CHAPTER 6

CHAPTER 6 FORMULATION OF REHABILITATION PLAN

6.1 Confirmation of Necessity and Urgency for Rehabilitation

The necessity, urgency and appropriateness of the Project is confirmed from the standpoints below.

- Government policy background
- Utility life of facilities (project life)
- Sustainable and upgraded agricultural activity
- Sustaining and conserving the environment

(1) Government Policy Background

Irrigation development projects and large scale schemes to rehabilitate irrigation systems such as the Mahaweli development project, MIRP (Major Irrigation Rehabilitation Project), etc. in recent years have been carried out mainly in the central and northern regions of the country. As a result, irrigation development and rehabilitation of existing facilities have lagged behind compared to other parts of Sri Lanka. During the 1980s, the JVP (People's Liberation Front) conducted anti-government activities aimed at forcing the withdrawal of Indian troops from the country, and these activities created great social disturbance throughout the nation. The youth at the time which joined the JVP reportedly in many cases did so out of frustration over socio-economic inequities in the region. The current President since election to the national presidency has placed priority on comprehensive development of the Southern Province. The creation of a stable and sustainable rural social base which would be promoted by the rehabilitation under the envisioned Project is thus well compatible with the priorities of government development policy.

(2) Utility Life of Facilities (project life)

Although a number of major irrigation schemes have been carried out years ago in the Southern Province, these are all extremely old facilities which exhibit severe deterioration. As a result, if the said irrigation schemes are left in their current state, it is clearly predictable that they will have lost half of their function in the next 10~20 years.

All three schemes targeted under the Project are very old, with year of construction of related facilities as indicated below.

	Year constructed	Utility life (years)
1) Liyangastota scheme		
Ridiyagama tank	1927	69
Liyangastota anicut	1889	107
WRB scheme	1928	68
WLB scheme	1927	69
2) Muruthawela Reservoir scheme		
LB Main Canal scheme	1971	25
Urubboka Oya scheme	1787	209
Kirama Oya scheme	1805~1812	191~184
3) Badagiriya scheme		
Badagiriya tank	1957	39

Even in the case of the most recently constructed facilities, 25 years have elapsed since construction. For some of the oldest facilities, over 100 years have elapsed and utility life has expired. Furthermore, as a result of two periods of field survey by the Team, progressive deterioration was observed for all the schemes. It is concluded that necessity is extremely high for urgent rehabilitation of the proposed schemes.

(3) Sustainable and Upgraded Agricultural Activity

- The INMAS program was launched by the government to improve the operation and maintenance of irrigation projects in the country, and FOs have been strengthened under the said program. From 1995, the AMA program was commenced under which agricultural development committees are established at the ASCs (Agrarian Services Centres) and at the district level. It is stipulated by the program that at least 50% of the said committee members are representatives of the FOs. Against this background, decentralization of government authority has been pursued in an effort to enlarge the active role which the farmer can play in the management of agricultural activities and establish FOs well rooted in the rural community. By promoting the active participation of farmers in projects, it is the aim of the government to stimulate the regional agro-economy. The rehabilitation plan under the Project will contribute to the achievement of the foregoing policy and development strategy.

- Deterioration of facilities under the schemes has resulted in loss of water control, and consequent unbalanced distribution of irrigation discharge. As a result, optimum timing for fertilizer application can not be done due to unpredictable periods of water shortage, or conversely, excessive discharge. In some cases, even the application of large amounts of fertilizer such as 400 kg/ha results in no increase in yield, subjecting the farmer to cost-ineffective farming where large amounts of production inputs are inefficiently utilized. This present situation warrants urgent improvement through a rehabilitation project for the schemes.

- It is necessary to effect water control in the Project area in response to irrigation demand during both the Maha and Yala seasons in order for the government to move forward with its program to promote the cultivation of OFCs under its present agricultural policy. However, present irrigation facilities are largely damaged and deteriorated, making such water management extremely difficult. Implementation of a rehabilitation project to address this situation is highly urgent.

(4) Sustaining and conserving the environment

- Implementation of the Project is not specifically targeted at upgrading environmental conditions of the area. However, on the other hand the beneficial environmental impact is not negligible either. By effecting the rehabilitation under the project, conservation of farm land, particularly paddy field, will be promoted, and by effectively controlling rain and irrigation runoff, loss of rich topsoil through erosion will be prevented.

- Also, improvement of water management through rehabilitation of the facilities will prevent fertilizer runoff from excessive discharge due to lack of water control. This will likewise prevent the buildup of potentially harmful chemical substances in the lower reaches of irrigation canals and in the downstream portion of the benefit area. This will indirectly contribute to conserving rural environment particularly in the case of the schemes under this Project, wherein canals are a source of water for domestic purposes and for livestock. Maintaining an acceptable level of water quality is accordingly extremely important. In light of the above, the Project will have significant beneficial environmental impact.

In conclusion, based on the above discussion, it is concluded that the Project is highly justified in terms of urgency and necessity of implementation.

6.2 Plan Formulation Strategy

The Study Team drew on the valuable body of experience and lessons learned from other irrigation rehabilitation projects carried out in Sri Lanka, and applied this to formulation of the Project plan. These experience and lessons can be summarized as follows:

- Adoption of a participatory type project wherein beneficiary farmers (the users) actively participate in the project from its incipient planning stage.

- Rehabilitation plan for irrigation facilities must be pragmatic and cost-effective.

- Formulation of a project which can readily obtain the coordinated and integrated support, cooperation and collaboration of the concerned higher government agencies (provincial and national level) in achieving design targets.

Basic strategy under each project component is as follows based on the above experience and lessons learned.

(1) Rehabilitation Plan for Irrigation Facilities

The need for overall rehabilitation of facilities is recognized in light of the fact that almost all have exceeded their utility lives. Rehabilitation under the Project will not simply focus on individual facilities on a one by one basis, but rather will strive for an integrate, overall system wise revival of function.

Accordingly, the deteriorated facilities outside the scope of rehabilitation under the Project will be intended for minimal level repair, and given low urgency status under the rehabilitation works.

(2) Agricultural Development Plan

In the case of a conventional new agricultural development project, agriculture and irrigation components function simultaneously and in an integrated manner to result in food crop production. In contrast, in the case of the Study area schemes the irrigation component has first expired its project life. The 2 major factors which have ended the irrigation project life are lack of water management and facility deterioration.

These 2 factors well know in the Project area, and these data are to be effectively applied to the formulation of the agricultural development plan.

(3) Environmental Conservation Plan

The environmental conservation plan will be formulated at sustainable revival and conservation of the rural environment within which the deteriorated facilities exist and present agricultural activities are being pursued. Toward this end, careful attention will be given during Project implementation during the three stages of design~implementation~operation to ensure that negative impacts due not occur to the environment. Also, a monitoring component will be included in the Project to detect unforeseeable negative impacts and promptly implement appropriate mitigating measures.

(4) Operation and Maintenance Plan

The operation and maintenance plan will target sustainable O&M by preparing a "logical frame" with the participation of the personnel and agencies which will comprise the O&M structure.

6.3 Agricultural Development Plan

6.3.1 Basic Plan Strategy

In approaching the basic strategy for the plan, not only irrigation conditions but also various criteria related to size of farm management have been applied. These basic criteria include selection of OFCs, anticipate yield, fertilizer application, farm labor, etc. Also, with regards to achievement of design yields, extension of superior seed and strengthening of agricultural support agencies is a key in addition to conditions of irrigation and fertilizer application.

(1) Selection of OFCs

Under the original Master Plan it was the intention to introduce OFCs to all schemes; however, based on discussions with farmers at FO meetings and the policy of the AD, it was decided to crop only paddy in the Liyangastota scheme and Urubokka Oya · Kirama Oya sub-scheme areas after rehabilitation of irrigation facilities. In these areas, tenant farmers are predominant, farm scale is fragmented, and irrigation discharge is relatively abundant even in the dry season.

Under the national agricultural development policy as well, principal focus is placed on increased paddy production in major irrigation areas, and instead OFC is recommended for introduction to rainfed upland fields.

In the case of the Muruthawela LB and Badagiriya schemes, OFC cultivation has been done over the years due to water shortages. These areas are located adjacent to the Uda Walawe and Kirindi Oya project areas wherein the introduction of OFCs has been promoted, and the farmers in the Muruthawela LB and Badagiriya scheme areas are strongly in favor of an organized introduction of OFC cultivation. As a result, an cropping of 20~30% of OFCs is planned under the Project in these areas. Economized use of irrigation discharge will improve cropping intensity.

With regards to selection of OFC varieties, chili and banana have been targeted with consideration to farmer aspirations and marketing conditions.

Chili

Chili is a major crop in the Anuradhapura area (Dry Zone) and conversion of paddy to upland cropping is being carried out on a large scale in the Mahaweli H,B,C systems. The Badagiriya scheme and Muruthawela LB sub-scheme areas are likewise located in Dry Zone, and drying of chili harvest will be facilitated.

Banana

Of the 12 varieties of fruit being promoted by the government, banana is given the highest priority. As a semi-perennial crop, farmers are eligible for perennial crop credit. In the adjacent Uda Walawe and Kirindi Oya project areas, cropped area of

banana has steadily increased through systematic introduction of the same to former paddy field area.

1982	135 ha	1989	476 ha
1983	155 ha	1990	891 ha
1984	205 ha	1991	1,114 ha
1985	235 ha	1992	1,488 ha
1986	251 ha	1993	1,833 ha
1987	304 ha	1994	2,406 ha
1988	410 ha	1995	2,582 ha

note: cropped area for banana is 3,460 ha (1994), including upland field, etc

Although extension of banana cropping has not been pursued in the Muruthawela LB sub-scheme and Badagiriya scheme areas, survey of the Muruthawela LB Tract I (Annex AG-5) of the 9 FOs, 8 indicated cultivation of banana as an OFC. In Tract I, water diversion is freely practiced, and the profitability of banana as an irrigated crop is clear.

Farmer experience with banana is ample through home gardening, etc., and under the Uda Walawe project as well it is a major OFC. There is a regional agricultural research station at Angunakolapellessa in the Muruthawela LB area, making readily available superior seed and cropping technology extension.

(2) Anticipated Harvest

a) Paddy

Under national agricultural policy, average yields nationwide including rain-fed fields sharply increased from 3.5 t/ha (1994) to 4.5 t/ha. Under the Uda Walawe rehabilitation project adjacent to a part of this Project area, an anticipated yield target of 5.5 t/ha has been set. According to the IIMI report on this area, possible yield is 6.0 t/ha, with farmers actually achieving 5.5 t/ha (1992 Yala Seasonal Report, Annex AG-9). At the Ambalantota rice research institute, average yield for AT varieties is 6.5 t/ha as shown in the following table. This was achieved using the DOA recommended fertilizer application of 450 kg/ha.

Pilot Farm Yields for AT Varieties

Variety	Duration	Year recommended	Type	Yield	Special feature
AT 353	3.5 months	1992	red	6.2 t	Disease resistant
AT 354	3.5 months	1992	white	6.9 t	Salt resistant
AT 402	4 months	1992	long stalk red	7.7 t	Disease resistant
AT 401	4 months	1992	long stalk red	5.8 t	Salt resistant
AT 5	4.5 months	1992	white Basmate	6.0 t	Disease resistant
AT 303	3 months	1990	red	6.4 t	Disease resistant

Under the farmer survey, it was found that 20% of farmers use over 400 kg/ha of fertilizer, and achieve yields in excess of 5.0 t/ha (100 bu/ac).

Considering the above, anticipated yield under the Project is set at 5.5 t/ha for both rainy and dry seasons, to be achieved by the 4th year from the first year that cultivation is possible. In order to achieve this, improved fertilizing methods and application amounts are necessary, as well as strengthened agricultural support with regards to superior seed extension, etc.

b) Chili and banana

The above described IIMI report cites a possible yield for chili of 2.5 t/ha, with actual farmer achievement being 1.2 t/ha. In the major producing areas of the Dry Zone (systems H, B and C), the target yield is generally 1 t/ha (dried chili). Under this Project as well, the anticipated yield is set at 1 t/ha assuming fertilizer application in accordance with DOA standards.

With regards to banana, average yields are 17 t/ha in the Uda Walawe rehabilitation project area, and 18 t/ha for banana in existing paddy field in the area. In unirrigated areas, banana production is generally 8 t/ha; however, with irrigation this rises to 15~20 t/ha.

Maximum yields recorded by the regional agricultural research station for the general farmer are 32 t/ha (13 t/ac), and 38 t/ha at the pilot farm.

In consideration under the Project of a banana tree replant period of 3 years as opposed to the convention 5 years, anticipated yield is set slightly on the lower side at 15 t/ha.

(3) Fertilizer Application

a) Paddy

Conventionally for paddy cultivation, it has been the practice to use V-mix as the base fertilizer, supplemented by TDM and urea, and this use of compound fertilizer is still the general practice. The DOA recommends the use of such simple fertilizers as TSP, MP, etc. alone at application amounts of 300 kg/ha (120 kg/ac). The standard for compound fertilizer use is 450 kg/ha (180 kg/ac) comprising 150 kg of V-mix, 150 kg of TDM and 150 kg of urea.

Relationship between the above fertilizer use and actual yield is roughly 200 kg for 3 t, 300 kg for 4 t, and 400 kg for 5 t (details in Annex AG-10). In the Project area, yields commensurate with volume of fertilizer use are not generally achieved. This is due in part to irrigation and water management conditions; however it is considered that inadequate guidance in fertilizer method, particularly regarding the timing for follow-up fertilizing, is a major reason.

During the 1980s, the DOA promoted follow-up fertilizing 2 times during the cropping season; however, with the suspension of fertilizer subsidies in the 1990s, the DOA has recommended follow-up fertilizing 1 time per season. Since the 1994/95 rainy season, a 30% fertilizer subsidy was reactivated. AIs however have not changed their policy of recommended 1 time follow-up fertilizing.

Nevertheless, it is recommended that follow-up fertilizing be carried out 3 times, i.e., 1 time 3~4 weeks after planting (50 kg/ha of urea), 1 time 8~10 weeks after planting (150 kg/ha of TDM) and 1 time in the first week after fruition (50 kg/ha).

b) Chili and banana

In the case of chili and banana, it is highly necessary that not only chemical fertilizer, but also organic fertilizers such as manure and rice straw be amply used from the standpoint of disease prevention. Accordingly, it is planned to supplement fertilizer application with organic fertilizers in amounts each season of 1,000 kg/ha for chili, and annually 2,000 kg/ha for banana (2 kg / tree).

Since introduction of banana cropping is planned at 0.05 ha (50 trees) per household in the Muruthawela LB sub-scheme and 0.1 ha per household (100 trees) in the Badagiriya scheme, fertilizer application amounts per year of 100 kg and 200 kg would be sufficient; however, it is recommended that cow manure be mixed with fertilizer as well as these are major cattle husbandry areas. In the case of chili, cultivated area is 0.1 ha per household making recommended application amount for fertilizer at 100 kg / household per season.

(4) Labor

Present paddy cropping requires 130~140 man-days per ha, of which employed labor accounts for 20~60 man-days. Under the project, labor man-days would remain

unchanged; however the portion provided by household members is planned to increase 10~20 man-days. Until now, the deteriorated state of irrigation facilities has absorbed a large portion of labor for water management. This will be reduced with facility rehabilitation under the Project, making overall increment in labor requirement small.

The female labor force averaging 1.5~2.0 persons per household would contribute 40~50 person-days of labor each year for paddy cultivation and 40~80 person-days for upland field cultivation. This is equivalent to about half of the 160~190 person-days per year of labor including non-agricultural pursuits. The increased labor requirement with expanded cropping under the Project would be 50% covered by female labor, equivalent to maximum increase of 30 person-days. Of this, 25 person-days would be absorbed in OFC cultivation related labor in those areas into which OFCs are to be introduced under the Project.

(5) Extension of Superior Seed, and Agricultural Support Agencies

It is a basic pre-condition under the Project that the extension of paddy seed production and related programs carried out independently by the cooperatives and the DOA be expanded, to provide system supply of produced superior seed to all the farmers in the Project area.

There are almost no FOs under the management of the ASCs in the Project area, and it is thus anticipated that the FOs established by the ID will play the major role in the above regard under the Project. Within the framework of the ID's INMAS program, Project Offices would be established at which 1 AI should be assigned per office. Under the present system, there is little or no liaison between the ID FOs and the DOA and ASCs, and integration of the respective efforts of these entities after completion of rehabilitation works should be given priority.

There is 1 AI permanently assigned to each ASC; however, supply of agricultural inputs (seed, fertilizer, agro-chemicals, etc.) to the individual farmer is at a low level in the Project area, accounting for only several percent. This is the result of difficult access to the areas, and lack of attractiveness in providing service (price, delivery, etc.). Accordingly, increased service with regards to such inputs by the ASCs to the individual farmer is not planned under the Project.

(6) Marketing Network for OFCs

The marketing network for OFCs will comprise the existing 15 polas. A price guarantee system between farmers and produce shippers would be introduced in in order to strengthen the production ~ management ~ marketing system for OFCs based on discussion and arrangement by the FOs for each scheme with the Pradeshiya Sabhas with oversee the polas, and the marketing entrepreneurs.

6.3.2 Liyangastota Scheme

(1) Land use and Cropping Plan

The land use plan is to be in line with the cropping pattern indicatd in Figure 6.3.2-1, with a total land use rate of 200% for both the rainy and dry seasons.

Present and design cropped areas are as follows:

	Present		Design	
Paddy				
Rainy Season	4,771 ha	(95%)	5,008 ha	(100%)
Dry Season	4,771 ha	(95%)	5,008 ha	(100%)
Land use rate	9,542 ha	(190%)	10,016 ha	(200%)

Under the plan, cropping ratio of 4.5 month varieties is to be raised from 20% to 40%. Adoption of 4.5 month varieties is in line with government policy and superior quality varieties (red AT401, AT 402, etc.) are available from the Ambalantota paddy research institute in the area. In particular, yield achievement for AT402 has been reported at 7.7 t/ha. With regards to long term varieties, it is necessary that the cooperatives and the Department of Agriculture improve the procurement and distribution of superior seed.

(2) Improvement of Planting Method, and Anticipated Yield and Design Production

In order to improve paddy planting, (i) good quality seed obtained through the Department of Agriculture and cooperatives is to be used, and (ii) fertilizer application amount is to be raised to 450 kg/ha.

