# *REHABILITATION OF IRRIGATION AND DRAINAGE SYSTEMS IN THE RIVER BASINS OF SOUTHERN SRI LANKA*

## *VOLUME I MAIN REPORT*

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## *ABBREVIATIONS*

| | |
|---|---|
| AGA | Assistant Government Agents |
| ASC | Agrarian Service Center |
| CEA | Central Environmental Authority |
| DAS | Department of Agrarian Service |
| DCO | Distributory Canal Organization |
| DFAR | Department of Fisheries and Aquatic Resources |
| DFEO | Divisional Fisheries Extention Office |
| DIE | Department of Immigration and Emigration |
| DM | Department of Meteorology |
| DOA | Department of Agriculture |
| FO | Farmers' Organization |
| FOO | Farmers' Organizations (*pl.*) |
| HIRDEP | Hambantota Integrated Rural Development Project |
| ID | Department of Irrigation |
| IIMI | International Irrigation Management Institute |
| IMD | Irrigation Management Division |
| IMF | International Monetary Fund |
| IMPSA | Irrigation Management Policy Support Activity |
| INMAS | Integrated Management of Major Irrigation System |
| IRDP | Integrated Rural Development Project |
| KOISP | Kirindi Oya Irrigation and Settlement Project |
| LCD | Land Commissionere Department |
| MANIS | Management of Irrigation Systems |
| MASL | Mahaweli Authority of Sri Lanka |
| MEA | Mahaweli Economic Agency |
| MIPE | Ministry of Irrigation, Power and Energy |
| MLLD | Ministry of Lands and Land Development |
| MOA | Ministry of Agriculture |
| MPCS | Multi-purpose Co-operative Society |
| NARA | National Aquatic Resources Agency |
| NAREPP | Natural Resources and Environmental Policy Project |
| NIRP | National Irrigation Rehabilitation Project |
| NORAD | Norwegian Agency for Development Cooperation |
| PMC | Project Management Committee |
| SAG | Study Advisory Group |
| SAM | Special Area Management |
| SD | Survey Department |
| SIDA | Swedish International Development Agency |
| SLFO | System Level Farmer Organization |
| SLPA | Sri Lanka Ports Authority |
| WLAC | Working Level Advisory Committee |
| WUG | Water Users' Group |
| AI | Agricultural Instructor (DOA) |
| AO | Agricultural Officer (DOA) |
| CRE | Chief Resident Engineer |
| DA | Divisional Assistant (ID) |
| DDI | Deputy Director of ID |
| DI | Director of ID |
| DO | Divisional Officer (DAS) |
| FI | Fisheries Inspector |
| IE | Irrigation Engineer |

| | |
|---|---|
| IO | Institutional Organizer |
| PE | Project Engineer (IRDP) |
| PM | Project Manager (IMD) |
| RE | Resident Engineer |
| RPM | Resident Project Manager (IMD) |
| RO | Research Officer |
| TA | Technical Assistant |
| EIA | Environmental Impact Assessments |
| EIRR | Economic Internal Rate of Return |
| IEE | Initial Environmental Examination |
| SWE | Salt-water Exclusion |
| WID | Women-in-Development |

## Conversion Factor

| | Form Metric System | | | To Metric System | | |
|---|---|---|---|---|---|---|
| Length | 1cm | = | 0.394 inch | 1inch | = | 2.54 cm |
| | 1m | = | 3.28 ft | 1 ft | = | 30.48 cm |
| | 1km | = | 0.621 mile | 1 mile | = | 1.609 km |
| | 1chaine | = | 30.48 m | 1 m | = | 0.033 chaine |
| Area | 1 $cm^2$ | = | 0.155 sq.in | 1 sq.ft | = | 0.0929 $m^2$ |
| | 1 $m^2$ | = | 10.76 sq.ft | 1 sq.yd | = | 0.835 $m^2$ |
| | 1 ha | = | 2.471 acres | 1 acre | = | 0.4047 ha |
| | 1 $km^2$ | = | 0.386 sq.mile | 1 sq.mile | = | 2.59 $km^2$ |
| Volume | 1 $m^3$ | = | 35.3 cu.ft | 1 cu.ft | = | 0.0283 $m^3$ |
| | $10^6$ $m^3$ | = | 810.7 acre.ft | 1 acre.ft | = | 1,233.5 $m^3$ |
| Velocity | 1 $m^3/s$ | = | 35.3 cusec | 1 cusec | = | 0.0283 $m^3/s$ |
| | 1 ton/ha | = | 891 lb/acre | 1 lb/acre | = | 1.12 kg/ha |
| Paddy/Rice | 1 kg | = | 0.048 bushels | 1 bushel | = | 20.87 kg |
| | 1 kg/ha | = | 0.019 bushel/acre | 1 bushel/acre | = | 51.55 kg/ha |
| | 1 ton paddy | = | 0.7 ton rice | 1 ton rice | = | 1.43 ton paddy |

# *Part 1: Master Plan Study*

# *Chapter 1*

# CHAPTER 1 INTRODUCTION

## 1.1 Objective and Scope of Work

The works under the Study comprised (i) a Master Plan Study of 7 irrigation and drainage schemes to be rehabilitated in the districts of Kalutara, Matara and Hambantota in southern Sri Lanka (Phase I), and (ii) a Feasibility Study of candidate schemes chosen for their viability at the master plan study stage (Phase II). This report embodies the findings and results of the said Master Plan Study.

