nd	R	R	RVFr	R	R	R100%,V36%	
5.Total cash income/ year	121500	39850	100760	31200	31000	nd	28100	31000	23600	nd	18000	nd	42000	nd	7950	474960	43200
6.Month of Money shortage	nd	9to2	nd	10to12	nd	nd	5,11	nd	2,6,12	nd	5,11,12	nd	9to2,5	2,5	2,8	2,5,10to12	
D.LIVING COST PER YEAR																Total	Average
1.Cash expense for Foods	66000	66000	nd	24000	36000	nd	54000	36000	18000	36000	24000	24000	84000	30000	18000	516000	39700(73%)
2.Clothes, sandals, etc.	3400	3400	2400	3000	7000	nd	8000	7000	3000	2400	nd	4000	5000	2000	5000	55600	4280
3.Furnitures, house reparing	5000	5000	700	1800	1500	nd	0	1500	0	2000	nd	500	7000	0	12000	37000	2850
4.Other living cost	3680	6680	1650	2950	15350	nd	9000	15350	6200	1850	nd	6700	16650	2050	9300	97410	7500
5.Total Cash cost for living	78080	81080		31750	59850		71000	59850	27200	42250		35200	112650	34050	44300	706010	54300

App.1-1 Result Table of Farmers Leaders Survey (2/3)

(Muruthawela Reservoir Scheme)