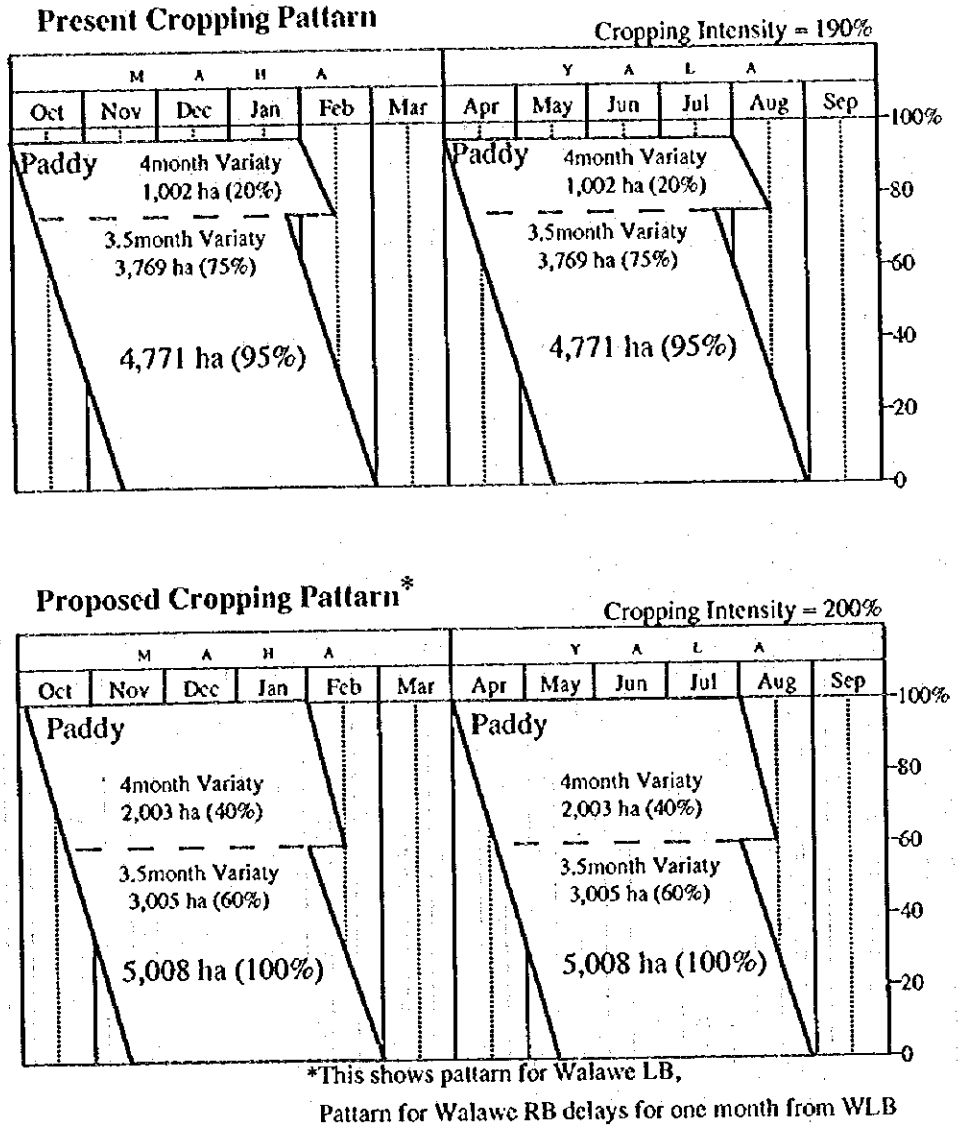
It is reported that there are 6 seed production farmers in the area designated by the cooperatives and 22 designated by the Department of Agriculture. However, systematic distribution via the FOs to the farmer is not being done.

With regards to improvement of fertilizer application amounts, it is anticipated that the tenant and landless farmers may suffer shortage of fertilizer amount for paddy field, and therefore need the assistance of cultivation loans via the FOs and with the support of the DOA and the ASCs.

Anticipated yields under the Project are 5.5 t/ha in the rainy and dry seasons. Although a target yield of near 6 t/ha would be possible depending on the degree of introduction of 4.5 month varieties, the design yield under the Project on the safe side at 5.5 t/ha has been planned.

Design production is computed at 55,100 t based on the above unit yield of 5.5 t/ha and cropped area of 10,016 ha (per year). This would be a 1.5 fold increase over the 36,700 t at present.

1. Liyangastota Scheme (A= 5,008 ha)



*This shows pattarn for Walawe LB,
Pattarn for Walawe RB delays for one month from WLB

	<Present>		<Proposed>	
Maha Paddy	4,771ha	(95%)	5,008ha	(100%)
Yala Paddy	4,771ha	(95%)	5,008ha	(100%)
	9,542ha	(190%)	10,016ha	(200%)

Figure 6.3.2-1 Present and Proposed Cropping Pattern in Liyangastota Scheme

(3) Anticipated Crop Production Cost and Farmer Income

Present and design crop production costs and farmer incomes are indicated below.

(per ha)	Paddy (both seasons average)			Design (both seasons)		
Inputs:						
1. Seed (kg)	150	Rs	1,300	100	Rs	1,250
2. Fertilizer (kg)	345	Rs	3,450	450	Rs	4,500
Vmix	145			150		
TDM	100			150		
Urea	100			150		
3. Agro-chemicals (lit./kg)	11	Rs	2,684	11	Rs	2,684
Weedicides	9			9		
Insecticides	2			2		
4. Farm equipment (ha)		Rs	6,336		Rs	6,336
Tilling						
Others						
5. Hired labor (m-d)	58	Rs	5,800	58	Rs	5,800
Family labor (m-d)	80			100		
Income:						
1. Yield (kg)	3,850			5,500		
2. Farm gate price (Rs/kg)	9.4			9.4		
3. Gross income (Rs)			36,190			51,700
4. Production cost (Rs)			19,570			20,550
5. Net income (Rs)			16,620			31,150

On the basis of the above operating cost, per household net income from paddy cultivation averages as follows for landholder farmers, tenant farmers and landless farmers.

	Av.cultivated	Present		Design	
	arae	Annual cropping	Income	Annual cropping	Income
1) Landholder farmers	1.0\ ha	1.8\ ha	Rs\ 29,900	2.0\ ha	Rs\ 62,300
2) Tenant farmers	0.5\ ha	1.0\ ha	Rs\ 16,600	1.0\ ha	Rs\ 31,150
3) Landless farmers	0.3\ ha	0.6\ ha	Rs\ 10,000	0.6\ ha	Rs\ 18,690

As can be seen from the above, the income increase for landholder farmers would be over 2 fold with the Project. That for landless farmers with the Project would exceed the present income for tenant farmers (this does not include costs of tenancy obligation).

(4) Improvement of Farmer Support System

The FOs in the Project area were organized by the ID, and number 24 on the left bank and 31 on the right bank. They range in size from 30~40 farm households to 300~400 households. Outside of the ID, these FOs have no liaison with the Department of Agriculture or the ASC cooperatives.

The DOA and the ASCs must formulate extension strategy aimed at the FOs. Firstly, designated seed production farmers should be selected at a rate of 1 household per 20. Seed production should be sufficient to meet the needs of 20 households. Overall, a total of around 250 such seed production farmers (1 ac each) are necessary, 10 households (1/2 ha each; total of 2 ha) capable of superior seed distribution to these 250 households (total 100 ha) must be selected as specially designated seed production farmers. To these specially designated seed farmers, it is necessary that the DOA supply 200 kg of registered seed (20 kg per designated seed farmer).

The DOA must also take steps to facilitate cultivation loans by banks where necessary to these seed farmers to ensure fertilizer and agro-chemical application at recommended levels.

It is recommendable the extension of paddy cultivation technology with regards to fertilizer application, etc. be an extension of the above system to ultimately reach each FO and farmer group.

The water use training is the responsibility of the ID; however, the DOA should coordinate with the ID in this regard to ensure that this training is extended to the seed production farmers.

(5) Female Labor

Seasonal shortages of labor are seen in the agricultural sector throughout Hambantota district. Particularly in the Project area, 20% of women are engaged in public works and day labor. In previous years, planting labor was the largest category of female participation in farm work; however, in recent years seeding is 90% by the broadcast method. Even in such case, 30% of paddy cultivation work is dependent upon female labor. Responses from women with regards to work preference indicated not interest in paddy cultivation or rice milling works; but rather 41% showed preference for farm product marketing and commercial related work.

Commercial activities with regards to paddy production, in addition to the marketing of milled rice, would include the marketing of seed. There is strong demand among farmers for good quality seed, and if good quality seed can effectively be extended through the use of female labor under coordinated marketing activities with the cooperation of such NGOs as the Janashawati banks (women's organizations) NGO, there is the potential for this type of activity to extend beyond the Project area to the district-wide level.

6.3.3 Muruthawela Reservoir Scheme

This scheme comprises the 3 sub-schemes of Muruthawela LB, Urubokka Oya and Kirama Oya. For the purposes of planning these are grouped in 2, i.e. the (i) the Muruthawela LB, and (ii) Urubokka · Kirama oyas in light of differences in terms of potential for introduction of OFCs, etc.

(1) Land Use Plan and Cropping Plan

1) Muruthawela LB sub-scheme

The land use plan is to be in line with the cropping patterns indicated in Figure 6.3.3-1 ~ 6.3.3-3. OFC water demand is planned at ½ that for paddy.

In order to achieve economy of water use, efficient labor application, and increased farm income, the introduction of banana (semi-perennial crop) is planned for a total of 20% (0.15 ha / household) of the cropped area under the sub-scheme. In the downstream area of the sub-scheme, there is a rural agricultural research center at Angunakolapelessa from which direct cropping guidance can be obtained. It would also be easy to obtain the cooperation of the Angunakolapelessa project office under the Uda Walawe project as well which is famous for banana production. A good market for banana exists in the area, and farmer interest in cultivating the same is high.

In past years, consideration has not been given to the introduction of OFCs, nor their marketability and profitability. Pulses such as green gram, cowpea, etc. have been cultivated without much concern for their profitability; however, given farmer experience in the area, and factors of profitability, marketing and farmer preference, the introduction of inter-cropping of OFCs is considered optimum. In the southern region, there is the virus resistant variety Runuf, and seed for MI, KA and local varieties is produced at the agricultural research center.

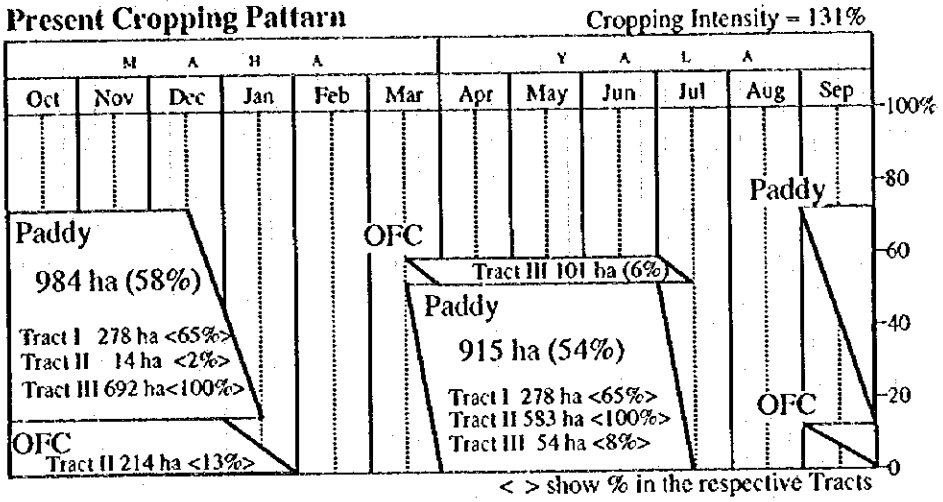
Present and design cropping areas are summarized in the table below; however, some small variation of this for paddy area would occur in actuality as a result of fluctuations in water supply and demand.

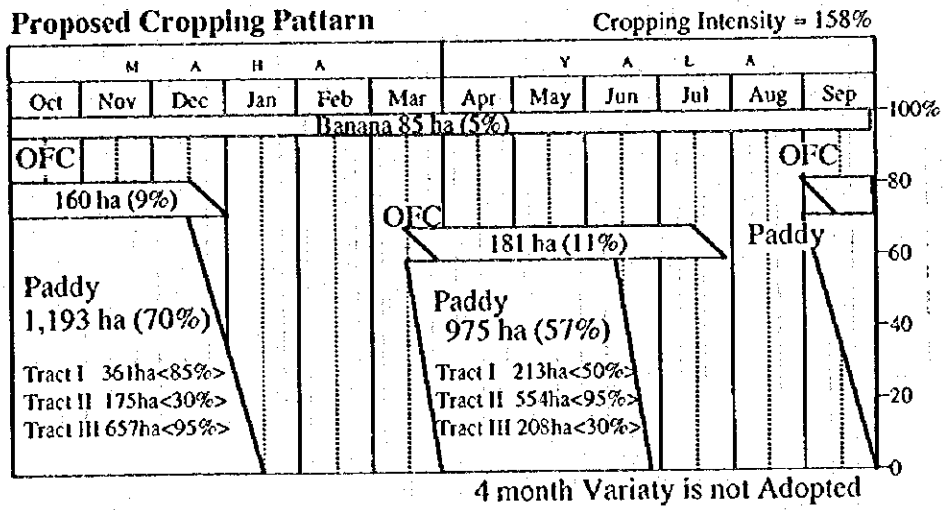
		Present			Design	
Rainy season	Paddy	984 ha	(58%)	Paddy	1,193 ha	(70%)
	OFC	214 ha	(13%)	Banana (perennial	85 ha	(5%)
				OFC	160	(9%)
Dry season	Paddy	915 ha	(54%)	Paddy	975 ha	(57%)
	OFC	101 ha	(6%)	Banana (perennial	85 ha	(5%)
				OFC	181	(11%)
Yearly landuse rate:		2,214 ha	(130%)		2,679 ha	(158%)

2.Muruthawela Reservoir Scheme (A=5,473 ha)

(1) Muruthawela LB A= 1,700 ha

Tract I 425 ha
Tract II 583ha
Tract III 692 ha

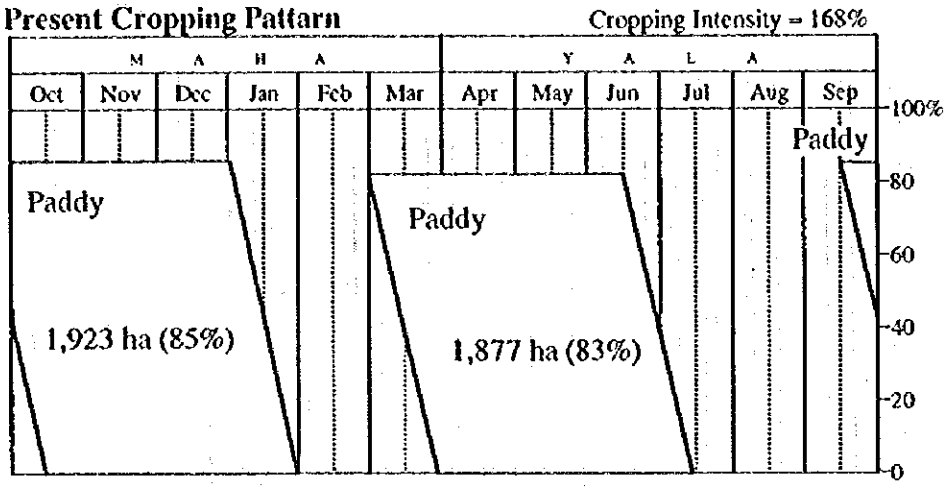


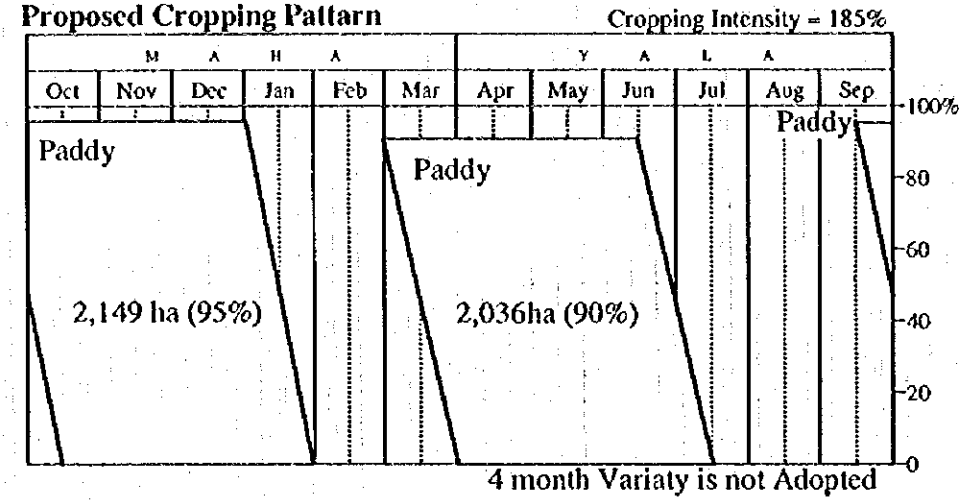


		<Present>	<Proposed>
Maha	Paddy	984ha (58%)	1,193ha (70%)
	OFC	214ha (13%)	160ha (9%)
	Banana		85ha (5%)
Yala	Paddy	915ha (54%)	975ha (57%)
	OFC	101ha (6%)	181ha (11%)
	Banana		85ha (5%)
		2,214ha (131%)	2,679ha (158%)

Figure 6.3.3-1 Present and Proposed Cropping Pattern in Muruthawela LB Sub-scheme

(2) Urubokka Oya Scheme (2,262 ha)

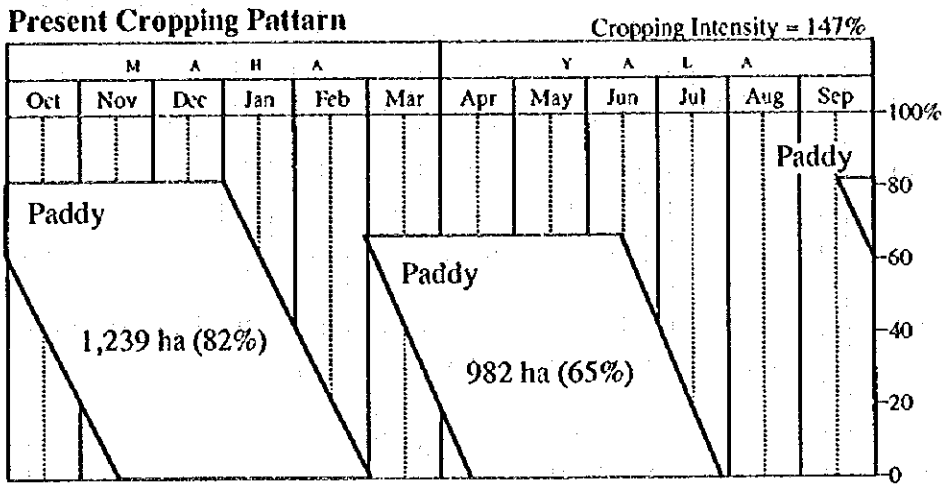


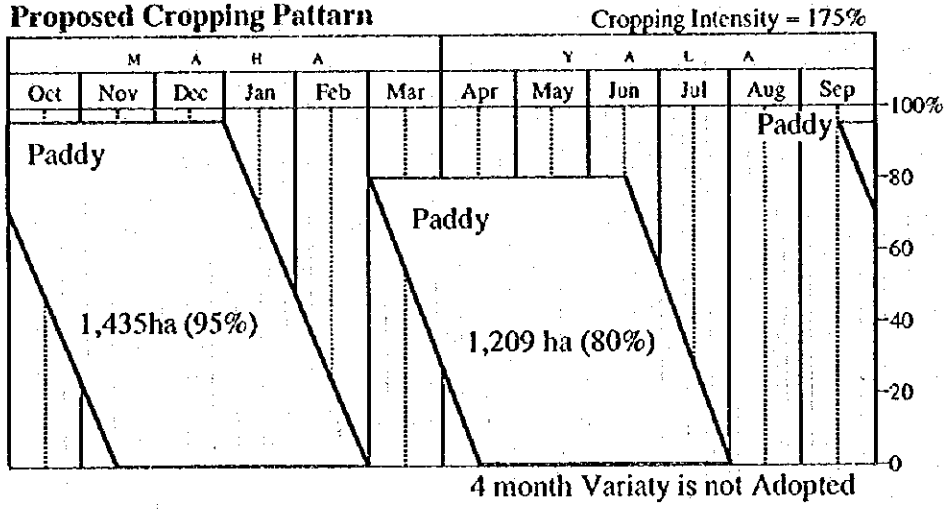


		<Present>		<Proposed>	
Maha	Paddy	1,923ha	(85%)	2,149ha	(95%)
Yala	Paddy	1,877ha	(83%)	2,036ha	(90%)
		3,800ha	(168%)	4,185ha	(185%)

Figure 6.3.3-2 Present and Proposed Cropping Pattern in Urubokka Sub-scheme

(3) Kirama Oya Scheme (1,511 ha)





		<Present>		<Proposed>	
Maha	Paddy	1,239ha	(82%)	1,435ha	(95%)
Yala	Paddy	982ha	(65%)	1,209ha	(80%)
		2,221ha	(147%)	2,644ha	(175%)

Figure 6.3.3-3 Present and Proposed Cropping Pattern in Kirama Oya Sub-scheme

From the above, the annual total for paddy and OFC cropped area shows around 15% increase respectively, with the introduction of banana cropping (85 ha perennially) being the major cropping change. Rotational cropping of paddy is currently practiced in the Tract II and III areas in the rainy and dry seasons. This system is undergoing steady improvement and it is expected that this would be continued under the Project.