## 1.2 Study Area

The Study area is as follows.

| Scheme | River | Benefit area (ha) | District |
|---|---|---|---|
| Irrigation schemes: | | | |
| Liyangastota | Walawe Ganga | 6,121 | Hambantota |
| Muruthawela | Urbokka Oya, Kirama Oya | 6,149 | Hambantota |
| Badagiriya | Malala Oya | 703 | Hambantota |
| Kachigala | Kachigala Oya | 516 | Hambantota |
| Subtotal | | 13,489 | |
| Drainage schemes: | | | |
| Benthara Ganga right bank | Bentara Ganga | 965 | Kalutara |
| Polwatte Ganga | Powatte Ganga | 560 | Matara |
| Thangalu Welyaya | Kirama Oya | 395 | Hambantota |
| Subtotal | | 1,920 | |
| Total | | 15,409 | |

## 1.3 Related Government Agencies

The primary executing agency for the Study works is the Irrigation Department under the Ministry of Irrigation, Power and Energy. Other concerned agencies are the Ministry of Agriculture, the Ministry of Fisheries and Aquatic Resources, Central Environmental Authority, and the National Planning Department. Concerned personnel from these agencies formed a Study Advisory Group which assisted and supported the Study Team in the execution of its works.

## 1.4 Study Schedule

The Study comprised Phase I and Phase II works.

Phase I included field survey 1 and home office works under which the candidate schemes for subsequent feasibility study were selected.

The Study Team carried out the field survey 1 from January 25 to April 12, 1995, the results of which were compiled in Progress Report I and submitted to the Sri Lankan government for its concurrence. Upon return to Japan, the Team immediately commenced home office work, the results of which were compiled in the Interim Report. The Interim Report was submitted to the Sri Lankan government on June 20, 1995 for its concurrence.

This Report is the Master Plan Study Final Report based on the results and findings contained in the above mentioned Progress Report I and the Interim Report.

Under Phase II of the Study, field survey of schemes selected for feasibility study was done from January 21 to April 19, 1996, the results of which are contained in a separate Feasibility Study Report compiled by the Team after its return to Japan.

# *CHAPTER 2*

# *CHAPTER 2 PROJECT BACKGROUND*

## 2.1 National Economic Development Plan

Targets of the Sri Lankan government under its national economic development plan include controlling inflation, robust economic growth, generation of employment opportunities, and equitable distribution of the benefits of economic growth and development. Within the framework of the ongoing World Bank and IMF recommended program for structural adjustment, the government has adopted a policy to achieve the foregoing targets through reduction of the government budget deficit, promotion of projects aimed at developing the economic base, and intensified support to the privatization of government run enterprises. At the same time, in order to further develop the nation's human resources over the long term, budget allocation to the social services sector is being expanded. The foregoing efforts are anticipated to encourage greater private sector participation in the marketplace, thereby strengthening and energizing the Sri Lankan economy which heretofore has suffered from rising government deficit, worsening international balance of payments, and growing unemployment and inflation.

## 2.2 Agricultural Sector

Under the government's new agricultural policy in which human resources development is to be pursued, and controls and regulations affecting the agricultural sector are to be loosened to foster greater independence and creative energy on the part of farmers; emphasis has been placed on shifting from monoculture to a more diverse, export oriented agricultural structure.

Until the mid 1980's, primary focus under agricultural strategy had been on new irrigation development schemes such as the Mahaweli Development Programme aimed at achieving self sufficiency in domestic rice production. However, in recent years, the government budget has been severely strained by operation and maintenance costs for irrigation facilities. Accordingly, the government is shifting away from a policy of new irrigation facility construction, which requires a high initial investment, to rehabilitation of existing deteriorated facilities in order to upgrade these to achieve better cropping rates and yields on farmland already under cultivation, and promotion of greater farmer participation in the O&M of such facilities after rehabilitation. Against this background, various irrigation rehabilitation projects have been pursued throughout the country, with particular emphasis in the north and east of rehabilitation of large scale schemes. It is now desirable that this Master Plan be implemented in southern Sri Lanka where unemployment is high.

## 2.3 National Environmental Strategy

The environmental strategy of the government is based primarily on the National Conservation Strategy, 1988. Under this strategy, increased material and goods consumption as a result of population growth is to be addressed by applying modern

technologies to existing production systems to increase their productivity, as opposed to the further exploitation of natural resources. Rehabilitation of existing irrigation schemes is quite compatible with this strategy.