	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	M-13	M-14	M-15		
A. LABOUR SURVEY																Total	Average
1.Nos. of family members	5	5	8	5	6	3	3	6	4	7	8	8	8	8	5	89	6
2.Age of house- owner	47	30	63	35	50	32	67	49	34	42	41	39	62	62	51	704	47
3.Nos. of children	3	1	6	1	3	0	1	4	2	3	6	4	6	4	3	47	3
4.Age of the eldest child	21	2	24	8	25		1	20	12	15	17	12	28	45	26	256	17
5.Age of the youngest child	14	2	14	8	20		1	10	4	11	6	5	18	37	14	164	11
6.Workable nos. in family	2	3	6	3	1	1	1	2	1	2	1	4	2	2	4	35	2.2
7.Unhealthy family member																	
8.Sick name																	
9.Sick days																	
10.Farm Worked days / yr.	nd	650	nd	nd	nd	nd	300	nd	300	nd	nd	385	nd	nd	750	2385	477
11.Outside Worked days/yr.	nd		nd	nd	nd	nd		nd		nd	nd	255	nd	nd		255	255
12.Husband main work																	
13.Commuting time(minutes)																	
14.Feeling on working	usual	hard	hard		usual	hard	hard		hard	usual	hard	easy	easy		hard	hard7, easy2	
15.Income satisfaction	no	no	no		no	no	no		no	no	no	yes	no		no	no10, yes 1	
16.Farm land acreage(ha)	1	0.4	0.8	nd	0.8	0.8	0.8	nd	0.8	0.4	0.8	0.6	1	0.8	1	10	0.8
17.Farming difficulty		WMC			W	W	W		WMC	W	WM	WC		WTMC	WM	W100%	
18.Crop knowledge source	A				A	Nei	D		A	A	D	A		A		A70%	
19.Will for irrigation	Y	Y	Y			Y	Y		Y	U	Y	Y	Y	Y	Y	Y85%	
20.Will for group farming	Y	Y	Y		U	Y	Y		Y	U	Y	N	Y	Y	Y	Y77%	
21.Farmer's successor	N	N	U		U	U	N		N	U	N	Y	N	N	N	N62%, Y8%	
B. PADDY CULTIVATION																Total	per ha
1.Paddy cropped area (ha)	0.8	nd	0.8	1.2	0.8	nd	nd	0.8	1.2	0.4	0.8	0.6	0.4	0.8	1	Av.=0.8	per ha
2.Machinery cost (Rs)	3800		4800	9300	6200			10000	9800	4300	8500	5750	3000	6500	7800	81750 /9.6	8520
3.Agro-chemical cost (Rs)	2000		3000	1500	1600			2500	3500	800	1500	740	1500	2000	2500	23140 /9.6	2410
4.Fertilizer (kg) / (Rs)	2000		5500	2000	2400			3700	4000	1200	2500	1500	2000	6000	2500	35300 /9.6	3680
5.Seeds paddy (Rs)	560		1200	1200	1300			560	840	280	560	1200	280	1800	700	10480 /9.6	1090
6.Hired labours cost (Rs)	800		600	1200	3600			1000	5500	1800	2500	2500	1500	2000	0	23000 /9.6	2400
7. Total Cost	9160		15100	15200	15100			17760	23640	8380	15560	11690	8280	18300	13500	173670 /9.6	18100
8.Family working days	120		95	115	50			41	125	40	90	44	20	41	280	1061 /9.6	111
9.Total yield (kg)	3140		3200	3140	2600			4700	7300	2700	3250	4080	1360	4180	3250	42900 /9.6	4470
10.Paddy G. income (Rs)	21980		22400	21980	18200			32900	51100	18900	22750	28560	9520	29260	22750	300300/9.6	31300
11.Paddy N.income (Rs)	12820		7300	6780	3100			15140	27460	10520	7190	16870	1240	10960	9250	128630/9.6	13200
C. FARMER'S INCOME																	Average
1.Main source of Income	nd	nd	nd	nd	farm	farm	farm	farm	farm	out-job	farm	farm	nd	nd	farm	farm 90%	
2.Share of Farm Income(%)					40%	70%	50%	60%	40%	30%	50%	70%			100%		57%
3.Loans or Debts(default)					Y	Y	N	Y	Y	Y	N	Y			Y	Y 78%	
4.Self-provided food					R	RV		R	RV	R	R	R			R		
5.Total cash income/ year					nd	35400	30800	26250	33000	26700	22750	10300			22750	207950 /9	23100
6.Month of Money shortage					8,12	1,2,8				5 to 9	9 to 6	12			1,8to10		
D.LIVING COST PER YEAR																Total	Average
1.Cash expense for Foods					18000	21600	9600	24000	18000	18000	18000	9000			24000	160200 /9	17800(66%)
2.Clothes, sandals, etc.					3000	1200	3000	0	3000	3000	4000	3000			2000	22200 /9	2470
3.Furnitures, house reparing					1500	700	900	900	1500	1200	5500	700			1500	14400 /9	1600
4.Other living cost					2500	9400	10050	760	4300	1700	2800	4000			4300	39810 /9	4420
5.Total Cash cost for living					25000	32900	23550	25660	26800	23900	30300	16700			31800	236610 /9	8490

App1-1 Result Table of Farmers Leaders Survey (3/3)