2) Urubokka Oya · Kirama Oya sub-schemes

Over 80% of the land in the sub-scheme areas is cultivated by tenant farmers. Since average cultivated area is a small 0.5 ha per farmer, there is not farmer interest in the introduction of OFCs. The strong tendency in the area is to crop for self-consumption rather than as a source of income.

The land use plan, is in line with the cropping patterns indicated in Figure 6.3.3-2 and 6.3.3-3. Specifically, this is as follows:

	Present		Design	
Paddy				
Rainy season Paddy	3,162 ha	(84%)	3,584 ha	(95%)
Dry season OFC	2,859 ha	(76%)	3,245 ha	(86%)
For 3,733 ha, annual cropping of 6,021 ha (160%)			6,829 ha	\(181%\)
For 7,800 households, cropping of 0.77 ha per househol			0.88 ha per household	

Within the sub-scheme areas, particularly in the case of Kirama Oya, overall water supply is not abundant and accordingly the increased introduction of 4.5 month varieties is precluded.

3) Overall plan

Overall plan for the Muruthawela Reservoir scheme (5,473 ha) is as follows:

		Present			Design	
Rainy season	Paddy	4,186 ha	(77%)	Paddy	4,777 ha	(87%)
	OFC	214 ha	(4%)	Banana (perennial)	85 ha	(2%)
				OFC	160	(3%)
Dry season	Paddy	3,734 ha	(68%)	Paddy	4,220 ha	(77%)
	OFC	101 ha	(2%)	Banana (perennial)	85 ha	(2%)
				OFC	180 ha	(3%)
Yearly landuse rate:		8,235 ha	(150%)		9,510 ha	(174%)

(2) Improvement of Planting Method, and Anticipated Yield and Design Production

1) Muruthawela LB sub-scheme

<Paddy cultivation>

In order to improve paddy cultivation, it is necessary that the Project Office plan such that the DOA assist in supply of good quality seed to the farmers. As insufficient fertilizer application of 200 kg/ha is observed in the area, the Project Office should support the farmers in obtaining cultivation loans to ensure fertilizer application sufficient to achieve the design yield of 5.5 t / ha for 3.5 month varieties.

<Upland crop cultivation>

Chilies and high cash vegetables (gourd varieties, etc.) only are to be recommended under the project. Extension low profitability pulses (green gram, cow pea, peanut, etc.) is not planned.

Extension area of chili would be planned on a seasonal basis at the Project Office by D-canal group and FO unit availing of the cooperation of the DOA and in close liaison with the agricultural research center in the area.

It would be advantageous that the under farmer organization the farmer groups for each F-canal establish a common nursery near the intake.

Anticipated yield for chilies with application of 900 kg / ha of fertilizer under the Project would be 1,000 kg / ha (dry season).

<Banana>

Planting interval for seedlings would be 3 m × 3 m, for a total of 1,000 seedlings per ha. Cultivated area would be 0.05 ha per household, for a total of 50 seedlings planted per household. Conventionally, overall replanting is usually done every 5 years, however, the agricultural research center has related that once every 3 years is recommended for pest prevention and this is to be adopted under the Project.

In consultation with the DOA and the research center, it is important that the Project Office introduce superior seedlings from the Uda Walawe banana producing area. As the research center provides direct guidance to around 300 farm households in the area regarding banana cultivation, it is possible to plan the introduction of superior seedlings from these farmers.

Application of fertilizer would be 250 kg / ha in the first year, to be increased to 500 kg/ha in the 2~3 years. In addition, 2,000 kg / ha of organic fertilizer (compost) would be applied yearly.

Anticipated yields would be 5 t / ha in the first year and 20 t / ha in the 2~3 years for an average of 15 t / ha.

2) Urubokka Oya · Kirama Oya sub-schemes

Only paddy cultivation is planned for the area, with the introduction of OFCs not considered under the Project. Extension of good quality seed, increase of fertilizer application to 450 kg / ha, and optimum timing for fertilizer application are considered more difficult in this area than in other parts of the Project area sue to the fact the overwhelming number of farmers are tenants (over 80%), there is no Project Office (instead is handled as a one part of the general area under the jurisdiction of the local agricultural office of DOA. Accordingly from the standpoint of low level paddy yields, it is necessary the extension efforts be concentrated in the area.

Anticipated yield under the Project for 3.5 month varieties of paddy is 5.5 t / ha.

3) Design production under the overall scheme

Annual paddy production:

Anticipated yield (5.5 t) × design cropped area (8,997 ha) = 49,480 t

Annual banana production:

Anticipated yield (15 t) × design cropped area (85 ha) = 1,275 t

Annual OFC production (computed in terms of chilies):

Anticipated yield (1 t) × design cropped area (340 ha) = 340 t (dried)

(3) Crop Production Cost and Farmer Income

Crop production cost and farmer income for the overall Muruthawela Reservoir scheme is as follows:

(per ha)	Paddy		Chili		Banana (1st year)		Banana (2nd year)	
Inputs:								
1. Seed / seedlings (kg)	100	Rs 1,250	2	Rs 1,600	1,000	Rs 6,000		
2. Fertilizer (kg)	450	Rs 4,500	900	Rs 8,100	250	Rs 2,500	500	Rs 5,000
Vmix	150							
TDM	150							
Urea	100							
	-		1,000	-				
3. Agro-chemicals (lit./kg)	9	Rs 2,300	10	Rs 2,500	6	Rs 1,500	6	Rs 1,500
Weedicides	7		4		4		2	
Insecticides	2		6		2		4	
4. Farm equipment (ha)		Rs 6,670		Rs 1,800				
Tilling								
Others								
5. Hired labor (m-d)	19	Rs 1,900	135	Rs 13,500	100	Rs 10,000	100	Rs 10,000
Family labor (m-d)	120		350		150		150	
Income:								
1. Yield (kg)		5,500	(dried)	1,000		5,000		20,000
2. Farm gate price (Rs/kg)		Rs 9.4		100		10		10
3. Gross income (Rs)		Rs 51,700		Rs 100,000		Rs 50,000		Rs 200,000
4. Production cost (Rs)		Rs 16,620		Rs 27,500		Rs 20,000		Rs 16,500
5. Net income (Rs)		Rs 35,080		Rs 72,500		Rs 30,000		Rs 183,500

On the basis of the above design crop production cost and taking into consideration per household cropped area of paddy and the income from OFCs for the present and with the Project are compared in the table below.

	Muruthawela LB		Urubokka·Kirama Oyas		Overall	
Present	Rs 25,260 /household	(100)	Rs 17,420 /household	(100)	Rs 18,970 /household	(100)
Design	Rs 44,770 /household	(177)	Rs 35,190 /household	(202)	Rs 37,520 /household	(198)

(From the results of agricultural survey, present OFC income is estimated at 1/3 that of paddy. Income from chena cultivation under the Urubokka Oya · Kirama Oya sub-schemes is included in OFC income. The with Project income from OFCs is considered the same as the present.)

(4) Improvement of Farmer Support System

With regards to the Muruthawela LB sub-scheme, it is necessary to permanently assign 1 AO to the present Project Office to be responsible for paddy cropping improvement, and the extension of banana and high cash OFCs, strengthen the INMAS program for better effectivity under close liaison between the AI and the FOs.

In particular, due to the particularly large need in the area to improve farm management, increase yields and introduce banana cropping, and the fact that good collaboration with the area agricultural research center and the banana producing area under the Uda Walawe project is essential, it is necessary to strengthen the system for agricultural extension under the responsibility of the AO and AI. These efforts would center on the Project Office.

Due to the fact that the Project Office has not directed efforts at Tract I in the past, it is necessary to establish a support system aimed at good liaison between the farmers of Tract I and those in Tracts II and III, with an equitable increase in farm income based on good cooperation among all the farmers in the sub-scheme area concerning water use.

In the case of the Urubokka Oya and Kirama Oya sub-schemes, it is considered that there is a current limit to the effectivity of agricultural extension due to the fact that tenant farmers are numerous, and the area is treated as one part of the general jurisdiction of the district level agricultural office. However, with the establishment of a Project Office in the area after rehabilitation, it will be necessary to effect an extension system centered on the FOs which focuses on cost-effective and practical improvements in agricultural technology including the extension of superior seed, increase in fertilizer application, and guidance in proper timing of fertilizer application. This would be done within a framework with emphasis on effective water management.

(5) Female Labor

Under the Muruthawela LB sub-scheme, it is planned to introduce the cultivation of 0.05 ha per household of banana (50 trees) and 0.12 ha of OFCs (chilies, green vegetables, etc.). In such case, there will be numerous opportunities for female participation in seedling raising, planting, water management, crop care, harvest, chili drying, farm product marketing, etc. Under the crop production cost plan, family labor contribution to the overall labor requirement for OFC cultivation is 8 person-days for banana per year and 42 person-days for chilies, for a total per year of 50 person days.

The Urubokka Oya · Kirama Oya sub-schemes are near Wet Zone, and as a result cattle are raised by almost all households. It is concluded that female labor will continue to play an important role in animal husbandry. Also, the reed and palm frond weaving production engaged in by more than 60% of the households of the area is expected to continue to be the greatest type of female labor in the said area.

6.3.4 Badagiriya Scheme

(1) Land Use and Cropping Plan

Land use plan is to be in line with the cropping pattern shown in Figure 6.3.4-1. OFC water demand is planned at ½ that for paddy.

Also, introduction of banana is planned for 10% of the total cropped area under the scheme (100 trees / 0.1 ha / household), in order to economize on water use and maximize efficient use of labor.

Present and design cropping areas are summarized in the table below; however, some small variation of this for paddy area would occur in actuality as a result of fluctuations in water supply and demand.

		Present			Design	
Rainy season	Paddy	536 ha	(78%)	Paddy	617 ha	(90%)
				Banana (perennial	69 ha	(10%)
Dry season	Paddy	367 ha	(54%)	Paddy	343 ha	(60%)
	OFC	40 ha	(6%)	Banana (perennial	69 ha	(10%)
				OFC	69 ha	(10%)
Yearly landuse rate:		943 ha	(138%)		1,167 ha	(180%)

Given farmer experience in the area, and factors of profitability, marketing and farmer preference, chili is considered the optimum OFC crop. There is a virus resistant, local variety in the southern region (Runuf) and the regional agricultural research center engages in chili seed production.

(2) Improvement of Planting Method, and Anticipated Yield and Design Production

1) Paddy cultivation

In order to increase paddy yield, it is necessary that the AD assist in providing good quality seed and the level of fertilizer application be raised to 450 kg / ha.

Anticipated yield for 3.5 month variety under the Project is 5.5 t / ha. As a target yield of 6 t / ha for 4.5 month varieties is possible, it is recommended that as much area as possible be cropped with this type of paddy in the rainy season. Although promotion of 4.5 month variety cultivation would accordingly be expected to raise unit yields somewhat, for the purposes of planning under the Project design yield is calculated on the safe side at an average 5.5 t / ha for both dry and rainy seasons.

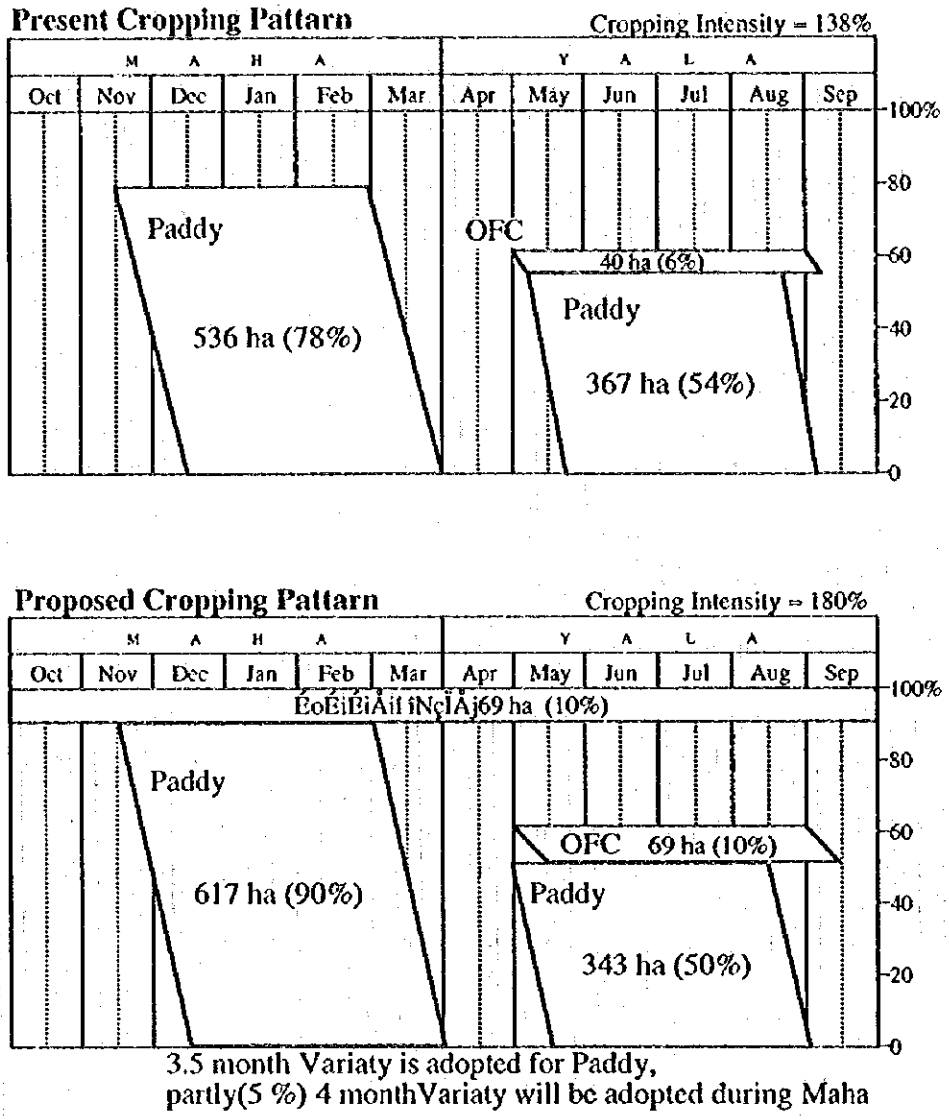
2) Upland Crops and Chili

As chili is an important component of the local diet, almost all households have experience in home gardening of this crop and this would facilitate promoting this crop. Seed should be distributed to the farmers via the FOs by the AD in collaboration with the regional agricultural research center.

As organization of farmer groups progresses, it would be advantageous in terms of water use to establish common nurseries at the F-canal group level. This type of farmer organizing would be effective as well in obtaining cultivation loans from the bank.

Anticipated unit yield for chili is 1,000 kg / ha (dry) under conditions of fertilizer application of 900 kg/ha.

3. Badagiriya Scheme (A=686 ha)



3.5 month Variaty is adopted for Paddy,
partly(5 %) 4 monthVariaty will be adopted during Maha

		<Present>		<Proposed>	
Maha	Paddy	536ha	(78%)	617ha	(90%)
	Banana			69ha	(10%)
Yala	Paddy	367ha	(54%)	343ha	(50%)
	OFC	40ha	(6%)	69ha	(10%)
	Banana			69ha	(10%)
		943ha	(138%)	1,167ha	(170%)

Figure 6.3.4-1 Present and Proposed Cropping Pattern in Badagiriya Scheme

3) Banana (perennial cropping)

Banana is a semi-perennial crop, from which about 3 side shoots appear each year from the parent tree. After harvest, one healthy side shoot is left standing, and the parent tree and other side shoots are cut. Seedling planting interval is 3 m × 3 m, with 1,000 seedlings per ha. As design cropped area is 0.1 ha per household, each household would raise 100 trees.

Conventionally, overall replanting is usually done every 5 years, however, the agricultural research center has related that once every 3 years is recommended for pest prevention and this is to be adopted under the Project.

In consultation with the AD and the research center, it is important that the Project Office introduce superior seedlings from the Uda Walawe banana producing area. As the research center provides direct guidance to around 300 farm households in the area regarding banana cultivation, it is possible to plan the introduction of superior seedlings from these farmers.

Application of fertilizer would be 250 kg / ha in the first year, to be increased to 500 kg ha in the 2~3 years. In addition, 2,000 kg / ha of organic fertilizer (compost) would be applied yearly.

Anticipated yields would be 5 t / ha in the first year and 20 t / ha in the 2~3 years for an average of 15 t / ha.

4) Design Production

On the basis of anticipated yield and design cropping area, design production is computed as follows:

Paddy:	5.5 t / ha ×	960 ha / year	= production of 5,280 t
Banana:	15 t /ha ×	69 ha / year	= producti on of 1,030 t
OFC (dry chili):	1 t / ha ×	69 ha / year	= production of 69 t

(3) Crop Production Cost and Farmer Income

Per ha production cost for paddy, chili and banana, and resultant farmer income are as follows.