## 2.4 Southern Region Development Strategy

The government's development strategy for southern Sri Lanka focuses on acceleration of regional economic growth, expansion of economic production activities, optimum utilization of available resources, and rectifying skewed levels of development between sectors and between regions. With careful identification and cognizance of the specific problems of the region, development strategy for southern Sri Lanka emphasizes a proper balance between economic growth per se and the equitable distribution of the benefits of development.

Within the agricultural sector, a mainstay of the southern region economy, projects such as the Southern Province Rural Development Project and the Small Farmers and Landless Credit Scheme aimed at increased income and the generation of employment opportunities for the rural population are being pursued.

In the infrastructure sector, development of Galle port as a major transshipment center is under planning. A free trade zone centered on the garment industry has been established at Koggala in Galle district. This free trade zone is planned to play an important role in absorbing surplus labor into labor intensive, export promoting industries. The success of the foregoing efforts in stimulating the regional economy, however, are predicated on a parallel modernization of agriculture in the region.

## 2.5 Economic Conditions

Real GDP growth in 1993 was 6.9% (target under the structural adjustment program: 5.5%). At the same time, inflation rate was 11.7% (target under the structural adjustment program: 7.5%); government deficit was 8.1% of the real GDP (target under the structural adjustment program: 8.0%); government expenditure was 27.9% (target under the structural adjustment program: 27.6%); and operating deficit was 6.5% (target under the structural adjustment program: 5.8%). As can be seen from the foregoing figures, targets under structural adjustment were essentially achieved, with the exception of inflation rate. Major economic indicators are forecast (the year 2000) at 8% economic growth rate, inflation rate below 5%, government deficit at 3~4% of real GDP, private sector investment at 25% of real GDP, and foreign investment rate of 20%.

# *CHAPTER 3*

# CHAPTER 3 EXPERIENCE AND LESSONS RELATED TO REHABILITATION OF IRRIGATION AND DRAINAGE SCHEMES IN SRI LANKA

## 3.1 Irrigation and Drainage Schemes Rehabilitation Projects

(1) Irrigation Schemes

Major such projects either carried out in the past or being implemented at present in Sri Lanka are as follows:

- Tank Irrigation Modernization Project (TIMP)
- Gal Oya Water Management Project
- Major Irrigation Rehabilitation Project (MIRP)
- National Irrigation Rehabilitation Project (NIRP)
- Village Irrigation Rehabilitation Project (VIRP)
- Uda Walawe Rehabilitation Project

Of the above, NIRP (currently being implemented) and VIRP (targeted at small scale schemes) where not analyzed under this Study.

(2) Drainage Schemes

- Gin Ganga Rehabilitation Project
- Nilwala Ganga Flood Protection Scheme

## 3.2 Participatory Management Programs

- INMAS (Integrated Management of Major Irrigation Systems)
- MANIS (Management of Irrigation Systems)
- ISMP (Irrigation System Management Project)

## 3.3 Experience and Lessons Learned

The following are the experience and lessons learned from the projects indicated above.

(i) Maximum effect is achieved under rehabilitation projects by low cost rehabilitation, accompanied by improvement of scheme operation and maintenance through strengthening farmer organizations and greater delegation to these organizations of responsibility for facility O&M.

(ii) The rehabilitation, apart from being less capital intensive should be designed for cost-effective management of all the key operations. The level of technology should be one which the executing agency and the farmer organizations would be able to manage on a sustainable basis at the level of

resources available to them. In this process it may by necessary to modify the original design and canal layout to meet new needs and policy changes.

(iii) Before embarking on the design of the rehabilitation program, planners should secure the best and most reliable information regarding the present functioning and behavior of the system. This information is often best known to the farmers and the field staff working in the area. It is possible that all the required information would not be available at the outset; therefore the plan should be sufficiently flexible to incorporate new information that would be forthcoming after commencing rehabilitation.

(iv) The knowledge and experience of farmers is essential to the planning and design of a practical system. Well organized farmer organizations should therefore be given every opportunity to participate in the planning and design of the rehabilitation.

(v) The PMC where both farmers and officials are well represented can plan a major role in the planning, design and management of the rehabilitation scheme. In order to achieve this type of effective participatory management, strengthening of the PMC's and the DCO's to a level that would enable them to take on that responsibility should precede the rehabilitation.

(vi) As a part of government policy, farmer organizations are expected to takeover the system below the D canal for operation and maintenance, a precondition for which is that the system should first be rehabilitated. Farmers are unwilling to take over the system unless they have been fully associated in the rehabilitation.

(vii) Physical rehabilitation and improvement of water management alone does not improve the benefit stream on a sustainable basis. Many other factors relating to agricultural technology, cropping, and institutional arrangements for agricultural credit, processing and marketing have a strong bearing on the success of a rehabilitation project. These aspects should be factored into the plans and designs for rehabilitation.