	(Badagiriya Scheme)								(Polwatte Ganga Scheme)							
	B-1	B-2	B-3	B-4	B-5	B-6			P-1	P-2	P-3	P-4	P-5	P-6		
A. LABOUR SURVEY							Total	Average							Total	Average
1.Nos. of family members	7	5	9	6	5	7	39	6.5	4	7	6	7	7	6	37	6
2.Age of house- owner	44	63	42	55	39	49	292	48.7	67	42	40	56	72	48	325	54
3.Nos. of children	3	3	3	4	3	4	20	3.3	2	4	4	4	4	4	22	4
4.Age of the eldest child	18	20		29	18	20	105	21	25	20	19	26	32	19	141	23
5.Age of the youngest child	10	1		22	8	8	49	10	21	9	14	20	23	6	93	15
6.Workable nos. in family	2	3	5	4	2	3	19	3.2	1	2	4	4	4	4	19	3.2
7.Unhealthy family member	1	0	1	1	0	1	4									
8.Sick name																
9.Sick days																
10.Farm Worked days / yr.			180	520			700 / 2	350	120	108	725	485	nd	48	1486 /5	297
11.Outside Worked days/yr.	0	0		200	0	0	200	100		96				288	384 /2	192
12.Husband main work	farm	farm	farm	farm	farm	farm	farm					pension				
13.Commuting time(minutes)																
14.Feeling on working	hard		usual	hard		usual			hard		usual		usual			
15.Income satisfaction	no		no	no	no	no	no		no		no		no	yes		
16.Farm land acreage(ha)	1.2	1.2	1.2	1.2	1.2	1	7	1.2	0.8	0.2	0.8	1.2	1.2	2.4	5.6 /6	0.9
17.Farming difficulty	WMC	WTMC	WMC	TMC	C	MC	MC		WC		W	LWC	W	LWM	W100%	
18.Crop knowledge source	N	A	A		A	A	A		A	A	A	A	A	D	A80%	
19.Will for irrigation	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y100%	
20.Will for group farming	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y100%	
21.Farmer's successor	N	Y	N	N	N				N	Y	N	Y	N	N	Y33%, N66%	
B. PADDY CULTIVATION							Total	per ha							Total	per ha
1.Paddy cropped area (ha)	1.2	1.2	2.4	nd	1.2	2	8		1.4	2.8	0.6	1.6	0.6	0.8	7.8/6=1.3	
2.Machinery cost (Rs)	12712	10500	10400		12000	26340	71952	8994	15400		5400	13000	4300	4400	42500 /5	8500
3.Agro-chemical cost (Rs)	4200	3000	4000		3775	5850	20825	2603	3000		600	600	600	2200	7000 /5	1400
4.Fertilizer (kg) / (Rs)	6900	5400	4500		3650	7796	28246	3531	9000		3000	6600	2000	3400	24000 /5	4800
5.Seeds paddy (Rs)	3000	3600	720		1250	2563	11133	1392	800		540	540	420	2200	4500 /5	900
6.Hired labours cost (Rs)	3650	3000	5000		2500	12000	26150	3269	5250		2900	4000	2250	4000	18400 /5	3680
7. Total Cost	30462	25500	24620	nd	23175	54549	158306	19788	33450		12440	24740	9570	16200	96400/5	19280
8.Family working days	ND	200	320		ND	200	720	129								
9.Total yield (kg)	6000	7000	6750	nd	3750	9184	32684	4086	4100		3140	3800	1500	2320	14860 /5	2972
10.Paddy G. income (Rs)	42000	49000	47250		26250	64288	228788	28599	28700		21950	26600	10500	16240	103990/5	20800
11.Paddy N.income (Rs)	11538	23500	22630		3075	9739	70482	8811	*4750		9510	1860	930	160	7710 /5	1542
C. FARMER'S INCOME								Average								Average
1.Main source of Income	farm	farm	farm	farm	farm	farm	f.100%	farming	farm	nd	farm	pension	farm	farm	farm80%	
2.Share of Farm Income(%)	30%	100%	70%	70%	100%	80%		75%	100%		80%	20%	50%	100%		70%
3.Loans or Debts(default)	Y	Y	N	Y	Y	Y	Y83%	Y83%	N		Y		N	N	Y25%,N75%	
4.Self-provided food	R	RV	RV	RV	R	RE	Ri Ve Eg	R100%	RVFr		RVFr	R	R	RVFr	R100%	
5.Total cash income/ year	42000	20000	30000	15500	30000	82000	219500/6	36600	35000		86000	55000	26000	37000	153000 /4	38000
6.Month of Money shortage	6 to10	ex4&12	10 to4	2,3,5-9	8 to2	no	9,10		6,7,12,1		4,6,11		3,4,5	6,7,11,12		
D.LIVING COST PER YEAR							Total	Average							Total	Average
1.Cash expense for Foods	20400	36000	21600	36000	18000	42000	174000/6	29000(64%)	20800		48000	26000	18000	27000	91800 /4	23000(66%)
2.Clothes, sandals, etc.	3000	2000	2000	5000	300	3000	15300 /6	2550	1000		14400	9000	1000	4000	15000 /4	3800
3.Furnitures, house reparing	2500	0	0	2000	0	2000	6500 /6	1080	0		2400	5000	3000	1500	11900 /5	2400
4.Other living cost	10880	6700	16440	11800	18000	13440	77260 /6	12880	4100		21000	12000	1700	5000	22800 /4	5700
5.Total Cash cost for living	36780	44700	40040	54800	36300	60440	273060 /6	45500	25900		85800	52000	23700	37500	139100 /4	34900