(per ha)	Paddy		Chili		Banana (1st year)		Banana (2nd year)	
Inputs:								
1. Seed (kg)	100	Rs 1,250	2	Rs 1,600	1,000	Rs 6,000		
2. Fertilizer (kg)	450	Rs 4,500	900	Rs 8,100	250	Rs 2,500	500	Rs 5,000
Vmix	150							
TDM	150							
Urea	150							
	-		1,000	-				
3. Agro-chemicals (lit./kg	9	Rs 2,294	10	Rs 2,500	6	Rs 1,500	6	Rs 1,500
Weedicides	7		4		4		2	
Insecticides	2		6		2		4	
4. Farm equipment (ha)		Rs 7,925		Rs 1,800				
Tilling								
Others								
5. Hired labor (m-d)	29	Rs 2,900	135	Rs 13,500	100	Rs 10,000	100	Rs 10,000
Family labor (m-d)	130		350		150		150	
Income:								
1. Yield (kg)		5,500	(dried)	1,000		5,000		20,000
2. Farm gate price (Rs/kg)		Rs 9.4		100		10		10
3. Gross income (Rs)		Rs 51,700		Rs 100,000		Rs 50,000		Rs 200,000
4. Production cost (Rs)		Rs 18,730		Rs 27,500		Rs 20,000		Rs 16,500
5. Net income (Rs)		Rs 32,970		Rs 72,500		Rs 30,000		Rs 183,500

On the basis of the above design crop production cost and cropped area (paddy 1.4 ha, chili 0.1 ha, banana 0.1 ha, net income per household is computed at Rs 66,600 per year which is 2.6 fold the current household income of Rs 25,450. The increase in income is the result mainly of larger unit yield for paddy; the paddy potion of income increase increasing 2.3 fold over that at present.

(4) Improvement of Farmer Support System

The 4 FOs in the scheme area are well organized, and as a result if the institutional support structure is effectively coordinated and a well functioning extension system established including training, etc., a significant increase in agricultural production can be expected.

Centering on the Project Office, the DOA, ASCs, and agricultural research center should collaborate closely with the ID in discussions on resolving farmer problems, increasing paddy production and introduction of OFCs as a basis for formulating an action plan and providing instruction and guidance to the FOs with regards to the items below.

The action plan would be discussed at the cultivation meetings each season, whereat specific training methods and responsibilities to borne by the farmer side would be decided.

1) Establish a communication network between farmers, particularly those at the extreme downstream end of canals where water shortage is a concern, and the ID water use management officer and the DOA crop officer.

- Training in communication between the FOs and the ID concerning water shortages
- Preparation of check cards each season of canals and irrigation blocks where water shortage occurs

2) Via the F-canal and D-canal groups, the DOA (AO - AI) carries out farm management survey of paddy, banana, chili, etc. cropping. Survey items would be simple, such as area, fertilizer application amounts, yield, etc.

3) Cultivation credits are necessary in the case of the introduction of OFCs (chili, banana). It is recommended that the DOA and ID be informed of cropped area each season by receive a list of farmer groups from the FOs in order to make arrangements with the bank in advance for credit extension to the farmers. In such case, farmers receiving credit would have their cultivation activities monitored by the DOA.

(5) Female Labor

The Hambantota district DOA responds monthly to a monitoring sheet from the central office regarding extension activities (Second Agricultural Extension Program; World Bank). In the monitoring sheet, 3 problems are raised each month, i.e. seed problems, disease and pest prevention (IPM) and seasonal labor shortages.

As male labor is being siphoned off into other sectors, effective utilization of female labor in agriculture is a major issue for the future. In order to restructure the present situation such that income generating labor opportunities are produced and the status of women elevated, it is necessary that farmer preferences and aspirations, and the support activities from the institutional side coincide with regards to OFC introduction, farm product marketing, animal husbandry, etc.

Under the Project, 0.1 ha of banana cropping and 0.1 ha of chili cropping in the in the dry season per household are to be introduced into the area, and in such case, there will be numerous opportunities for female participation in seedling raising, planting, water management, crop care, harvest, chili drying, farm product marketing, etc. Under the crop production cost plan, family labor contribution to the overall labor requirement for OFC cultivation is 15 person-days for banana per year and 35 person-days for chilies.

6.4 Irrigation and Drainage Plan

6.4.1 Irrigation Plan

(1) Basic Strategy for the Irrigation Plan

The basic strategy under the irrigation plan is to identify the various problems afflicting each scheme, and the constraints to efficient water use, and focus on measures to eliminate these. On the basis of field survey of each scheme, the following major problems are identified.

1) Liyangastota scheme

Both the LB and RB sub-schemes of the Liyangastota scheme draw their water from the Walawe ganga via the Liyangastota anicut. Upstream of the scheme area, the Uda Walawe reservoir was constructed in 1968 (V = 240 million m^3) to control discharge of the Walawe ganga, and as a result both LB and RB sub-schemes have an ample water source for irrigation throughout the year.

However, system facilities show significant deterioration, and require urgent rehabilitation. According, strategy under this scheme is focused on ameliorating its deteriorated state.

2) Muruthawela Reservoir scheme

(i) LB sub-scheme

The water source for this sub-scheme is the Muruthawela Reservoir (48 million m^3). Although their is some fluctuation from year to year, overall the scheme suffers from water shortage and seasonal rotational irrigation is being practiced at present in the Tract-II, and Tract-III areas. Also, Tract-I was not officially incorporated into the original plan, and for many years illegal diversion of discharge from the main canal has been the practice. Thus the scheme suffers both water shortage and social problems, both of which must be addressed in addition to the significant deterioration of the irrigation facilities.

Accordingly, strategy under this scheme is focused on:

- Study and analysis of water source
- Mitigation measures for water shortage
- Legalization of Tract I participation in the scheme
- System and facility rehabilitation

(ii) Urubokka Oya · Kirama Oya sub-schemes

Although flood discharges are not abundant in the case of both schemes, in a ordinary water year (Maha) cropping is essentially possible throughout the entire area. Kirama Oya sub-scheme comprises 18 anicuts, and the Urubokka sub-

scheme is a combination of 8 anicuts and the command area of the High Level Canal. These sub-schemes are not integrated which in turn has been a cause deterring a unified FO organization for the area.

With consideration to this fact, strategy under both sub-schemes will focus on:

- Rationalization of water distribution in the LB sub-scheme
- Upgrading system irrigation efficiency
- Construct new O&M roads along canals, and connect anicut sites by road.
- Rehabilitation of each system

(iii) Badagiriya scheme

This scheme draws its water from the Badagiriya tank. Since the tank does not have sufficient discharge inflow from its own catchment, the system was incorporated under the RB, most downstream portion of the Kirindi Oya scheme area in order to receive 5,000 ac-ft (6.2 million m^3) of supplemental irrigation discharge per year. Also, as highly permeable soil is generally distributed in the scheme area, water loss from feeder and main canals is significant.

Accordingly, strategy under this scheme is focused on:

- Study and analysis of water source
- Mitigation measures for water shortage
- Measures to prevent seepage along feeder and main canals
- System rehabilitation

The rehabilitation plan is formulated on the basis of the above described strategy for each scheme.

(2) Basic Strategy for Drainage Plan

Almost all of the canals in the Project area are unlined drainage cum irrigation canals. With the exception of the most downstream portion of the Kirama Oya sub-scheme, there is not serious drainage damage occurring in the scheme areas. Accordingly, the present drainage system layout will be maintained, taking measures to ensure sufficient freeboard in design irrigation canal cross-section to handle the design drainage discharge.

In the case of drainage canals, there is a need to improve canal cross-sections and longitudinal profiles; however, this is to be the responsibility of the farmers and is to be therefore outside the scope of this Project. Nevertheless, rehabilitation of structures along drainage canals (gates, diversion pipes, transition sections, etc.) will be included under the Project.

In the downstream basin of the Kirama Oya, drainage rehabilitation will be addressed through rehabilitation of canal bunds (also used as farm roads), gates, canal cross-section improvement, etc.

(3) Basic Strategy for the Rehabilitation Plan

On the basis of field survey results and water balance calculations, basis strategy is as follows.

1) Recovery of system function

Formulation of the irrigation plan is targeted at the recovery of each overall scheme as an integrated system. Accordingly, each individual facility is not to be completely rehabilitated per se, but rather the salvage value of these facilities is to be maximized, and maximum priority given to the present irrigation practices and facility use.

2) Level of facility rehabilitation

Principal facilities under the schemes comprise tanks, discharge gauging facilities, main canals, distribution canals (D-canals) and field canals (F-canals).

With the exception of the field canals, the above main facilities are presently operated and maintained under the jurisdiction of the ID. Level of facility upgrade under the rehabilitation plan is to be as follows:

Tanks:

As the Study is aimed at the recovery of the function of existing facilities through rehabilitation, neither diversion from new water sources nor increasing the storage capacity of tanks (embankment raising, etc.) are considered under the rehabilitation plan. Instead, rehabilitation measures at Ridiyagama Reservoir will include increasing crest width of reservoir bund, raising the elevation of the flood spillway (1 ft) and additional embanking on the downstream side of the reservoir bund.

Discharge gauging facilities:

The existing and deteriorated facilities are to be completely rehabilitated as they are crucial to overall system management. In addition, new such facilities are to be installed at the start point of distribution canals in order to obtain accurate records of irrigation discharge.

Main canals:

Segments of canals where discharge carrying cross-section is insufficient and slope collapse has occurred, and turnout facilities which have experienced severe deterioration will be rehabilitated. Canal lining method will in principal be a combination of unlined, and lining with stone masonry and will reflect the findings of assessment of the present irrigation / drainage systems.

Distribution canals:

D-canals and equivalent branch canals with be rehabilitated to include appropriate O&M roads along the canals. Lining method is to be stone masonry or standard section unlined canal.

Field canals:

Rehabilitation of F-canal channels is to be done by the farmers themselves, and is therefore excluded from the scope of the project. However, canal structures along these canals will be included in the rehabilitation works under the Project.

Anicuts:

As these are presently in relatively good condition despite the fact that they have exceeded their design utility lives, rehabilitation will be in accordance with the degree of deterioration identified for each structure. Mainly, rehabilitation will comprise replacing gates and repair of seriously damaged embankment protection works upstream and downstream of the structures.

3) Facility rehabilitation and expansion of irrigated area. Present cropping intensity in the Liyangastota scheme which has ample water resources is 95% (Maha / Yala). Under facility rehabilitation and scheme improvement, cropped area is to be increased to 100%. In the case of the other 2 schemes (Muruthawela Reservoir and Badagiriya) for which shortage of water resources has been identified through present water balance analysis, rehabilitation of facilities alone will not achieve 100 percent irrigation of the scheme areas. Present water balance was determined on the basis of criteria including discharge inflow into the schemes from their catchment areas, tank discharge records, irrigation period, irrigation requirement, reuse of drainage runoff for irrigation, irrigation efficiency, etc. and finally verified on the basis of irrigated area as confirmed in the field. Of these various criteria, irrigation efficiency will be directly improved by rehabilitation of the facilities. Irrigation efficiency basically comprises canal conveyance efficiency (Ec) had field loss (Ea).

Under the Project, as F-canals are outside the scope of the envisioned rehabilitation, the same value for Ea is applied for both with and without Project scenarios. On the other hand, the canal conveyance efficiency Ec will be improved, and as such the conventional design efficiency value is applied under the Project. The difference in the present Ea and the with-Project Ea is the criteria for design increment in irrigable area.

Scheme	Sub-scheme	Canal conveyance efficiency Ec (%)	
		Present	Design
Muruthawela	Muruthawela LB	50	65
Reservoir	Urubokka	40	65
	Kirama	40	65
Badagiriya		50	65

note: Present Ec value verified from present water balance calculation
Design Ec value adopted from ID design criteria

(4) Irrigation Requirement · Calculation Criteria

Irrigation water requirement is calculated in accordance with ID design criteria. The FWR (field water requirement) was computed applying the following criteria.

1) Design crops and staggered cropping pattern

Paddy : low land, 105 day variety
OFC : ground nuts, 110 variety (on the basis of discussions with ID)
Banana : variety in Uda Walawe area

Staggered cropping pattern is 3 step based on the conditions in the scheme areas. Proportion for each step is 30% (step 1), 40% (step 2) and 30% (step 3).

2) Crop factor (Kc)

Step wise crop factors for maturation period are as follows.

	CF	Initital	Development	Mid	Late	Total
Paddy	days	20	30	30	25	105
(105 day type)	Kc	1.00	1.15	1.20	0.90	
OFC	days	20	30	40	20	110
(110 day type)	Kc	0.65	0.80	1.00	0.80	

source: ID design criteria

Crop factor for banana (perennial crop) is as follows.

Banana	Maha						Yala					
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Kc	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05	1.00	1.00

source: Uda Walawe feasibility study report

3) Evapotranspiration (ET)

Evapotranspiration in the case of the design crops is computed as follows.

$$ET = Kc \times ETo$$

ETo was determined for each scheme from the region-wise monthly evapotranspiration amounts as set out in ID design criteria.

Scheme	Observation point (station no.)
Muruthawela Reservoir	8 Ridiyagama
Liyangastota	8 Ridiyagama
Badagiriya	16 Tissamaharama

Computed ETo values are shown below.

ETo	Maha						Yala					
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Muruthawela Liyangastota	5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
Badagiriya	4.93	4.63	3.72	3.72	4.30	4.19	4.64	4.69	4.96	5.18	5.28	5.36

4) Water requirement for land preparation (LP)

Paddy: Land preparation is assumed at 30 days, of which 5 days is soaking (Ls) and the remaining 25 days is tilling (Lt). The last day assumes standing water.

OFC: Land preparation period including furrowing, etc. is assumed as follows.

Ls = 1.5 in. / 15 days

5) Effective rainfall (ER)

Effective rainfall is assumed as follows based on ID design criteria.

ER = 0.67 (R-1)

ER = 9 in. (rainfall in excess of 9 in.)

Effective rainfall for each scheme adopts observed rainfall at the following locations.

Scheme	Observation point	Station
Liyangastota	No.24	Mamadala Sta.
Muruthawela Reservoir	No.18	Kirama Sta.
Badagiriya	No.40	Badagiriya Tank Sta.

6) Irrigation efficiency

Field loss (Ea):

Ea for the Muruthawela LB sub-scheme is assumed at 50% for both with and without Project. In the case of the other 2 schemes, the same is assumed at 60% for both with and without Project.

Canal conveyance loss (Ec):

This is computed as follows based on degree of facility deterioration and the results of calculations for present water balance.

Scheme	Sub-scheme	Ec (%)	
		Present	Design
Liyangastota	WRB	50	65
	WLB	50	65
Muruthawela	LB	50	65
Reservoir	Urubokka	40	65
	Kirama	40	65
Badagiriya		50	65

note: Ec = 65% (design) is adopted from ID design criteria (applied to main, branch and feeder canals). Present Ec is determined from the results of present water balance calculation.

(5) Cross-section Improvement Plan for Canals

1) Calculation of Design Discharge

Design discharge is computed on the basis of the peak unit irrigation requirements indicated below, multiplied by the size of the benefit area.

Scheme	Sub-scheme	Unit irrigation requirement (lit/s/ha)
Liyangastota	WRB, WLB	2.70
Muruthawela	LB	2.30
Reservoir	Urubokka, Kirama	2.50
Badagiriya	--	2.30

Design discharge, canal gradient, segment length and standard cross-section are indicated on a scheme-wise basis in Table 6.4.1-1 and Figure 6.4.1-1. Manning's formula was adopted for hydraulic calculations, applying ID calculation criteria for roughness coefficients (n = 0.020 in the case of masonry lining, and n = 0.035 in the case of earthen canal).

2) Design Discharge Distribution

The design discharge for the 3 schemes (total of 6 sub-schemes) is as shown in Figure 6.4.1-2 ~ 7.

3) Unit Cost for Canal Construction

Construction unit costs for each type of canal are tabulated below on the basis of ID computation data (ID system up to August 1995).

(per m)

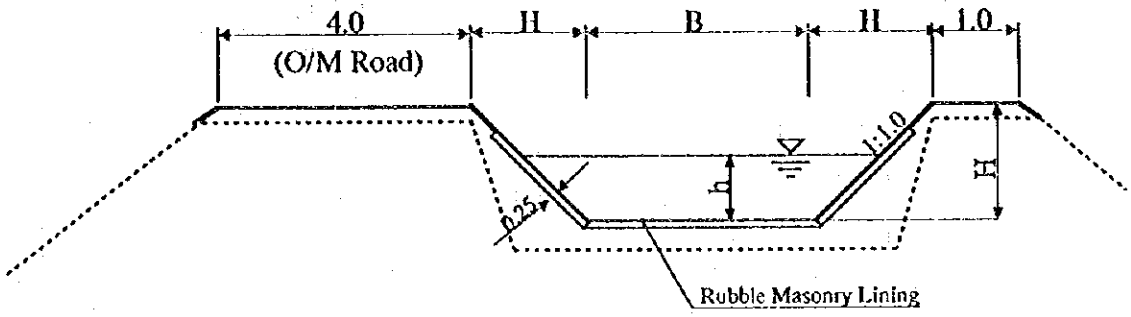
Canal type	Standard dimensions B × H (m)	Construction unit cost (Rs)	Remarks
1. Masonry lining			Unit Rs/m
Type LI	8.0 × 1.70	8,097	
LII	5.0 × 2.00	6,198	
LIII	4.0 × 1.80	5,558	
LIV	3.0 × 1.40	4,280	
LV	2.0 × 1.40	3,540	
LVI	1.0 × 1.00	2,639	
2. Earthen			Unit Rs/m
Type EI	8.0 × 2.80	1,144	
EII	5.0 × 2.20	610	
EIII	4.0 × 2.00	577	
EIV	3.0 × 1.50	511	
EV	2.0 × 1.40	380	
EVI	1.0 × 1.00	124	
3. F-canal	--	230	Rs/km
4. Drainage canal	--	140	Rs/km

note: ID values have been adopted for unit cost for rehabilitation works (Rs/km) for F-canal and drainage canal.