(viii) In rehabilitation projects a mid term review, say after the 2nd and 3rd year of implementation, would help planners and project staff to take stock of the situation and make mid-course corrections both to the concept and design as well as the processes adopted in the program. A mid-term evaluation by an independent professional group would be a very effective means of improving project efficiency and the eventual impact of the project.

# CHAPTER 4

# *CHAPTER 4 PRESENT CONDITION OF SOUTHERN REGION*

## 4.1 Natural Conditions

The seven schemes under the Study are located in the 3 districts of Kalutara, Matara and Hambantota in the Southern Region of Sri Lanka. Topographically, the central upland area is located at the north of the region with elevations over 2,000 m. From there, moving southward elevations drop abruptly to around 500 m after which terrain tapers off gradually in elevation to the coast. A mountainous area is located along the border between the Southern and Sabaragamuwa provinces, dominated by Mt. Gongala with elevation of 1,350.

Climatically the southeastern part of the region belongs to the Dry Zone, while the western part belongs to the Wet Zone. The Benthara Ganga and Polwatte Ganga basins lie within Wet Zone. Other basins of the area are within Dry Zone. Annual rainfall in the Dry Zone is under 1,500 mm, and that in the southwestern Wet Zone exceeds 2,500 mm. Rainfall in mountainous areas is 4,000~5,000 mm per year.

With the exception of mountainous areas, temperatures are 26~28° C, with average humidity of 70~80%. Annual evapotranspiration is 1,500~1,000 mm

In terms of geology, ground formation is divided into the Highland Series and the Vijayan Series. Kalutara, Galle and Matara districts are comprised of Highland Series. Hambantota district is a transition zone between the 2 series, with the area west of the Walawe Ganga being largely Highland Series and the area east of the same being largely Vijayan Series.

Red-yellow podzolic soils are principally distributed in the wet zone, and reddish brown earth in the dry zone. Along the rivers in Southern Region, alluvial soils are dominant.

Especially designated areas for environmental protection are the Yala National Park located at the eastern edge of the Study area, the Bundala Bird Sanctuary along the coast east from Hambantota town, and the Lunuganwehera Sanctuary to the north of the same. Also, the Sinharaja Forest Reserve is situated at the common border between Galle, Matara and Ratnapura districts. The reserve is virgin forest. Also of environmental importance is the fact that mangrove forests are found along the coast.

## 4.2 Agro-economy

### 4.2.1 Agriculture

(1) Population and Households

Matara district exhibits the highest population density at 621 persons/km² (2.3 fold the national average) and Hambantota exhibits the lowest at 206 persons/km². Average household size (district-wise statistics) is 4.4 persons. Out of total households,

percentage of farm households is highest in Hambantota (89%) and lowest in Tangalle (59.0%).

(2) Cropped Area

Target cropped area in the 3 districts is the highest for Hambantota at 42,255 ha (25.1% compared to 1993).

Cropping rate (1993) is notably lower in Hambantota at 130%, than Kalutara (153%) and Matara (174%). Failed crop rate during drought year (1992) was the highest for Hambantota district at 7.7%.

In terms of cropping rate for Subsidiary Food Crops in Hambantota district (1993), that for green gram is the highest (15.7% of the national total). Under vegetables, cropping rate for chilies was the highest (6.1% of the national total).

Hambantota district is a main producer of citronella (90.1% of the national total), while Matara district is a major area of cinnamon production (40.9%) of the national total).

(3) Crop Production and Yields

Production of paddy in Hambantota district (1993) is 136,000 t per year, equivalent to 5.3% of the national total. This is the largest production total of the 3 districts in the Study area.

Production in Hambantota district of green gram (1993) is the largest for any district in the country during the Maha season (24% of the national total), and second in the country during the Yala season (17.5% of the national total). Production of other crops as well, such as millet, sesame and cowpea ranks high among the other districts of the country. Unit yields for green gram are 238 kg/ha in the Maha season and 134 kg/ha in the Yala season.

Under Minor Export Crops, production (1993) of pepper showed significant increase, while clove and cardamon experienced decline in production.

(4) Chemical Fertilizer Use

Fertilizers generally used in Sri Lanka for paddy and pulse cultivation are TDM, urea and compound fertilizer. Relative usage of organic fertilizer is higher for vegetable cultivation, with lesser input of chemical fertilizers. Target application amount for fertilizer for paddy cultivation in Hambantota district (1995) was 344 kg/ha which is slightly above the national average of 331 kg/ha. The same amounts for the other 2 districts of the Study area are below the national average.

(5) Seed

Cropping rate (1993) for improved varieties is at a high level for all 3 districts. Of particular note in the case of Kalutara district is that the cropping rate for old improved varieties and traditional varieties is higher than that of the other 2 districts.

Hambantota district shows the most significant introduction of new improved varieties, and can be considered an advanced area for paddy cultivation.

(6) Land Preparation

Hambandota district exhibits a significant level of farm mechanization, with 88.3% of land prepared by tractor, and 11.7% by draft animal or manually. Conversely, labor intensive methods are pervasive in Kalutara district.