App.1-2 Crop Budget

1. Paddy Crop Budget per ha for Every Scheme

(1) Liyangastota Scheme

	Present Condition		Without Project		With Project	
1) Seeds	(100kg) Rs	869	(100kg) Rs	869	(100kg) Rs	1,250
2) Machinery	Rs	6,336	Rs	6,336	Rs	6,336
3) Fertilizer	(375kg) Rs	4,508	(375kg) Rs	4,508	(450kg) Rs	5,400
4) Agro-chemicals	Rs	2,958	Rs	2,958	Rs	2,958
5) Hired-labour	(20m.d) Rs	1,970	(20m.d) Rs	1,970	(20m.d) Rs	1,970
6) Family-labour	man-days	80 m.d.	man-days	80 m.d.	man-days	80 m.d
7) Total cash cost	Rs	16,641	Rs	16,641	Rs	17,914
8) Unit yield	kg	3,400	kg	3,060	kg	5,500
9) Gross return	Rs	23,800	Rs	21,420	Rs	38,500
10) Net return	Rs	7,159	Rs	5	Rs	20,586

(2) Muruthawela Reservoir Scheme

	Present Condition		Without Project		With Project	
1) Seeds	(100kg) Rs	853	(100kg) Rs	853	(100kg) Rs	1,250
2) Machinery	Rs	6,669	Rs	6,669	Rs	6,669
3) Fertilizer	(240kg) Rs	2,881	(240kg) Rs	2,881	(450kg) Rs	5,400
4) Agro-chemicals	Rs	1,886	Rs	1,886	Rs	1,886
5) Hired-labour	(19m.d) Rs	1,879	(19m.d) Rs	1,879	(19m.d) Rs	1,879
6) Family-labour	man-days	111 m.d	man-days	111 m.d	man-days	111 m.d
7) Total cash cost	Rs	14,168	Rs	14,168	Rs	17,084
8) Unit yield	kg	3,500	kg	3,150	kg	5,500
9) Gross return	Rs	24,500	Rs	22,050	Rs	38,500
10) Net return	Rs	10,332	Rs	7,882	Rs	21,416

(3) Badagiriya Scheme

	Present Condition		Without Project		With Project	
1) Seeds	(100kg) Rs	1,227	(100kg) Rs	1,227	(100kg) Rs	1,250
2) Machinery	Rs	7,925	Rs	7,925	Rs	7,925
3) Fertilizer	(260kg) Rs	3,111	(260kg) Rs	3,111	(450kg) Rs	5,400
4) Agro-chemicals	Rs	2,294	Rs	2,294	Rs	2,294
5) Hired-labour	(29m.d) Rs	2,881	(29m.d) Rs	2,881	(29m.d) Rs	2,881
6) Family-labour	man-days	114 m.d	man-days	114 m.d	man-days	114 m.d
7) Total cash cost	Rs	17,436	Rs	17,436	Rs	19,750
8) Unit yield	kg	3,600	kg	3,240	kg	5,500
9) Gross return	Rs	25,200	Rs	22,680	Rs	38,500
10) Net return	Rs	7,764	Rs	5,244	Rs	18,750

(4) Polwatte Ganga Scheme (Thangalu Welyaya & Kachigala Ara Scheme)