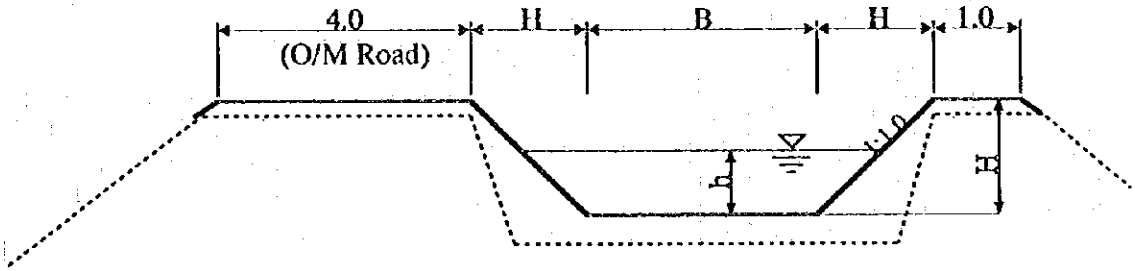
Table 6.4.1-1 Designed Canal Type for Respective Canal Sections

Sub-scheme		Canal	Station	Q(m³/s)	I	Type
Liyangastota Scheme	Walawe RB	RB Main	0+000 ~ 6+000	6.63	0.0004	E I-a
			6+000 ~ 11+730	6.63	0.0003	E I-b
			11+730 ~ 13+275	6.49	0.0004	L II
			13+275 ~ 17+113	4.81	0.0004	L III
			17+113 ~ 22+460	2.14	0.0004	L IV
			22+460 ~ 26+300	1.06	0.0004	E IV
		D-1	0+000 ~ 0+900	1.15	0.0004	L V
		Jansegama	0+000 ~ 2+650	0.39	0.0004	L VI
		Walawe Watta	0+000 ~ 3+000	0.72	0.0004	L V
		D-2	0+000 ~ 1+600	0.27	0.0004	L V
		D-3	0+000 ~ 2+075	2.25	0.0004	L IV
			2+075 ~ 7+500	1.00	0.0004	L V
		Wickramanayake	0+000 ~ 2+212	1.06	0.0004	L V
		Wick RB	0+000 ~ 3+200	0.46	0.0004	E V
		Wick LB	0+000 ~ 1+750	0.19	0.0004	E VI
		Lunama	0+000 ~ 0+800	0.23	0.0004	E VI
		Dawage	0+000 ~ 6+000	0.34	0.0004	E VI
		New Canal	0+000 ~ 2+500	0.18	0.0004	E VI
		D-32	0+000 ~ 2+700	0.19	0.0004	E VI
	Walawe LB	Feeder Canal	0+000 ~ 6+475	7.77	0.00035	Resectioning
		LB Main	0+000 ~ 12+203	5.65	0.00035	L I
		NRB	0+000 ~ 0+899	1.25	0.00035	L V
			0+000 ~ 1+700	0.21	0.00035	L VI
			1+700 ~ 4+500	0.21	0.00035	E VI
		NCB	0+000 ~ 2+344	1.00	0.00035	L V
			2+344 ~ 3+200	0.05	0.00035	E VI
		SLB	0+000 ~ 4+802	2.39	0.00035	L III
			4+802 ~ 10+300	0.79	0.00035	L V
			10+300 ~ 15+800	0.34	0.00035	E VI
		SCB	0+000 ~ 2+216	1.17	0.00035	L V
			2+216 ~ 3+800	0.46	0.00035	L VI
		SRB	0+000 ~ 2+799	2.46	0.00035	L IV
			2+799 ~ 5+450	1.50	0.00035	L V
			5+450 ~ 7+600	0.48	0.00035	E V
Muruthawela Reservoir Scheme	Muruthawela LB	LB Main	0+000 ~ 0+550	3.15	0.0003	L II
			0+550 ~ 0+905	3.15	0.0003	E II
			0+905 ~ 1+035	3.15	0.0003	Aqueduct
			1+035 ~ 5+650	3.15	0.0003	E II
			5+650 ~ 8+000	2.44	0.0003	L II
			8+000 ~ 9+000	2.44	0.0003	E II
			9+000 ~ 11+735	2.44	0.0003	L II
			11+735 ~ 13+267	1.81	0.0003	E III
			13+267 ~ 14+443	1.59	0.0003	L III
		Tract II D-1	0+000 ~ 2+987	0.84	0.0004	L V
			2+987 ~ 4+504	0.41	0.0004	L VI
		Tract III D-1	0+000 ~ 4+934	1.59	0.0004	L IV
			4+934 ~ 7+278	1.02	0.0004	L V
			7+278 ~ 8+750	0.17	0.0004	E VI
		Tract III D-2	0+000 ~ 2+214	0.16	0.0004	L VI
	Urubokka Oya	High Level	0+000 ~ 3+900	1.29	0.0002	L V
		New High Level	3+900 ~ 14+000	1.12	0.0004	L VI
		Anicut Scheme	-	-	0.0004	L VI, E VI
	Kirama Oya	Anicut Scheme	-	-	0.0004	L VI, E VI
BadagiriyaScheme		Feeder No.1	0+000 ~ 6+400	1.13		L III
		Main Canal	0+000 ~ 5+222	1.58	0.0002	L III
			5+222 ~ 6+832	0.65	0.0002	L IV
			6+832 ~ 8+604	0.34	0.0002	L V
		DC-1	0+000 ~ 1+698	0.52	0.0004	L V
		DC-3	0+000 ~ 0+844	0.23	0.0004	L VI
		FC-1	0+000 ~ 1+880	0.18	0.0004	L VI

Rubble Masonry Lining



Earth Lining



Dimensions

Lining	Type	B (m)	H (m)	h (m)
Rubble Masonry (n=0.020)	LI	8.0	1.7	0.85
	LII	5.0	1.5~2.4	0.75~1.20
	LIII	4.0	1.3~2.3	0.65~1.15
	LIV	3.0	1.0~1.9	0.50~0.95
	LV	2.0	0.9~1.9	0.45~0.95
	LVI	1.0	0.4~1.3	0.20~0.65
Earth Lining (n=0.035)	EI	8.0	2.6~2.8	1.30~1.40
	EII	5.0	2.0~2.3	1.00~1.15
	EIII	4.0	1.8~2.0	0.90~1.00
	EIV	3.0	1.5	0.75
	EV	2.0	1.2~1.4	0.60~0.70
	EVI	1.0	0.2~1.5	0.10~0.75

Figure 6.4.1-1 Typical Cross Sections

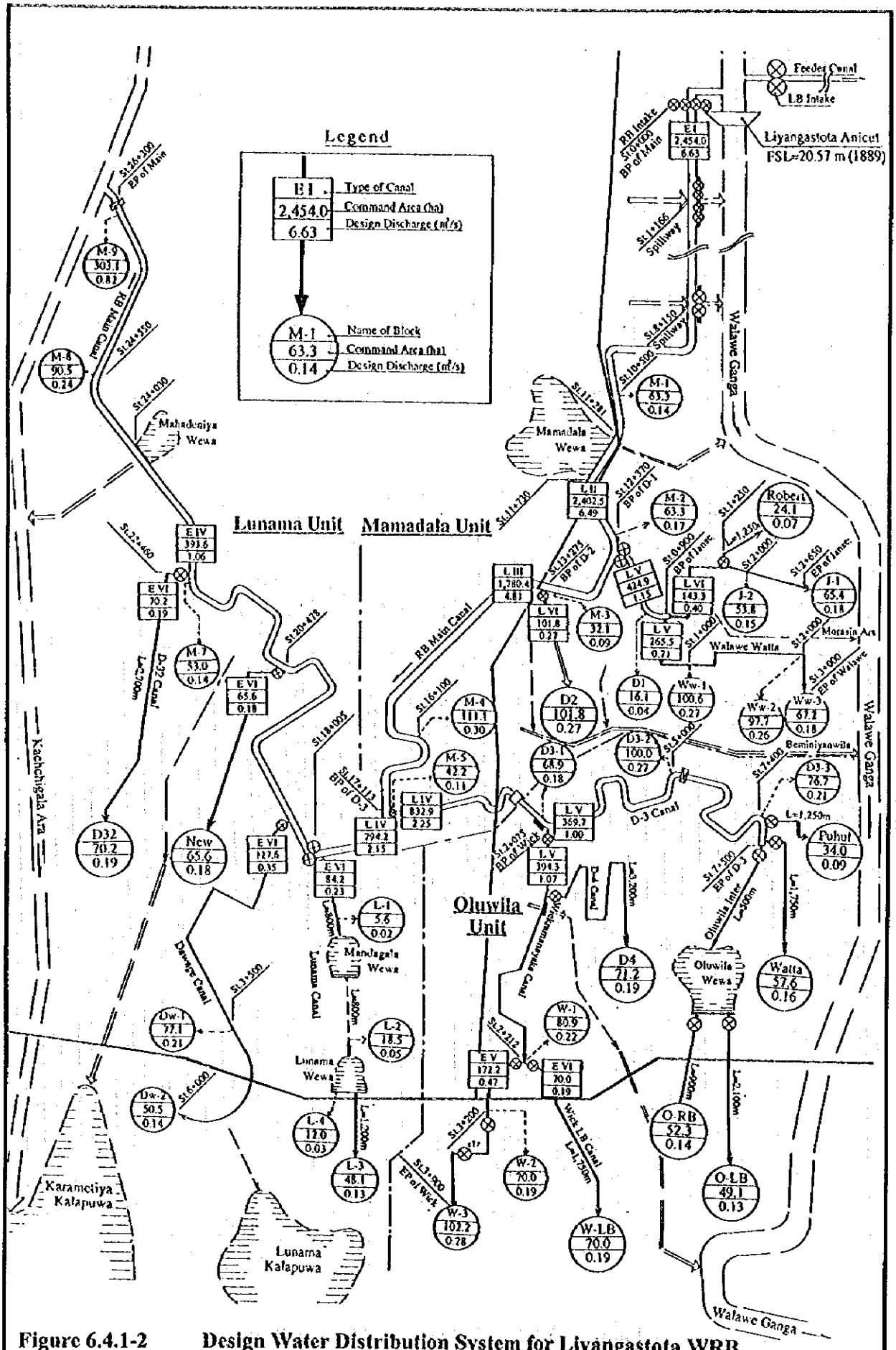


Figure 6.4.1-2 **Design Water Distribution System for Liyangastota WRB Sub-scheme**