(7) Sowing

Sowing by the broadcast method is high for all 3 districts. Although Hambantota shows the highest rate of sowing by transplantation, the level is only 3%.

(8) Weeding

Rate of weedicide use range from a high of 84.9% in Matara district to 61.2% in Kalutara district.

(9) Pest Control

Hambantota exhibits the highest use rate of fungicides at 37.9% in the Maha season. In contrast, such utilization is almost nil in Kalutara district.

(10) Marketing System of Agricultural Products

Purchase of paddy from farmers is done by the Paddy Marketing Board (PMB), the Multipurpose Co-operative Societies (MPCS), and private marketing agents. The private marketing agents, however, account for the main portion of such purchase. The PMB purchases paddy under the guaranteed price scheme at Rs 7.42/kg. Purchase price by private marketing agents ranges Rs 7.0~7.6/kg for white rice.

At present, rice is also imported under a bonded warehouse system by eight licensed importers under contract with the Food Commissioner's Department.

Marketing route for subsidiary food crops comprises purchase by the Cooperative Wholesale Establishment (CWE) and private traders, and marketing through "polas". Marketing of vegetables is primarily through the polas where large scale purchases are made by collectors and dealers.

(11) Marketing System of Agricultural Inputs

Seed for paddy and Subsidiary Food Crops is produced by seed farms directly under the Seeds and Planting Materials Division and passed on to the farmer via the Agrarian Services Centres, Multi-purpose Co-operative Societies and farmer organizations.

Production of seedlings for Minor Export Crops is done at the central nursery in Matara district or contracted out to private farmers. These are then supplied to registered cultivators of MEC's.

Around 94% of chemical fertilizer supply in the country is imported. Roughly 7 government and private enterprises control 95% of this market. Imported fertilizers are passed on to authorized agents and dealers, the Muli-purpose Cooperative Societies, and the Agrarian Services Centers.

Insecticides, fungicides and weedicides are marketed through the private sector, Agrarian Services Centres and the Multi-purpose Co-operative Societies.

At present 2-wheel and 4 wheel tractors are leased to farmers through the Agrarian Services Centres, and the Multi-purpose Co-operative Societies.

(12) Rural Credit

Under the New Comprehensive Rural Credit Scheme aimed at increasing agricultural productivity, cultivation loans for paddy and Subsidiary Food Crops are available from 7 banks both national and private. Lending interest is 16% p.a., with a payback period of 8 months. However, it is noted that loan recovery rate has deteriorated.

### 4.2.2 Livestock Industry

In Hambantota district where a relatively thriving livestock industry is seen, lack of sufficient grazing land for cattle and buffalo often results in animal intrusion into chena cultivated lands, paddy fields and home gardens. To rectify this situation, the DAPH's veterinary surgeon's offices view the securing of designated grazing areas, strict registration of livestock and establishment of livestock markets as important goals.

### 4.2.3 Fisheries Industry

In the case of sea fishing, coastal fishing is most widespread in Matara district, while seine fishing is the common method in Hambantota district. Fishermen continue to specialize their fishing operations (90~95% of fishermen in the Study area are full time fishermen), with fishing co-operative societies being established to respond to their needs and requirements.

### 4.2.4 Rural Industry

The 200 Garment Industry program is currently being promoted nation-wide, and under the said program labor intensive garment factories are being constructed in the Study area. In addition to providing job opportunities in rural areas where unemployment is high, the garment industry generates exports which earn valuable foreign exchange for the country. Behind this policy is the realization that the export oriented manufacturing sector centered on the garment industry provides the engine for economic growth under the government's economic development strategy of shifting from import-substitute industrialization to export-promoting industrialization, within the framework of a free trade policy.

## 4.3 Socio-economic Conditions

The government is attempting to attract private sector investment into the strengthening of hydropower, telecommunications, transportation, harbor and other infrastructure related facilities through the introduction of Build, Own and Operate / Build, Operate and Transfer (BOO / BOT) programs.

### 4.3.1 Rural Infrastructure

(1) Roads and Highways

In regard to roads in the Study region, a combination of inadequate maintenance and repair and the fact that roads are traversed by trucks overloaded with agricultural produce and inputs has resulted in road surface damage, and at locations pavement materials are exposed. This situation poses dangers of being unsafe, and causing load damage to agricultural products

(2) Water Supply

Intake rate from piped schemes is highest in Hambantota district at 22%. However, there is high dependency in the Study area on unprotected water sources (45~65%).

(3) Electrification

Island wide electrification rate in 1994 was 44.2%. Within the Study area, electrification rate is highest in Kalutara district at 63.7% and lowest in Hambantota district at 23.2%.

(4) Telecommunications

Telephone extension rate (1994)in the Study area ranges from a high of 5.09 units per 1,000 persons in Kalutara district and a low of 2.28 units per 1,000 persons in Matara district.