	Present Condition		Without Project		With Project	
1) Seeds	(100kg) Rs	900	(100kg) Rs	900	(100kg) Rs	1,250
2) Machinery	Rs	4,500	Rs	4,500	Rs	4,500
3) Fertilizer	(400kg) Rs	4,800	(400kg) Rs	4,800	(450kg) Rs	5,410
4) Agro-chemicals	Rs	1,400	Rs	1,400	Rs	1,400
5) Hired-labour	(37m.d) Rs	3,680	(37m.d) Rs	3,680	(37m.d) Rs	3,680
6) Family-labour	man-days	151 m.d	man-days	151 m.d	man-days	151 m.d
7) Total cash cost	Rs	15,280	Rs	15,280	Rs	16,240
8) Unit yield	kg	3,000	kg	2,700	kg	5,000
9) Gross return	Rs	21,000	Rs	18,900	Rs	35,000
10) Net return	Rs	5,720	Rs	3,620	Rs	18,760

(5) Benthara Ganga Scheme

	Present Condition		Without Project		With Project	
1) Seeds	(100kg) Rs	900	(100kg) Rs	900	(100kg) Rs	1,250
2) Machinery	Rs	4,500	Rs	4,500	Rs	4,500
3) Fertilizer	(300kg) Rs	3,600	(300kg) Rs	3,600	(450kg) Rs	5,410
4) Agro-chemicals	Rs	1,400	Rs	1,400	Rs	1,400
5) Hired-labour	(37m.d) Rs	3,680	(37m.d) Rs	3,680	(37m.d) Rs	3,680
6) Family-labour	man-days	151 m.d	man-days	151 m.d	man-days	151 m.d
7) Total cash cost	Rs	13,780	Rs	13,780	Rs	16,240
8) Unit yield	kg	2,500	kg	2,250	kg	5,000
9) Gross return	Rs	17,500	Rs	15,750	Rs	35,000
10) Net return	Rs	3,720	Rs	1,970	Rs	18,760

2. OFC Crop Budget per ha for All Schemes

(1) Chilli Cultivation*

	Present Condition		Without Project		With Project	
1) Seeds	(2kg) Rs	1,600	(2kg) Rs	1,600	(2kg) Rs	1,600
2) Nursery cost	Rs	1,800	Rs	1,800	Rs	1,800
3) Fertilizer	(500kg) Rs	6,000	(500kg) Rs	6,000	(900kg) Rs	10,800
4) Agro-chemicals	Rs	2,500	Rs	2,500	Rs	2,500
5) Hired-labour	(135m.d) Rs	13,500	(135m.d) Rs	13,500	(135m.d) Rs	13,500
6) Family-labour	man-days	350 m.d.	man-days	350 m.d.	man-days	350 m.d
7) Total cash cost	Rs	25,400	Rs	25,400	Rs	30,200
8) Unit yield	(dry) kg	500	(dry) kg	450	(dry) kg	1,000
9) Gross return	Rs	50,000	Rs	45,000	Rs	100,000
10) Net return	Rs	24,600	Rs	19,600	Rs	69,800

(2) Reed Cultivation**

	Present Condition		Without Project		With Project	
1) Plant material		1,000		1,000		1,000
2) Hired-labour	(30m.d) Rs	3,000	(30m.d) Rs	3,000	(30m.d) Rs	3,000
3) Family-labour	man-days	60 m.d	man-days	60 m.d	man-days	60 m.d
4) Total cash cost	Rs	4,000	Rs	4,000	Rs	4,000
5) Unit yield	(dry)	4,000	(dry)	4,000	(dry)	4,000
6) Gross return	Rs	16,000	Rs	16,000	Rs	16,000
7) Net return	Rs	12,000	Rs	12,000	Rs	12,000

Source:* Chilli budget was made up with modification
from "Cost of Cultivation of Crops(DOA),1994"
** Reed budget was estimated by hearing at Benthota.