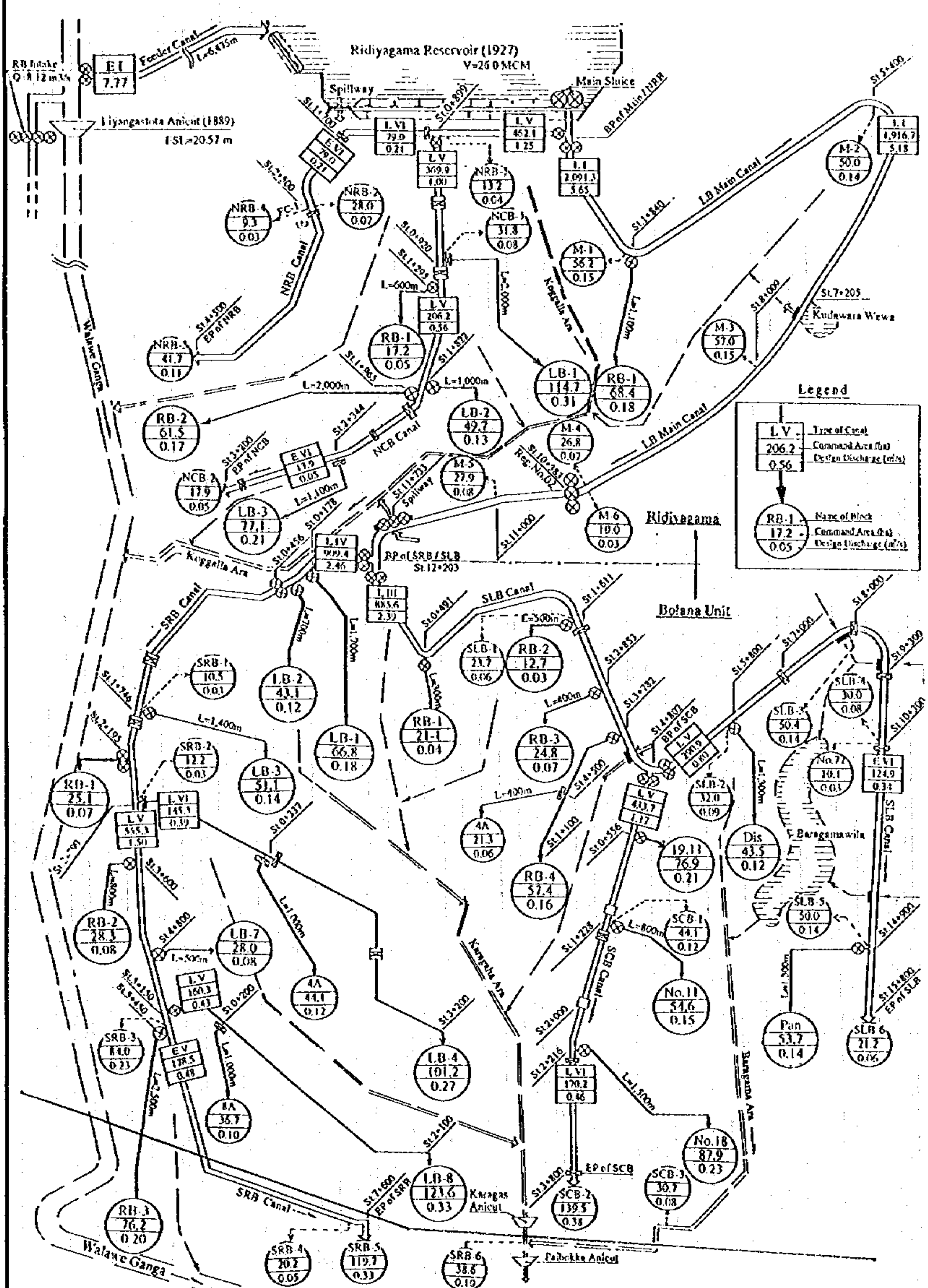


Figure 6.4.1-3 Design Water Distribution System for Liyangastota WLB Scheme

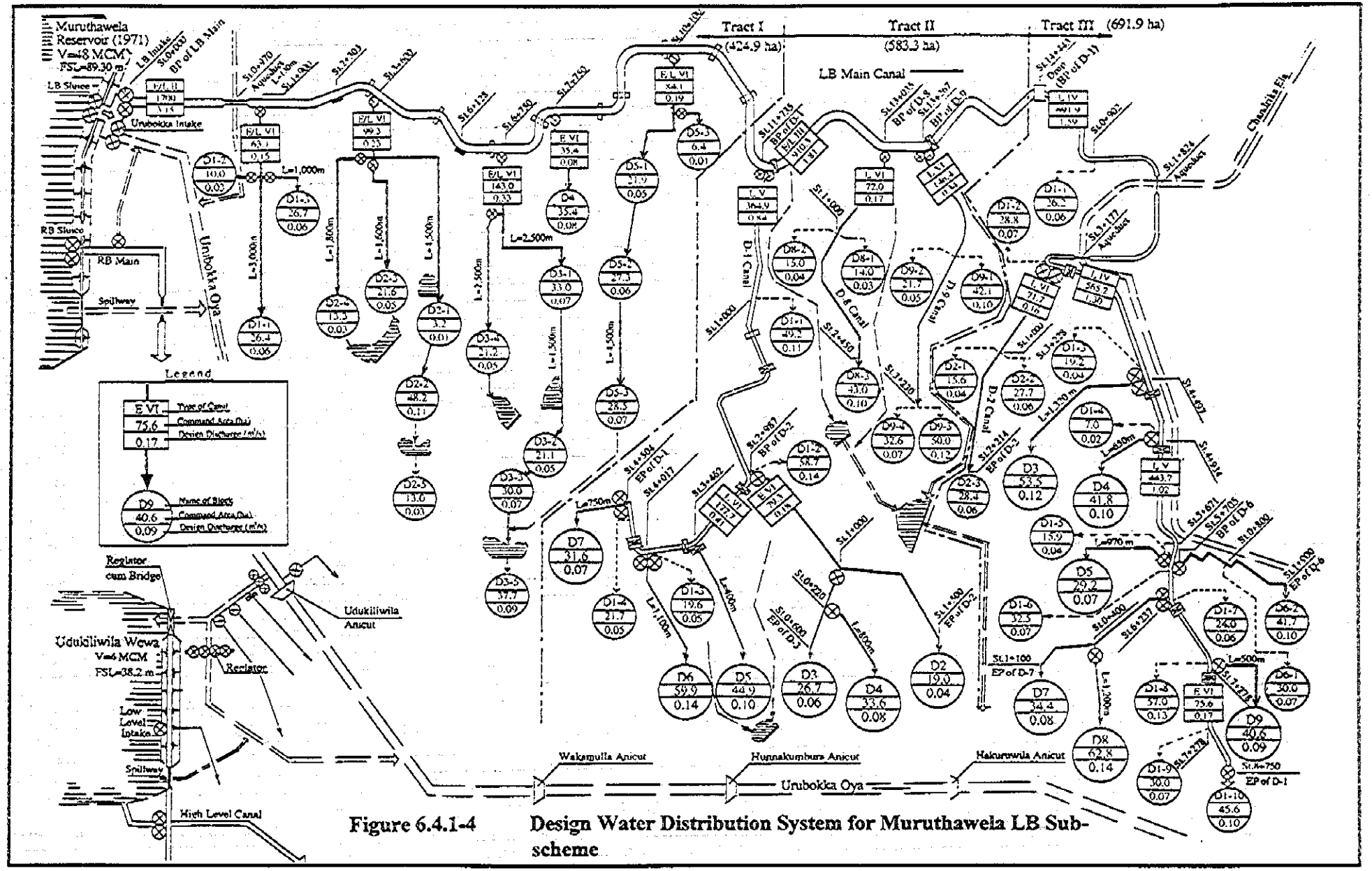


Figure 6.4.1-4 Design Water Distribution System for Muruthawela LB Sub-scheme

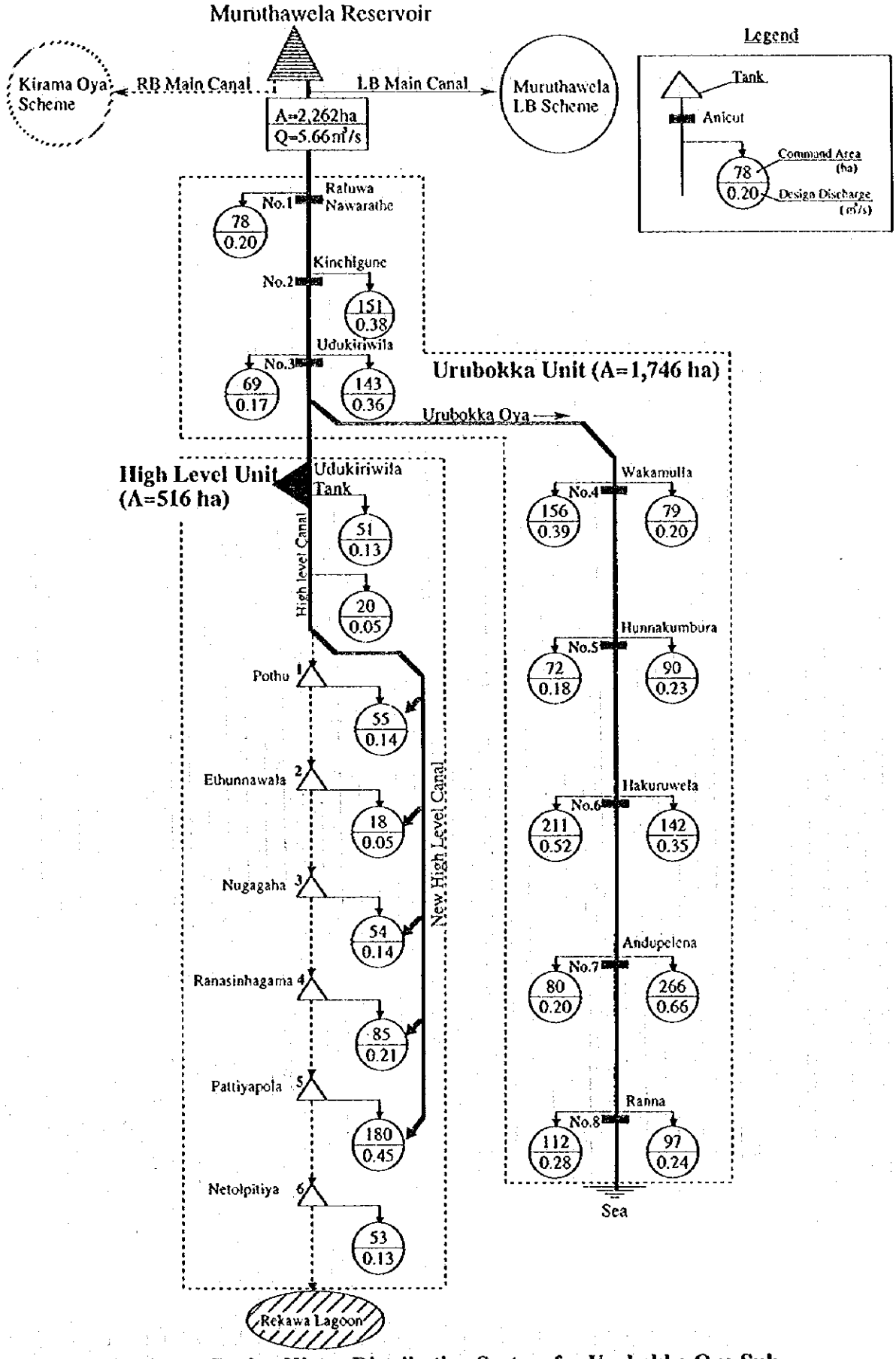


Figure 6.4.1-5 **Design Water Distribution System for Urubokka Oya Sub-scheme**

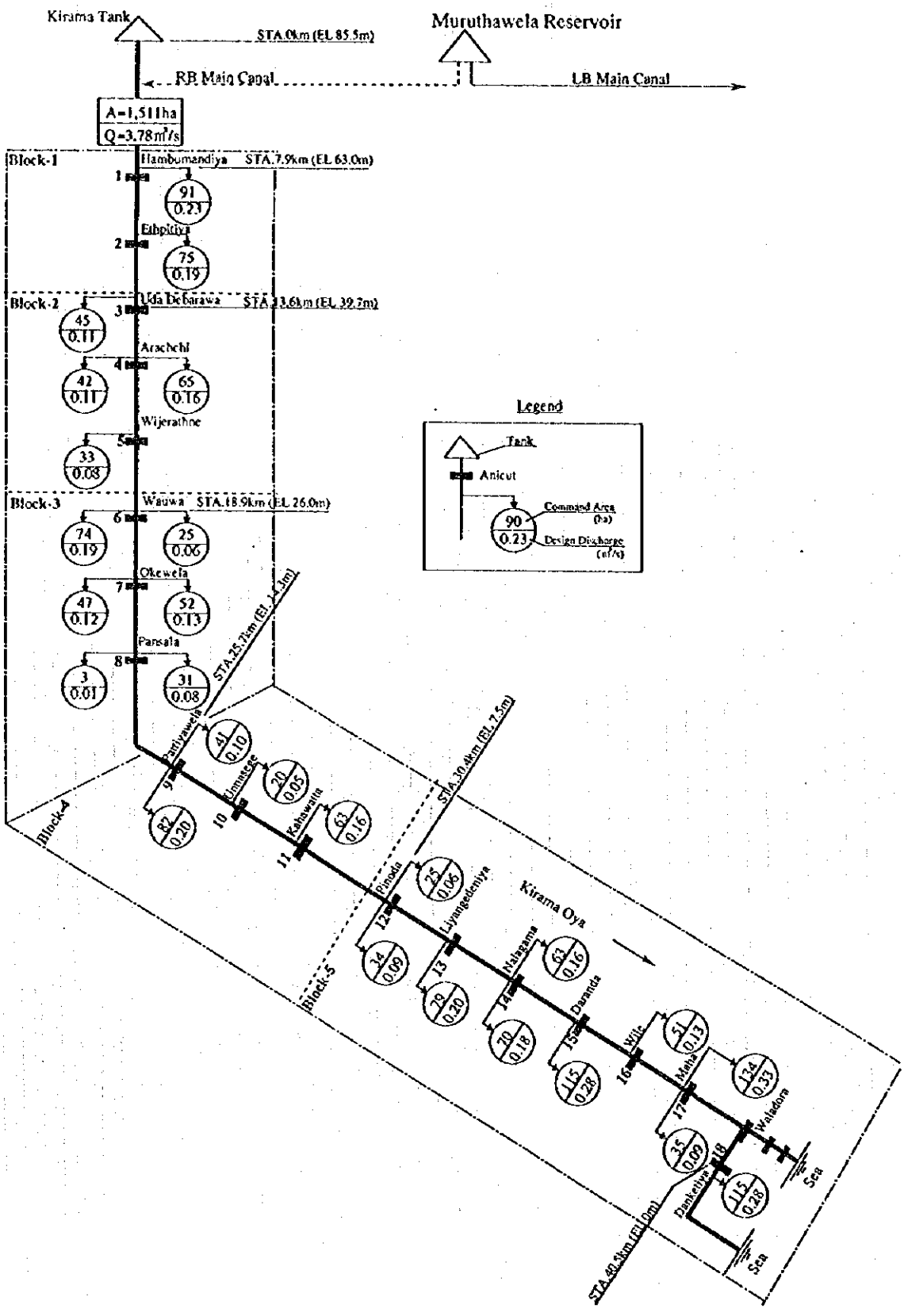


Figure 6.4.1-6 Design Water Distribution System for Kirama Oya Sub-scheme

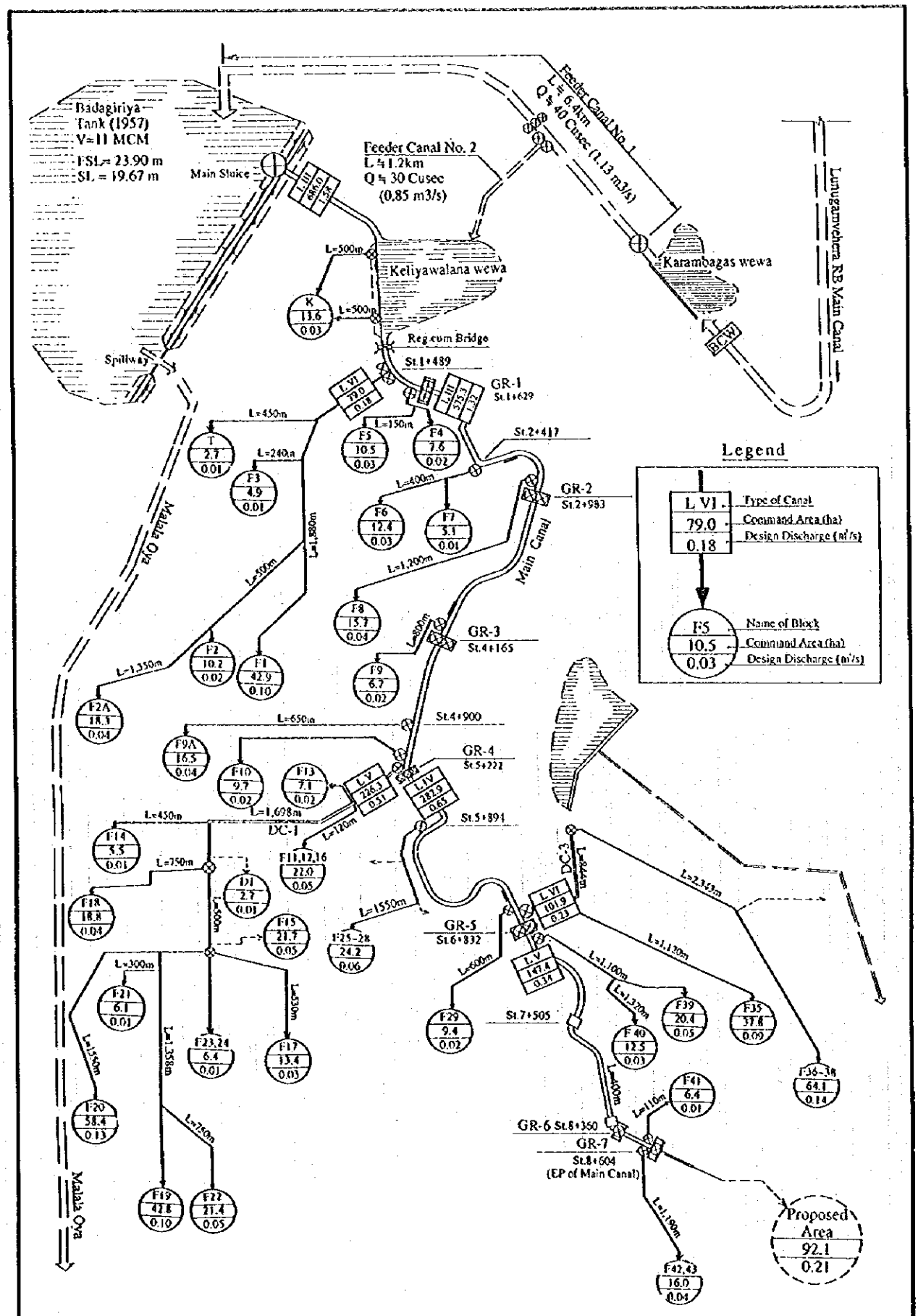


Figure 6.4.1-7 Design Water Distribution System for Badagiriya Scheme

6.4.2 Scheme-wise Irrigation Plan

6.4.2.1 Liyangastota Scheme

(1) Irrigation Plan

Design irrigated area is 5,007 ha for this scheme. Under the scheme, double cropping of paddy would be continued with the Project. The present paddy cropping intensity of 190% would be improved to 200%.

Irrigation design features are as follows.

Item	WRB sub-scheme		WLB sub-scheme		Remarks		
Scheme area (ha)	2,454	(100%)	2,553	(100%)	Total	5,007	(200%)
Present irrigated area (ha)	2,331	(95%)	2,425	(95%)	Total	4,756	(190%)
Design irrigated area (ha)	2,454	(100%)	2,553	(100%)	Total	5,007	(200%)
Design crops	paddy (double cropping)		paddy (double cropping)				
Irrigation period							
	135 days from October 1		135 days from September 15		Maha		
	135 days from April 1		135 days from March 1		Yala		
Design unit water requirement	q = 2.70 ℓ/s/ha		q = 2.70 ℓ/s/ha		peak value during land preparation		
Canal conveyance efficiency (Ec)	65%		65%				
Field loss (Ea)	60%		60%				

(2) Outline of Facility Rehabilitation Plan

<WRB sub-scheme>

Total length of main canal (26.3 km) and D-canal (43.8 km) is to be subject to rehabilitation with lining method to be as indicated in the table below. Length of new D-canal is planned at 2.5 km.

Type of works	Unit	Qty.	Remarks
1. Main canal rehabilitation			
(1) Masonry lining	km	10.7	main canal STA11 + 730 ~ STA 22 + 460
(2) Earth canal works	km	15.6	main canal STA0 ~ STA11 + 730 and main canal STA22 + 460 ~ STA 26 + 300
(3) Standard section	sites	312	@ 50 m pitch for the above segments
2. D-canal rehabilitation			
(1) Masonry lining	km	17.9	D-1~3 and Wickramanayaka canal
(2) Earth canal works	km	25.9	all segments except for above
(3) Standard section	sites	830	@ 50 m pitch
3. D-canal new construction			
(2) Earth canal works	km	2.5	main-6 split from main canal at STA20 + 478
(3) Standard section	sites	50	@ 50 m pitch
4. Farm road construction	km	13.0	
5. F-canal / drainage canal	set	1	earthen canal works; cross-section improvement
6. Turnout works			
Main canal diversion	sites	6	RC construction, with steel sluice gate on main canal side
7. Discharge gauging facilities			
Main canal	sites	1	Directly downstream of Liyangastota anicut RB intake
Branch canal	sites	10	parshall flume works (RC structure w/ transition)
8. Tank gate rehabilitation	sites	2	main canal STA + 730, STA 24 + 030 (steel gate, RC operating pier)
9. Appurtenant structures	set	1	drop works, crossing drainage works, etc.

<WLB sub-scheme>

Total length of main canal and D-canal (78 km) is to be subject to rehabilitation with lining method to be as indicated in the table below. In the case of the left bank feeder canal (ℓ = 6.4 km), total length is to be subject to earthen canal cross-section improvement.

Type of works	Unit	Qty.	Remarks
1. Main canal rehabilitation			
Masonry lining	km	12.2	LB main
2. Branch canal rehabilitation			
(1) Masonry lining	km	23.6	NRB, NCB, SRB, SLB, SCB
(2) Earth canal works	km	11.3	branch canals excluding the above
(3) Standard section	sites	226	all lengths of earthen canal
3. D-canal rehabilitation			
(1) Masonry lining	km	7.3	NCB/LB-1, SRB/LB-4, LB-8
(2) Earth canal works	km	24.1	D-canals excluding the above
(3) Standard section	sites	482	all lengths of earthen canal
4. Main canal turnout works	sites	1	including upstream/downstream canal connection works, and steel gate installation
5. Branch canal turnout works	sites	3	same as above
6. Branch~D canal turnouts	sites	51	including RC canal w/ installation of gates, discharge gauging facilities
7. Appurtenant facilities	set	1	drop works, crossing structures
8. RB feeder canal rehab.	set	1	unlined canal cross-section rehab. (total length of L = 6.5 km)
9. Liyangastota anicut rehab.	set	1	fixed weir gate rehab. works (16 bays, W = 1.753 m × H = 3.505 m) flood spillway gate rehab. works (1 bay, W = 1.83 × 3.35 m)
10. Ridiyagama tank slope rehab.	set	1	Bund crest widening (5.0 m); additional embanking of downstream bund slope and toe drainage works (total length 2.0 km); raising of flood spillway (L = approx. 140 m)
11. Farm road construction	km	12.0	
12. F-canal, drainage canal	set	1.0	earthen canal works; canal cross-section improvement

6.4.2.2 Muruthawela Reservoir Scheme

(1) Muruthawela LB sub-scheme

1) Irrigation plan

Design crops under this scheme in addition to paddy are banana and OFCs. On the basis of results of design water balance calculation, present cropping intensity of 130% (yearly) can be improved to 158%.

Irrigation design features are as follows.

Item	Features									Remarks		
Original project area (ha)	Tract I 425			Tract II 583			Tract III 692			Total 1700		
Present irrigated area (ha)	Maha	Yala	Total	Maha	Yala	Total	Maha	Yala	Total	Maha	Yala	Total
	278	278	556	228	583	811	692	155	847	1,998	1,016	3,014
	(65%)	(65%)	(130%)	(15%)	(100%)	(102%)	(100%)	(14%)	(114%)	(70%)	(60%)	(130%)
Design irrigated area (ha)	Maha	Yala	Total	Maha	Yala	Total	Maha	Yala	Total	Maha	Yala	Total
	425	277	702	321	583	904	692	381	1,073	1,438	1,241	2,679
	(100%)	(65%)	(165%)	(55%)	(100%)	(155%)	(100%)	(55%)	(155%)	(85%)	(73%)	(158%)
Design crops	Paddy, OFC, Banana			same as left			same as left			paddy 2,168 ha (128%) OFC 341 ha (20%) banana 170 ha (10%) Total 2,679 ha (158%)		
Irrigation period (paddy) Maha Yala	135 days from September 15 135 days from April 15			same as left			same as left					
Design unit water requirement (peak)	q = 2.1 ℓ/s/ha			q = 2.3 ℓ/s/ha			q = 2.3 ℓ/s/ha					
Canal conveyance efficiency (Ec)	65%			65%			65%					
Field loss (Ea)	50%			50%			50%					

2) Outline of Facility Rehabilitation Plan

<Muruthawela LB sub-scheme>

Construction item	Unit	Qty.	Remarks
<Tract I>			
1. Diversion works (new)	sites	5	new diversion works from main canal (w/ parshall flume)
2. D-canal (new)			
(1) Masonry, mortar lining	km	15.0	
(2) Unlined canal	km	11.4	
(3) Standard section	sites	228	
3. Appurtenant works	sets	1	
4. F-canal / drainage canal	set	1	earthen canal works; cross section improvement
<Tract II>			
1. Main canal diversion works	sites	3	D-1, D-8, D-9 turnouts (parshall flume)
2. D-canal rehabilitation			
(1) Masonry, mortar lining	km	10.2	D-1, D-8, D-9 canals (masonry, mortar lining)
(2) Unlined canal	km	5.1	all segments with the exception of the above
(3) Standard section	sites	102	unlined canal segments
3. D-1 canal diversion works	sites	4	
4. D-1 canal gate regulators	sites	1	
5. Appurtenant works	sets	1	gate replacement, dropworks rehabilitation, etc.
6. F-canal / drainage canal	set	1	earthen canal works; cross section improvement
<Tract III>			
1. D-canal rehabilitation			
(1) Masonry, mortar lining	km	9.5	D-1 (STA0+000~STA7+278), D-2
(2) Unlined canal	km	9.1	all segments with the exception of the above
(3) Standard section	sites	182	unlined canal segments
3. D-1 canal gate regulators	sites	7	
4. Appurtenant works	sets	1	gate replacement, dropworks rehabilitation, etc.
5. F-canal / drainage canal	set	1	earthen canal works; cross section improvement
<Main canal>			
1. Main canal cross section rehabilitation	km		masonry, mortar lining (including 200 m at start point)
(1) Masonry, mortar lining	km	6.8	
(2) Unlined canal	km	7.5	
(3) Standard section	sites	151	
2. Main canal diversion works	sites	1	gate type turnout works
3. Discharge gauging facilities	sites	1	parshall flume
4. Aqueduct rehabilitation	sets	1	all 15 aqueduct spans; tear down and new construction of entire 130 m length (Q = 3.15 m³/s, RC structure)

(2) Urubokka Oya sub-scheme

1) Irrigation plan

Double cropping of paddy will be continued in the area under the Project. On the basis of design water balance calculations the present paddy cropping intensity of 168% per year will be improved to 185% with the Project.

Salient features of the irrigation plan are as follows.

Item	Feature
Scheme area (ha)	2,262
Present irrigated area (ha)	3,800 ha per year (Maha 85% + Yala 83% = 168%)
Design irrigated area (ha)	4,185 ha per year (Maha 95% + Yala 90% = 185%)
Design crops	double cropping of paddy
Irrigation period (including 30 days of land preparation)	Maha: 135 days from September 15 Yala: 135 days from March 1
Design unit water requirement	q = 2.5 ℓ/s/ha (at peak land preparation)
Canal conveyance efficiency (Ec)	Ec = 65%
Field loss (Ea)	Ea = 60%

2) Outline of Facility Rehabilitation Plan

<Urubokka unit>

Type of works	Unit	Qty.	Remarks
1. D-canal rehabilitation			
(1) Masonry lining	km	33.7	
(2) Earth canal works	km	26.5	
(3) Standard section	sites	530	
2. Anicut rehabilitation	sites	5	no. 4~8 anicuts
3. Appurtenant works	sets	1	
4 Farm road construction	km	8.5	
5 F-canal / drainage canal	set	1	earthen canal works; cross-section improvement
<High Level Unit>			
1. Invert masonry lining	km	3.9	all canal in the High Level unit
2. New construction	km	4.5	portion of new construction of connector canal
3. D-canal rehabilitation			
(1) Masonry lining	km	10.0	
(2) Earth canal works	km	9.6	
(3) Standard section	sites	192	
4. Appurtenant works	sets	1	
5 Farm road construction	km	2.5	
6 F-canal / drainage canal	set	1	earthen canal works; cross-section improvement

(3) Kirama Oya sub-scheme

1) Irrigation plan

Double cropping of paddy will be continued in the area under the Project. On the basis of design water balance calculations the present paddy cropping intensity of 147% per year will be improved to 175% with the Project.