(5) Education

The government has prioritized human resources development including education as a central issue under development strategy aimed at economic growth with social equity. In line with this, redistribution of public funds is recognized as urgent to rectify regional disparities in education levels by region and capacities of educational facilities. Introduction of a vocational training system is currently being examined.

(6) Medical Services

The government is pushing for increased fiscal investment in the medical services sector aimed at reduction of the outbreak rate for preventable diseases and establishment of a base level of medical service throughout rural areas, particularly targeted at poverty income groups.

### 4.3.2 Poverty Alleviation

Under its welfare policy, the government has in place a school lunch program, food stamp system, and the Janasaviya Programme. Under the Janasaviya Programme, income subsidies are extended to poverty income earners, and the Janasaviya Trust Fund is available to individuals to create their own employment opportunities. This fund is applied to a wide range of sectors by the district and divisional secretaries' offices. To replace the Janasaviya Programme, the present administration has launched the Samurdhi Programme under which grants are extended to a target 1~1.2 million households below the poverty line. In addition, a Samurdhi Foundation and National Development Trust Fund are also to be established. According to D.S. division level statistics for the Study area, recipient households of the government relief fund range 40~80% of the total households for each D.S. division.

## 4.4 Land Use

Approximately 74% (527,000 ha) of the total land in the southern region is agricultural land. However, in Hambantota district, percentage of agricultural land is low at 57% (151,000 ha) compared with the other 2 districts. Also, 26% of the total area in Hambantota district comprises chena or abandoned area.

## 4.5 Irrigation Development

Since the Irrigation Ordinance enactment in 1856, the government has focused mainly on irrigation development projects (including the Mahaweli development program) in the north and north-central of the country. In the Southern Province, on the other hand, traditional irrigated agriculture by the cascade system (utilizing small scale tank schemes) has been pursued.

In recent years, earnest efforts to develop agriculture in southern Sri Lanka commenced in the 1980's. Prior to this, other projects to promote agricultural development in the Southern Province have included the construction of Liyangastota anicut works in 1889, and, following establishment of the present Irrigation

Department, the construction of Ridiyagama tank in 1927, Badagiriya tank in 1957 and Muruthawela tank in 1971 was carried out as the mainstay of a settlement program for the area.

Between the 1960s and 1980s, the government commenced construction of 2 modern, large scale irrigation development and settlement projects comprising the large tank schemes at Udawalawe and Kirindi oya. However, against this background, the irrigation facilities built during the period 1920~1970 continued to deteriorate in function due to expiry of design utility lives for structures, and inadequate maintenance and repair.

In recent years, the government has accorded priority to irrigation facility rehabilitation projects which will enjoy sustainable O&M through active farmer participation, and enable the diversification of crop production. Such projects are aimed at the recovery of function of existing facilities and thereby upgrading the efficiency and productivity of farming activities. A part of this type of rehabilitation is being carried out at present under the Integrated Rural Development Project for the region; however, budget constraints have required that large scale schemes not be included for rehabilitation under the said project. Accordingly, rehabilitation of such large scale schemes as well is urgently required.

### 4.6 Drainage Development

In the southern region, efforts at drainage projects have significantly lagged behind the pursuit of irrigation projects due to government priority over the years on irrigation development. However, in recent years, a new priority has been accorded to drainage projects, particularly those integrally related to irrigation schemes, from the standpoint of efficient use of water, land and other available resources. Under such policy, the Gin Ganga Project, Nilwala Ganga Project, etc., have been carried out under assistance from such donor countries as China and France.

### 4.7 Environmental Issues

Special characteristics of the natural and social environments of the southern region are as follows:

Natural resources: Biodiversity of the region is high due to extensive marshland, mangrove forest and other natural forest areas. The Wet Zone in particular is habitat to a number of rare and endangered species. As a result, a program to establish environmental conservation areas including natural parks, preserves and wetland conservation zones has been pursued by the government over the years. The Bundala National Park in eastern Hambantota district is a registered wetland area under the Ramsar Treaty. However, in the area immediately around the park, their is increasing conflict between elephant herds and encroaching human settlements.

| | |
|---|---|
| Health and sanitation: | There is a high incidence of malaria in the lowland from Matara district eastward. Incidence of filariyasis is observed in the Wet Zone. There is also concern regarding the impact to humans by water contamination by agro-chemical runoff. |
| Education: | Literacy rate in the southern region is lower than the national average in the case of both male and female. The female literacy rate is lower than that for males. |
| Fishery: | Catches in the Southern Province have increased around 60% overall during the past 10 years. However, freshwater fishing has declined. |
| Women's issues: | The literacy rate for women is less than that for men, and exhibiting a particularly low level in rural areas. Furthermore, literacy rates for women show an abrupt decline over the age of 40. On the other hand, women must perform arduous household and farm chores, including water fetching and firewood collecting. There are support programs for women in the form of extension of financing, training, etc. through NGO's. |

### 4.8 Related Agencies

In addition to the prime agency, the Irrigation Department, other government agencies related to the Project are:

(1) Western Provincial Council and Southern Provincial Council

(2) Agrarian Services Offices

(3) Provincial Directors of Irrigation

(4) Project Management Committees and Department of Agriculture

# CHAPTER 5

# CHAPTER 5 PRESENT CONDITIONS OF THE STUDY AREAS

## 5.1 Meteorology and Hydrology

### (1) Basin Meteorology

Meteorology by scheme and basin area is collated as follows based on the data from 8 weather stations and 49 rain gauging in the Study area.