Salient features of the irrigation plan are as follows.

Item	Feature
Scheme area (ha)	1,511 ha
Present irrigated area (ha)	2,221 ha per year (Maha 82% + Yala 65% = 147%)
Design irrigated area (ha)	2,644 ha per year (Maha 95% + Yala 80% = 175%)
Design crops	double cropping of paddy
Irrigation period (including 30 days of land preparation)	Maha: 135 days from September 15 Yala: 135 days from March 1
Design unit water requirement	q = 2.5 ℓ/s/ha (at peak land preparation)
Canal conveyance efficiency (Ec)	Ec = 65%
Field loss (Ea)	Ea = 65%

2) Outline of Facility Rehabilitation Plan

Type of works	Unit	Qty.	Remarks
1. D-canal rehabilitation			
(1) Masonry lining	km	31.9	
(2) Earth canal works	km	17.6	
(3) Standard section	sites	352	
2. River bank and bed protection works downstream of anicut	sites	10	10 anicuts excepting no. 3~5, 10, 14~15, 17~18
3. Anicut gate replacement	sites	12	13 anicuts excepting no.4~5, 8, 12
4. Farm road construction	km	26.9	
5. River crossing works	sets	6	
6. Bund height raising works	km	2.0	left bank embankment on Kirama oya between anicuts no. 17 and 18
7. Danketiya drainage works	sets	1	drainage canal rehab.; gate removal and new installation works; drainage pipe installation
8 F-canal	set	1	earthen canal works
9 Drainage canal	set	1	cross-section improvement

6.4.2.3 Badagiriya Scheme

1) Irrigation plan

In addition to paddy, banana and OFCs are to be introduced under the Project. On the basis of design water balance calculations the present paddy cropping intensity of 138% per year will be improved to 170% with the Project.

Salient features of the irrigation plan are as follows.

Item	Features			Remarks		
Original project area (ha)	686 ha					
Present irrigated area (ha)	Maha	Yala	Total	paddy	903	(132%)
	536	407	943	OFC	40	(6%)
	(78%)	(59%)	(138%)	OFC	0	(0%)
				Total	943	(138%)
Design irrigated area (ha)	Maha	Yala	Total	paddy	960	(140%)
	686	481	1,167	OFC	69	(10%)
	(100%)	(70%)	(170%)	OFC	138	(20%)
				Total	1,167	(170%)
Design crops	paddy banana	paddy OFCs, banana				
Design unit water requirement (peak)	q = 2.3 ℓ/s/ha (at peak land preparation)					
Canal conveyance efficiency (Ec)	65%					
Field loss (Ea)	60%					

2) Outline of Facility Rehabilitation Plan

Construction item	Unit	Qty.	Remarks
1. Feeder canal no. 1 rehabilitation	km	2.0	between split point for feeder canal no. 2 and Badagiriya tank
2. Main canal rehabilitation	km	8.6	masonry lining
3. D-canal rehabilitation			
(1) FC - 1 + FC-2	km	1.70	
(2) DC-1+DC-3	"	3.0	
(3) FC-36	"	0.9	
4. Gate regulator rehabilitation	sites	4	
5. Discharge gauging facilities	sites	5	parshall flume
6. New land preparation	sets	92.1	cutting, stump clearing, new canal works (2.3 km)
7 F-canal			earthen canal works
8 Drainage canal			canal cross-section improvement

6.4.3 Scheme-wise Water Requirement Plan

6.4.3.1 Water Requirement Plan for Liyangastota Scheme

1) Water source plan

Water source will be the present diversion via Liyangastota anicut from Walawe Ganga. The results of water balance calculation indicate that full area irrigation of the target area will be possible under the envisioned rehabilitation plan.

2) Design irrigation period

Design irrigation period is as per below.

Sub-scheme	Maha season	Yala season	Remarks
WRB	from early October	from early April	according to field survey
WLB	from mid September	from mid March	discharge regards for Ridiyagama tank

3) Design crops

Design crop is paddy for the entire area. Variety ratio would be the 3.5 month (60%) and the 4.0 month (40%) for both Maha and Yala seasons.

4) Design irrigation requirement

Calculation results for both sub-schemes are given in Table 6.4.3.1-1 and Table 6.4.3-2 (3.5 month variety paddy).

5) Design irrigable area

Design irrigable area based on the above is:

WRB = 2,454 ha (100% each for Maha/Yala)
WLB = 2,553 ha (100% each for Maha/Yala)

Table 6.4.3.1-1 Design Water Requirement for Liyangastota Walawe RB Scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger	Mamadala	30%	30%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
and Crop Factors	2nd Stagger	Oluwila	40%	40%				1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
	3rd Stagger	Lunama	30%	30%					1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
ETo (Evapotranspiration of Reterence Crop)					5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP	Ls	(4.0inch/5days)				1.20						1.20				
						1.60						1.60				
(Land Preparation)							1.20						1.20			
	Lt	(7.5inch/25days)				2.25						2.25				
						1.20	1.80					1.20	1.80			
							2.25						2.25			
	Total LP				0.00	6.25	5.25	0.00	0.00	0.00	0.00	6.25	5.25	0.00	0.00	0.00
2. E						1.44						1.30				
(Evapo. during LP)						0.96	0.76					0.86				
(E=ETo)							1.15						1.55			
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)				0.90	2.10					0.90	2.10			
4. ETc	ETc (S_1)						1.15	0.91	0.99				1.55	1.16	1.23	
Crop Water							0.44	0.48	1.12				0.60	0.61	1.39	
Requirement	ETc (S_2)						1.15	0.40	0.32	0.34			1.55	0.51	0.39	0.48
								1.52	1.65	1.52				1.94	2.06	2.14
(ETc=ETo x KC)	ETc (S_3)							1.19	0.95	1.01				1.52	1.18	1.43
								0.46	0.50	1.14				0.58	0.62	1.61
	Total ETc				0.00	0.00	2.73	4.94	5.52	4.00	0.00	0.00	3.70	6.32	6.87	5.65
5. Farm Loss at ETc																
(Farm Loss + ETc)		Total ETc/60%			0.00	0.00	4.55	8.24	9.20	6.67	0.00	0.00	6.17	10.53	11.45	9.42
6. FWR (1+2+3+5)	Average	(inch/month)			0.00	7.15	11.90	8.24	9.20	6.67	0.00	7.15	13.52	10.53	11.45	9.42
Field Water		(mm/month)			0	182	302	209	234	169	0	182	343	267	291	239
Requirement		(mm/day)			0.00	6.05	10.08	6.98	7.79	5.64	0.00	6.05	11.45	8.91	9.69	7.98
	Peak	(mm/day)					13.86						14.72			

Total FWR = 2.419 mm

Table 6.4.3.1-2 Proposed Water Balance Study for Liyangastota Walawe RB Sub-scheme (1985/86 ~ 1994/95)

(1 / 2)

* Station of Rainfall Data
1) 1985 Sep~1988 Sep : Embilipitiya
2) 1988 Oct~1995 Aug : Mamadota

Command Area = 2,454 ha

Success Rate (Maha: 100%) (Yala : 100%)

		RB Issue			*Rainfall		Unit FWR	Unit FIR	FIR	Water Balance			
						ER			A=2,454ha (100%)	Volume	Area	Success Area	Success Rate
		(c)	(d)	(e) (dx65%)		(f)	(g)	(h) (g-f)	(i) (h x A)	(j) (e-i)	(k) (j / g)	(l) (k≥2,454)	(m) (l/2,454)
		(Ac.ft)	(000m3)		(mm)	(mm)	(mm)	(mm)	(000m3)	(000m3)	(ha)	(ha)	(%)
1985/86	Sep	N.A.			135	73							
	Oct	N.A.			265	160							
	Nov	N.A.			224	133							
	Dec	N.A.			179	103							
	Jan	N.A.			143	79							
	Feb	N.A.			97	48							
Maha total		0	0	0	1,043	597						N.A.	N.A.
	Mar	N.A.			49	0	0	0	0	0			
	Apr	50,918	62,833	40,841	138	75	182	107	2,614	38,228			
	May	32,644	40,282	26,184	49	0	343	343	8,429	17,755			
	Jun	18,142	22,387	14,552	19	0	267	267	6,562	7,990			
	Jul	18,895	23,316	15,156	7	0	291	291	7,137	8,018			
	Aug	5,155	6,361	4,135	55	0	239	239	5,872	-1,737			
Yala total		125,754	155,180	100,867	316	75	1,323	1,248	30,614	70,253	5,312	7,766	100%
Total		125,754	155,180	100,867	1,359	672	1,323	1,248	30,614				
1986/87	Sep	9,341	11,527	7,493	99	49	0	0	0	7,493			
	Oct	31,055	38,322	24,909	165	94	182	88	2,161	22,748			
	Nov	15,593	19,242	12,507	57	0	302	302	7,419	5,088			
	Dec	42,401	52,323	34,010	44	0	209	209	5,136	28,875			
	Jan	41,428	51,122	33,230	67	28	234	206	5,058	28,172			
	Feb	11,041	13,625	8,856	1	0	169	169	4,155	4,701			
Maha total		150,861	186,162	121,005	433	171	1,096	975	23,928	97,077	8,856	11,310	100%
	Mar	23,476	28,970	18,831	187	109	0	0	0	18,831			
	Apr	34,249	42,263	27,471	238	143	182	39	958	26,513			
	May	18,279	22,557	14,662	29	0	343	343	8,429	6,233			
	Jun	22,064	27,227	17,698	11	0	267	267	6,562	11,136			
	Jul	18,793	23,191	15,074	0	0	291	291	7,137	7,937			
	Aug	0	0	0	112	58	239	182	4,457	-4,457			
Yala total		116,862	144,208	93,735	577	309	1,323	1,122	27,543	66,192	5,005	7,459	100%
Total		267,723	330,370	214,741	1,010	479	2,419	2,097	51,471				
1987/88	Sep	4,113	5,076	3,299	101	51	0	0	0	3,299			
	Oct	21,510	26,543	17,253	265	161	182	21	514	16,739			
	Nov	46,305	57,140	37,141	200	117	302	185	4,548	32,593			
	Dec	26,954	33,261	21,620	55	0	209	209	5,136	16,484			
	Jan	22,175	27,363	17,786	58	0	234	234	5,735	12,051			
	Feb	29,698	36,647	23,821	78	35	169	134	3,287	20,534			
Maha total		150,754	186,031	120,920	757	364	1,096	783	19,219	101,701	9,278	11,732	100%
	Mar	32,732	40,391	26,254	150	83	0	0	0	26,254			
	Apr	70,690	87,231	56,700	178	102	182	80	1,953	54,748			
	May	62,899	77,617	50,451	83	38	343	305	7,490	42,961			
	Jun	18,181	22,436	14,583	64	26	267	242	5,934	8,649			
	Jul	18,687	23,060	14,989	50	0	291	291	7,137	7,852			
	Aug	13,423	16,564	10,767	38	0	239	239	5,872	4,895			
Yala total		216,612	267,300	173,745	561	249	1,323	1,157	28,386	145,358	10,990	13,444	100%
Total		367,367	453,330	294,665	1,318	613	2,419	1,940	47,606				
1988/89	Sep	5,954	7,347	4,776	80	37	0	0	0	4,776			
	Oct	24,918	30,749	19,987	134	73	182	109	2,666	17,320			
	Nov	53,713	66,282	43,083	205	120	302	182	4,464	38,619			
	Dec	8,910	10,995	7,147	121	64	209	145	3,569	3,578			
	Jan	21,315	26,303	17,097	93	45	234	189	4,628	12,468			
	Feb	17,682	21,820	14,183	17	0	169	169	4,155	10,028			
Maha total		132,492	163,495	106,272	650	339	1,096	794	19,482	86,790	7,917	10,371	100%
	Mar	13,202	16,291	10,589	67	28	0	0	0	10,589			
	Apr	33,513	41,354	26,880	105	53	182	128	3,150	23,731			
	May	39,262	48,449	31,492	20	0	343	343	8,429	23,063			
	Jun	18,327	22,615	14,700	44	0	267	267	6,562	8,138			
	Jul	24,285	29,968	19,479	85	40	291	251	6,158	13,322			
	Aug	10,166	12,545	8,154	42	0	239	239	5,872	2,282			
Yala total		138,755	171,223	111,295	362	121	1,323	1,229	30,170	81,125	6,134	8,588	100%
Total		271,247	334,718	217,567	1,012	460	2,419	2,023	49,653				
1989/90	Sep	1,680	2,073	1,347	65	26	0	0	0	1,347			
	Oct	30,179	37,241	24,206	42	0	182	182	4,457	19,750			
	Nov	34,242	42,255	27,466	92	45	302	258	6,320	21,145			
	Dec	22,425	27,672	17,987	11	0	209	209	5,136	12,851			
	Jan	25,160	31,048	20,181	52	0	234	234	5,735	14,446			
	Feb	25,753	31,779	20,657	0	0	169	169	4,155	16,502			
Maha total		139,439	172,068	111,844	261	71	1,096	1,051	25,803	86,041	7,849	10,303	100%
	Mar	23,074	28,473	18,508	75	33	0	0	0	18,508			
	Apr	29,963	36,974	24,033	56	0	182	182	4,457	19,576			
	May	38,875	47,972	31,182	124	66	343	277	6,808	24,374			
	Jun	22,579	27,862	18,110	48	0	267	267	6,562	11,548			
	Jul	19,565	24,143	15,693	12	0	291	291	7,137	8,555			
	Aug	13,954	17,220	11,193	0	0	239	239	5,872	5,321			
Yala total		148,010	182,644	118,718	315	99	1,323	1,257	30,836	87,882	6,645	9,099	100%
Total		287,449	354,712	230,562	576	170	2,419	2,308	56,639				

Table 6.4.3.1-2 Proposed Water Balance Study for Liyangastota Walawe RB Sub-scheme (1985/86 ~ 1994/95)

* Station of Rainfall Data
1) 1985 Sep~1988 Sep : Embilipitiya
2) 1988 Oct~1995 Aug : Mamadola

Command Area = 2,454 ha

Success Rate
(Maha: 100%)
(Yala : 100%)

		RB Issue			*Rainfall		Unit FWR	Unit FIR	FIR	Water Balance			
					ER				A=2,454ha (100%)	Volume	Area	Success Area	Rate
		(c) (Ac.ft)	(d) (000m3)	(e) (dx65%)	(f) (mm)	(mm)	(g) (mm)	(h) (g-f) (mm)	(i) (h x A) (000m3)	(j) (e-i) (000m3)	(k) (j / g) (ha)	(l) (k+2,454) (ha)	(m) (l/2,454) (%)
1990/91	Sep	3,590	4,430	2,880	17	0	0	0	0	2,880			
	Oct	24,271	29,950	19,468	238	142	182	40	969	18,498			
	Nov	47,005	58,005	37,703	256	155	302	148	3,622	34,081			
	Dec	31,000	38,254	24,865	155	87	209	122	3,001	21,864			
	Jan	26,469	32,663	21,231	203	119	234	114	2,808	18,423			
	Feb	29,045	35,842	23,297	3	0	169	169	4,155	19,142			
Maha total		161,381	199,144	129,444	873	503	1,096	593	14,556	114,887	10,480	12,934	100%
	Mar	22,954	28,325	18,412	47	0	0	0	0	18,412			
	Apr	30,119	37,167	24,158	129	69	182	112	2,753	21,405			
	May	18,924	23,353	15,179	104	53	343	291	7,138	8,041			
	Jun	18,435	22,749	14,787	250	150	267	117	2,869	11,918			
	Jul	14,895	18,381	11,947	91	44	291	247	6,054	5,893			
	Aug	1,965	2,425	1,576	39	0	239	239	5,872	-4,296			
Yala total		107,293	132,400	86,060	660	317	1,323	1,006	24,687	61,373	4,640	7,094	100%
Total		268,674	331,544	215,504	1,533	820	2,419	1,599	39,243				
1991/92	Sep	5,562	6,864	4,461	29	0	0	0	0	4,461			
	Oct	20,583	25,400	16,510	265	161	182	21	514	15,996			
	Nov	39,928	49,271	32,026	195	114	302	189	4,630	27,396			
	Dec	24,619	30,380	19,747	150	84	209	126	3,084	16,664			
	Jan	27,796	34,300	22,295	25	0	234	234	5,735	16,560			
	Feb	34,625	42,727	27,773	0	0	169	169	4,155	23,618			
Maha total		153,113	188,942	122,812	665	358	1,096	738	18,118	104,694	9,551	12,005	100%
	Mar	36,467	45,000	29,250	0	0	0	0	0	29,250			
	Apr	42,139	52,000	33,800	16	0	182	182	4,457	29,343			
	May	26,572	32,789	21,313	145	80	343	264	6,471	14,842			
	Jun	26,071	32,172	20,912	20	0	267	267	6,562	14,350			
	Jul	17,199	21,223	13,795	65	26	291	264	6,490	7,305			
	Aug	3,356	4,141	2,692	38	0	239	239	5,872	-3,181			
Yala total		151,803	187,325	121,761	282	106	1,323	1,216	29,851	91,910	6,949	9,403	100%
Total		304,916	376,267	244,573	947	464	2,419	1,955	47,969				
1992/93	Sep	0	0	0	113	59	0	0	0	0			
	Oct	28,620	35,317	22,956	88	42	182	140	3,432	19,524			
	Nov	43,954	54,240	35,256	271	165	302	138	3,376	31,880			
	Dec	7,914	9,766	6,348	95	46	209	163	3,996	2,352			
	Jan	19,315	23,835	15,493	22	0	234	234	5,735	9,758			
	Feb	7,463	9,209	5,986	18	0	169	169	4,155	1,831			
Maha total		107,267	132,367	86,038	606	312	1,096	843	20,694	65,344	5,961	8,415	100%
	Mar	17,255	21,293	13,840	28	0	0	0	0	13,840			
	Apr	35,122	43,340	28,171	106	54	182	127	3,127	25,045			
	May	18,497	22,825	14,836	169	96	343	247	6,061	8,775			
	Jun	19,653	24,251	15,763	117	62	267	206	5,051	10,712			
	Jul	13,499	16,658	10,828	45	0	291	291	7,137	3,690			
	Aug	0	0	0	0	0	239	239	5,872	-5,872			
Yala total		104,026	128,368	83,439	466	212	1,323	1,110	27,249	56,190	4,248	6,702	100%
Total		211,292	260,735	169,477	1,072	524	2,419	1,954	47,943				
1993/94	Sep	2,936	3,622	2,355	12	0	0	0	0	2,355			
	Oct	21,803	26,905	17,488	154	86	182	95	2,337	15,151			
	Nov	54,497	67,250	43,712	337	209	302	93	2,291	41,422			
	Dec	17,151	21,164	13,757	237	142	209	68	1,660	12,097			
	Jan	15,909	19,632	12,761	56	0	234	234	5,735	7,026			
	Feb	14,668	18,100	11,765	12	0	169	169	4,155	7,610			
Maha total		126,964	156,674	101,838	642	437	1,096	659	16,178	85,660	7,814	10,268	100%
	Mar	32,940	40,648	26,421	130	70	0	0	0	26,421			
	Apr	26,932	33,234	21,602	102	51	182	130	3,202	18,400			
	May	17,120	21,126	13,732	38	0	343	343	8,429	5,303			
	Jun	12,262	15,131	9,835	10	0	267	267	6,562	3,273			
	Jul	0	0	0	60	0	291	291	7,137	-7,137			
	Aug	0	0	0	45	0	239	239	5,872	-5,872			
Yala total		89,253	110,139	71,590	385	121	1,323	1,272	31,203	40,387	3,054	5,508	100%
Total		216,218	266,813	173,428	1,027	558	2,419	1,931	47,380				
1994/95	Sep	0	0	0	214	126	0	0	0	0			
	Oct	22,405	27,648	17,971	250	150	182	31	770	17,201			
	Nov	51,510	63,563	41,316	137	75	302	228	5,584	35,732			
	Dec	28,753	35,482	23,063	29	0	209	209	5,136	17,928			
	Jan	19,532	24,103	15,667	132	71	234	162	3,982	11,684			
	Feb	38,023	46,920	30,498	56	0	169	169	4,155	26,343			
Maha total		160,223	197,715	128,515	817	423	1,096	800	19,627	108,888	9,933	12,387	100%
	Mar	28,279	34,897	22,683	11	0	0	0	0	22,683			
	Apr	65,946	81,378	52,896	185	107	182	74	1,828	51,068			
	May	66,095	81,561	53,015	133	72	343	272	6,665	46,350			
	Jun	17,365	21,429	13,929	53	0	267	267	6,562	7,367			
	Jul	21,777	26,872	17,467	29	0	291	291	7,137	10,330			
	Aug	18,144	22,390	14,554	42	0	239	239	5,872	8,681			
Yala total		217,607	268,527	174,542	453	179	1,323	1,144	28,064	146,478	11,075	13,529	100%
Total		377,830	466,242	303,057	1,270	602	2,419	1,943	47,691				

Table 6.4.3.1-3 Design Water Requirement for Liyangastota Walawe LB Scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage and Crop Factors	1st Stagger	LBM/NRB/NCB	30%	30%			1.00	1.15	1.20	0.90		1.00	1.15	1.20	0.90	
	2nd Stagger	SLB/SCB	40%	40%				1.00	1.15	1.20	0.90		1.00	1.15	1.20	0.90
	3rd Stagger	SRB	30%	30%					1.00	1.15	1.20	0.90		1.00	1.15	1.20	0.90
ETo (Evapotranspiration of Reference Crop)					5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP (Land Preparation)	Ls	(4.0inch/5days)			1.20	1.60 1.20					1.20 1.60	1.20				
	Lt	(7.5inch/25days)			0.90	1.35 3.00 0.90	1.35				2.25 1.20	1.80 2.25				
	Total LP				2.10	8.05	1.35				6.25	5.25	0.00			
2. E (Evapo. during LP) (E=ETo)					0.77	0.72 1.92 0.72	0.57				1.46 0.98	0.86 1.30				
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)				2.10	0.90				0.90	2.10				
4. ETc Crop Water Requirement (ETc=ETo x KC)	ETc (S_1)					1.08	0.29 1.10	0.23 1.19	0.25 1.12			1.30 0.50	1.19 0.62	1.21 1.37		
	ETc (S_2)						1.53 0.59	1.21 0.63	1.32 1.49			1.30	0.52 1.99	0.39 2.02	0.41 1.85	
	ETc (S_3)						0.86	0.30 1.14	0.24 1.24	0.25 1.14			1.55 0.60	1.16 0.61	1.23 1.39	
	Total ETc				0.00	1.08	4.36	4.70	5.65	1.39		3.09	6.47	6.76	4.88	0.00
5. Farm Loss at ETc (Farm Loss + ETc)		Total ETc/60%			0.00	1.80	7.26	7.83	9.41	2.32	0.00	5.15	10.78	11.27	8.14	0.00
6. FWR (1+2+3+5) Field Water Requirement	Average	(inch/month)			2.10	11.95	9.51	7.83	9.41	2.32	7.15	12.50	10.78	11.27	8.14	0.00
		(mm/month)			53	304	242	199	239	59	182	317	274	286	207	0
		(mm/day)			1.78	10.12	8.05	6.63	7.97	1.96	6.05	10.58	9.12	9.54	6.89	0.00
	Peak	(mm/day)				14.48						14.17				

Total FWR = 2,361 mm

Table 6.4.3.1-4 Proposed Water Balance Study for Liyangastota Walawe LB Sub-scheme (1985/86 ~ 1994/95)

* Station of Rainfall Data
1) 1985 Sep~1988 Sep : Embilipitiya
2) 1988 Oct~1995 Aug : Mamadola

Command Area = 2,553 ha

Success Rate (Maha: 100%) (Yala : 98%)

		Rdiyagama Tank Issue Records			*Rainfall		Unit FWR	Unit FIR	FIR	Water Balance			
						ER			A=2,553ha (100%)	Volume	Area	Success Area	Rate
		(c) (Ac.ft)	(d) (000m3)	(e) (dx65%)		(f) (mm)	(g) (mm)	(h) (g-f) (mm)	(i) (h x A) (000m3)	(j) (e-i) (000m3)	(k) (j / g) (ha)	(l) (k+2,553) (ha)	(m) (l/2,553) (%)
1985/86	Sep	N.A.			135	73							
	Oct	N.A.			265	160							
	Nov	N.A.			224	133							
	Dec	N.A.			179	103							
	Jan	N.A.			143	79							
	Feb	N.A.			97	48							
Maha total		0	0	0	1,043	597						N.A.	N.A.
	Mar	0	0	0	49	0	182	182	4,637	-4,637			
	Apr	11,770	14,524	9,440	138	75	317	242	6,188	3,252			
	May	12,181	15,031	9,770	49	0	274	274	6,990	2,781			
	Jun	11,959	14,758	9,592	19	0	286	286	7,311	2,281			
	Jul	12,166	15,013	9,759	7	0	207	207	5,278	4,480			
	Aug	10,956	13,520	8,788	55	0	0	0	0	8,788			
Yala total		59,032	72,846	47,350	316	75	1,266	1,191	30,404	16,946	1,339	3,892	100%
Total		59,032	72,846	47,350	1,359	672	1,266	1,191	30,404				
1986/87	Sep	0	0	0	99	49	53	4	99	-99			
	Oct	9,673	11,936	7,758	165	94	304	210	5,365	2,394			
	Nov	10,991	13,563	8,816	57	0	242	242	6,170	2,646			
	Dec	11,430	14,105	9,168	44	0	199	199	5,080	4,089			
	Jan	12,175	15,024	9,766	67	28	239	211	5,400	4,365			
	Feb	9,689	11,956	7,771	1	0	59	59	1,502	6,270			
Maha total		53,958	66,584	43,279	433	171	1,095	925	23,615	19,664	1,795	4,348	100%
	Mar	0	0	0	187	109	182	73	1,866	-1,866			
	Apr	7,691	9,491	6,169	238	143	317	175	4,465	1,704			
	May	11,733	14,479	9,411	29	0	274	274	6,990	2,421			
	Jun	11,256	13,890	9,029	11	0	286	286	7,311	1,718			
	Jul	12,041	14,858	9,658	0	0	207	207	5,278	4,380			
	Aug	3,853	4,755	3,091	112	58	0	0	0	3,091			
Yala total		46,575	57,473	37,357	577	309	1,266	1,015	25,910	11,448	904	3,458	100%
Total		100,532	124,057	80,637	1,010	479	2,361	1,940	49,525				
1987/88	Sep	0	0	0	101	51	53	3	67	-67			
	Oct	7,535	9,298	6,044	265	161	304	143	3,650	2,394			
	Nov	8,061	9,948	6,466	200	117	242	125	3,183	3,283			
	Dec	12,164	15,011	9,757	55	0	199	199	5,080	4,677			
	Jan	12,397	15,298	9,944	58	0	239	239	6,105	3,839			
	Feb	4,922	6,074	3,948	78	35	59	23	598	3,350			
Maha total		45,081	55,629	36,159	757	364	1,095	732	18,683	17,476	1,595	4,149	100%
	Mar	5,194	6,410	4,166	150	83	182	98	2,514	1,652			
	Apr	9,975	12,309	8,001	178	102	317	215	5,500	2,501			
	May	12,010	14,821	9,634	83	38	274	235	6,013	3,621			
	Jun	11,389	14,054	9,135	64	26	286	261	6,657	2,478			
	Jul	11,676	14,408	9,365	50	0	207	207	5,278	4,087			
	Aug	1,284	1,585	1,030	38	0	0	0	0	1,030			
Yala total		51,529	63,587	41,331	561	249	1,266	1,017	25,963	15,368	1,214	3,767	100%
Total		96,610	119,216	77,491	1,318	613	2,361	1,748	44,646				
1988/89	Sep	5,880	7,256	4,717	80	37	53	17	430	4,287			
	Oct	11,456	14,137	9,189	134	73	304	231	5,890	3,300			
	Nov	7,031	8,676	5,639	205	120	242	121	3,096	2,544			
	Dec	12,384	15,282	9,933	121	64	199	135	3,449	6,484			
	Jan	9,724	11,999	7,800	93	45	239	194	4,954	2,846			
	Feb	0	0	0	17	0	59	59	1,502	-1,502			
Maha total		46,475	57,351	37,278	650	339	1,095	757	19,320	17,958	1,639	4,193	100%
	Mar	9,810	12,106	7,869	67	28	182	154	3,920	3,948			
	Apr	8,427	10,400	6,760	105	53	317	264	6,746	14			
	May	10,382	12,812	8,328	20	0	274	274	6,990	1,338			
	Jun	11,133	13,739	8,930	44	0	286	286	7,311	1,619			
	Jul	6,316	7,793	5,066	85	40	207	167	4,259	807			
	Aug	0	0	0	42	0	0	0	0	0			
Yala total		46,069	56,849	36,952	362	121	1,266	1,145	29,225	7,726	610	3,164	100%
Total		92,544	114,200	74,230	1,012	460	2,361	1,901	48,545				
1989/90	Sep	7,035	8,682	5,643	65	26	53	27	693	4,950			
	Oct	10,266	12,668	8,234	42	0	304	304	7,753	482			
	Nov	9,077	11,201	7,280	92	45	242	197	5,027	2,253			
	Dec	10,721	13,230	8,599	11	0	199	199	5,080	3,520			
	Jan	8,863	10,937	7,109	52	0	239	239	6,105	1,004			
	Feb	0	0	0	0	0	59	59	1,502	-1,502			
Maha total		45,963	56,718	36,867	261	71	1,095	1,024	26,159	10,707	977	3,531	100%
	Mar	13,959	17,226	11,197	75	33	182	149	3,794	7,403			
	Apr	10,364	12,789	8,313	56	0	317	317	8,106	207			
	May	11,193	13,812	8,978	124	66	274	208	5,303	3,675			
	Jun	12,685	15,653	10,174	48	0	286	286	7,311	2,864			
	Jul	4,605	5,683	3,694	12	0	207	207	5,278	-1,585			
	Aug	0	0	0	0	0	0	0	0	0			
Yala total		52,806	65,162	42,355	315	99	1,266	1,167	29,792	12,564	993	3,546	100%
Total		98,768	121,880	79,222	576	170	2,361	2,191	55,951				

Table 6.4.3.1-4 Proposed Water Balance Study for Liyangastota Walawe LB Sub-scheme (1985/86 ~ 1994/95)

* Station of Rainfall Data
1) 1985 Sep~1988 Sep : Embilipitiya
2) 1988 Oct~1995 Aug : Mamadola

Command Area = 2,553 ha

Success Rate (Maha: 100%) (Yala : 98%)

		Ridiyagama Tank Issue Records			*Rainfall		Unit FWR	Unit FIR	FIR	Water Balance			
					ER				A=2,553ha (100%)	Volume	Area	Success Area	Success Rate
		(c) (Ac ft)	(d) (000m3)	(e) (dx65%)	(f) (mm)	(mm)	(g) (mm)	(h) (g-f) (mm)	(i) (h x A) (000m3)	(j) (e-i) (000m3)	(k) (j / g) (ha)	(l) (k+2,553) (ha)	(m) (l/2,553) (%)
1990/91	Sep	11,254	13,887	9,027	17	0	53	53	1,362	7,665			
	Oct	4,165	5,140	3,341	238	142	304	162	4,124	-783			
	Nov	5,016	6,189	4,023	256	155	242	87	2,220	1,803			
	Dec	8,146	10,052	6,534	155	87	199	112	2,859	3,675			
	Jan	4,514	5,570	3,621	203	119	239	120	3,060	561			
	Feb	417	515	335	3	0	59	59	1,502	-1,167			
Maha total		33,512	41,353	26,880	873	503	1,095	592	15,126	11,753	1,073	3,626	100%
	Mar	13,386	16,518	10,737	47	0	182	182	4,637	6,100			
	Apr	9,101	11,231	7,300	129	69	317	248	6,333	967			
	May	12,345	15,234	9,902	104	53	274	221	5,647	4,255			
	Jun	9,659	11,920	7,748	250	150	286	136	3,469	4,279			
	Jul	5,686	7,017	4,561	91	44	207	163	4,151	410			
	Aug	0	0	0	39	0	0	0	0	0			
Yala total		50,178	61,920	40,248	660	317	1,266	949	24,237	16,011	1,265	3,818	100%
Total		83,689	103,273	67,127	1,533	820	2,361	1,542	39,363				
1991/92	Sep	11,634	14,356	9,332	29	0	53	53	1,362	7,970			
	Oct	7,095	8,756	5,691	265	161	304	143	3,650	2,041			
	Nov	10,891	13,440	8,736	195	114	242	128	3,269	5,467			
	Dec	12,963	15,996	10,397	150	84	199	115	2,944	7,453			
	Jan	8,106	10,003	6,502	25	0	239	239	6,105	397			
	Feb	0	0	0	0	0	59	59	1,502	-1,502			
Maha total		50,690	62,551	40,658	665	358	1,095	738	18,832	21,826	1,992	4,546	100%
	Mar	10,678	13,176	8,565	0	0	182	182	4,637	3,927			
	Apr	5,842	7,209	4,686	16	0	317	317	8,106	-3,420			
	May	4,960	6,121	3,979	145	80	274	194	4,952	-974			
	Jun	4,674	5,768	3,749	20	0	286	286	7,311	-3,562			
	Jul	2,232	2,754	1,790	65	26	207	180	4,604	-2,814			
	Aug	429	529	344	38	0	0	0	0	344			
Yala total		28,815	35,557	23,112	282	106	1,266	1,160	29,610	-6,498	-513	2,040	80%
Total		79,504	98,108	63,771	947	464	2,361	1,897	48,442				
1992/93	Sep	480	592	385	113	59	53	0	0	385			
	Oct	6,409	7,909	5,141	88	42	304	262	6,687	-1,546			
	Nov	6,448	7,956	5,172	271	165	242	77	1,963	3,208			
	Dec	7,850	9,687	6,297	95	46	199	153	3,894	2,403			
	Jan	11,635	14,358	9,332	22	0	239	239	6,105	3,228			
	Feb	10,353	12,775	8,304	18	0	59	59	1,502	6,802			
Maha total		43,174	53,276	34,630	606	312	1,095	789	20,151	14,479	1,322	3,875	100%
	Mar	0	0	0	28	0	182	182	4,637	-4,637			
	Apr	13,548	16,719	10,867	106	54	317	263	6,722	4,145			
	May	7,973	9,838	6,395	169	96	274	177	4,526	1,869			
	Jun	9,792	12,083	7,854	117	62	286	225	5,739	2,115			
	Jul	12,182	15,033	9,771	45	0	207	207	5,278	4,493			
	Aug	5,535	6,830	4,439	0	0	0	0	0	4,439			
Yala total		49,030	60,503	39,327	466	212	1,266	1,054	26,902	12,425	982	3,535	100%
Total		92,204	113,779	73,956	1,072	524	2,361	1,843	47,053				
1993/94	Sep	5,561	6,862	4,460	12	0	53	53	1,362	3,098			
	Oct	9,475	11,693	7,600	154	86	304	217	5,548	2,053			
	Nov	6,104	7,533	4,896	337	209	242	33	834	4,062			
	Dec	6,414	7,914	5,144	237	142	199	57	1,463	3,681			
	Jan	6,395	7,892	5,130	56	0	239	239	6,105	-975			
	Feb	0	0	0	12	0	59	59	1,502	-1,502			
Maha total		33,949	41,894	27,231	642	437	1,095	658	16,813	10,418	951	3,504	100%
	Mar	12,285	15,159	9,854	130	70	182	112	2,853	7,001			
	Apr	9,314	11,493	7,471	102	51	317	266	6,800	670			
	May	11,598	14,312	9,303	38	0	274	274	6,990	2,313			
	Jun	12,079	14,906	9,689	10	0	286	286	7,311	2,378			
	Jul	9,043	11,160	7,254	60	0	207	207	5,278	1,976			
	Aug	527	650	423	45	0	0	0	0	423			
Yala total		54,846	67,680	43,992	385	121	1,266	1,145	29,232	14,760	1,166	3,719	100%
Total		88,795	109,574	71,223	1,027	558	2,361	1,803	46,046				
1994/95	Sep	8,174	10,087	6,557	214	126	53	0	0	6,557			
	Oct	8,440	10,415	6,770	250	150	304	153	3,917	2,852			
	Nov	6,606	8,152	5,299	137	75	242	167	4,261	1,038			
	Dec	11,265	13,901	9,036	29	0	199	199	5,080	3,956			
	Jan	8,140	10,044	6,529	132	71	239	168	4,281	2,248			
	Feb	0	0	0	56	0	59	59	1,502	-1,502			
Maha total		42,625	52,599	34,189	817	423	1,095	746	19,040	15,149	1,383	3,936	100%
	Mar	12,797	15,791	10,264	11	0	182	182	4,637	5,627			
	Apr	9,918	12,239	7,956	185	107	317	210	5,370	2,585			
	May	9,414	11,617	7,551	133	72	274	202	5,154	2,397			
	Jun	11,605	14,321	9,308	53	0	286	286	7,311	1,997			
	Jul	10,986	13,557	8,812	29	0	207	207	5,278	3,534			
	Aug	649	801	521	42	0	0	0	0	521			
Yala total		55,370	68,327	44,413	453	179	1,266	1,087	27,751	16,662	1,316	3,870	100%
Total		97,995	120,926	78,602	1,270	602	2,361	1,833	46,791				