<Irrigation Schemes>

| Scheme: | Liyangastota | Muruthawela Reservoir | Badagiriya | Kachigala Ara |
|---|---|---|---|---|
| Location: | Hambantota district | Hambantota and Matara districts | Hambantota district | Hambantota district |
| Basin: | Walawe ganga | Urubokka oya and Kirama oya | Malara oya | Kachigala Ara |
| Catchment area: | 2,442 km² | 348 km² | 399 km² | 220 km² |
| Basin conditions: | Walawe ganga is the largest basin in the south and is the 6th largest river in Sri Lanka. It comprises the largest irrigated paddy cultivation area and its catchment area the 3 provinces of Sabaragmuwa, Uva and Southern. River length is 150 km. | The Urubokka and Kirama oyas are located to the southwest of the Walawe ganga. The Urubokka oya has its headwaters at 1000 m elevation and flows southward through Muruthawela to empty into the Indian ocean. River length is | Malala oya is located to the east of Walawe ganga. Its headwaters are in hill zone from where the river flows southward into the Indian ocean. River length is 60 km. Elevation in the northern part of the basin is around 100 m | The Kachigala Ara basin is located to the southwest of and extends parallel to the Walawe ganga basin. Its headwaters are in hilly zone at the south side of Chandrica Wewa, from where the river flows southward through Kalametiya lagoon Indian ocean. River length is 30 km; and elevation in the north of the basin is around 100 m. |
| Climatic classification and rainfall amounts: | The southern 2/5 of the basin belongs to Dry Zone, while the northern 1/3 is Wet Zone. Rainfall is 1,000~1,500 mm in the south and 2,000~2,500 in the north. | A portion of the northern part of the basin belongs to Wet Zone, while the greater portion to the south is Dry Zone. Rainfall in the basin ranges greatly from 1,200 mm to 3,000 mm. | The basin is located in the eastern part of the Study area in Dry Zone. Rainfall is 1,000~1,500 km. | The basin belongs to Dry Zone, with rainfall of 1,300~1,500. |
| Basin Rainfall: | | | | |
| Yearly average: | 1,859 mm | 1,726 mm | 1,123 mm | 1,186 mm |
| Flood with 10 year return period: | 2,375 mm | 2,161 mm | 1,497 mm | 1,534 mm |
| Drought with 10 year return period: | 1,362 mm | 1,299 mm | 760 mm | 847 mm |
| Mean temperature: | 27° in ARS | 27° in ARS | 27° in Hambantota | 27° in ARS |
| Mean humidity: | 80% | 80% | 75% | 80% |
| Evapotranspiration | 1,800 mm | 1,800 mm | -- | 1,800 mm |
| Wind speed: | 4.7 km/hr | 4.7 km/hr | 18.6 km/hr | 4.7 km/hr |
| Sunshine hours | 2,560 hr/year | 2,560 hr/year | -- | 2,560 hr/year |

note ARS is located at Angunakolapelessa

<Drainage schemes>

| Scheme: | Bentara Ganga R.B. | Polwatte Ganga | Thangalu Welyaya |
|---|---|---|---|
| Location: | Kalutara district | Matara district | Hambantota district |
| Basin: | Welipenne ganga | Polwatte ganga | Kirama oya |
| Catchment area: | 230 km² | 233 km² | 223 km² |
| Basin conditions: | This is a tributary of the Benthara ganga (catchment area: 622 km²), with confluence with the same 8 km from the river mouth. Headwaters are located in hilly zone with around 100 m elevation. Anual rainfall exceeds 4,000 mm. Although the flows west to the Indian ocean, the Welipenne ganga flows southward to its confluence with the Benthara ganga. | The Polwatte ganga basin is flanked on both sides by 2 pump drainage scheme areas, i.e. Gin ganga and Nilwale ganga schemes. Headwaters of the river are in mountain area with elevation around 500 m. The river flows southward to bay. River length is 25 km. | the Tangalu Welyaya is an area of poor drainage adjacent to the Kirama oya at the extreme downstream of the basin. The headwaters of the Kirama oya are in mountainous area with elevation around 500 m. The river flows south into the River length is 40 km. |
| Climatic classification and rainfall amounts: | The basin is in Wet Zone with annual rainfall reaching 3,000~4,000 mm. It is an area of maximum rainfall in Sri Lanka. | The basin is in Wet Zone with annual rainfall of 2,500~3,500 mm. | A portion of the northern part of the basin is in Wet Zone, with the greater part to the south being in Dry Zone. Annual rainfall is 1,300~2,500 mm. |
| Basin Rainfall: | | | |
| Yearly average: | 3,772 mm | 2,809 mm | 1,776 mm |
| Flood with 10 year return period: | 4,556 mm | 3,479 mm | 2,344 mm |
| Drought with 10 year return period: | 3,025 mm | 2,154 mm | 1,264 mm |
| Mean temperature: | 27° in Ratnapura | 27° in Galle | 27° in ARS |
| Mean humidity: | 76% | 80% | 80% |
| Evapotranspiration: | 1,470 mm | -- | 1,800 mm |
| Wind speed: | 4.2 km/hr | 8.0 km/hr | 4.7 km/hr |
| Sunshine hours | 2,130 hr/year | -- | 2,560 hr/year |

(2) River Discharge

Discharge gauging station data available for the 7 schemes are as follows:

1. Samanalawewa (Walawe ganga) : daily mean discharge data
2. Embilipitiya (Walawe ganga) : monthly mean discharge data
3. Liyangastota (Walawe ganga) : monthly mean discharge data
4. Muruthawela (Urubokka oya) : monthly mean discharge data
5. Downstream of Kirama regulator (Kirama oya) : monthly mean discharge data
6. Yakkalamulla (Polwatte ganga) : daily mean discharge data

(3) Tide Levels

Tidal data recorded at Galle harbor has been applied under this Study. Values for the Study area are as follows.

| Location | Average high tide | Average tide | Average low tide |
|---|---|---|---|
| Benthara ganga estuary | + 0.91 m | + 0.48 m | + 0.11 m |
| Polwatte ganga estuary | + 0.81 m | + 0.43 m | + 0.09 m |
| Tangalla oya estuary | + 0.70 m | + 0.37 m | + 0.08 m |
| Colombo port | + 0.95 m | + 0.50 m | + 0.11 m |

## 5.2 Irrigation Schemes

Main issues affecting the irrigation schemes are as follows.

| Scheme | Area size (ha) | Problem points brought to light by Study findings |
|---|---|---|
| (1) Liyangastota Scheme<br>1) WRB Scheme:<br>2) WLB Scheme:<br>Total: | <br>3,282<br>2,767<br>6,049 | 1) WRB Scheme: 3,282 ha<br>Main and branch canals (constructed in 1927) do not have sufficient cross section to accommodate present expanded irrigation area. Accordingly, excessive load has come to bear on the canal facilities, accelerating their deterioriation and resulting in unmanaged irrigation of the area.<br>2) WLB: 2,767 ha<br>i. Stoplog gates (total of 16 nos. cannot be raised due to sediment buildup at the upstream side of the anicut (constructed in 1889). As a result, managed diversion is impossibe, and water distribution is done on an ad hoc basis year to year by the Irrigation Department.<br>ii. Intake canal (anicut~tank, L = 6.6 km) has decreased water flow section due to sediment influx from river.<br>iii. Slope collapse at downstream side of Ridiyagama tank requires levee widening and toe drainage channel.<br>iv. Deteriation of facilities from intake regulation gates~branch canal show the most marked deterioration under this scheme requiring overall rehabilitation. |
| (2) Muruthawela Reservoir<br>1) LB Main Scheme<br>2) Urubokka Oya Scheme<br>3) Kirama Oya Scheme<br>Total: | <br>1,698<br>2,175<br>2,276<br>6,149 | 1) LB Main Scheme: 1,698 ha (Tract I + II + III)<br>Discharge is being illegally diverted at the Tract I area upstream. Single cropping rotation irrigation is being carried out in the downstream Tract II and III areas.<br>2) Urubokka Oya Scheme: 2,175 ha<br>Seepage is heavy at the 8 locations of anicut due to facility deterioration. As a result, managed diversion is not possible. Also, increasing damage has occurred along main and branch canals, requiring rehabilitation. This area has the oldest irrigation facilities, constructed prior to Muruthawela Reservoir, and have never been repaired in the past.<br>3) Kirama Oya Scheme: 2,276 ha<br>This scheme is intended to receive discharge from the Muruthawela Reservoir via the RB canal. However, with the exception of one period 1984~87, diversion has not been carried out under the scheme. Also, the upstream tank does not have sufficient capacity to service the entire benefit area. Accordingly, cropping rate during the Yala season is around 60%. |
| (3) Badagiriya Scheme | 703<br>(mainly around 60%) | This scheme is intended to receive irrigate via the RB canal from Muruthawela Reservoir as well. However, with the exception of one period 1984~87,RB canal diversion has not been carried out under the scheme. Also, the upstream tank does not have sufficient capacity to service the entire benefit area. Accordingly, cropping rate during the Yala season is around 60%. |
| (4) Kachigala Ara Scheme | 516 | Irrigation facilities due not function at present due to damage from excessive drainage discharge from the upstream Uda Walawe project |

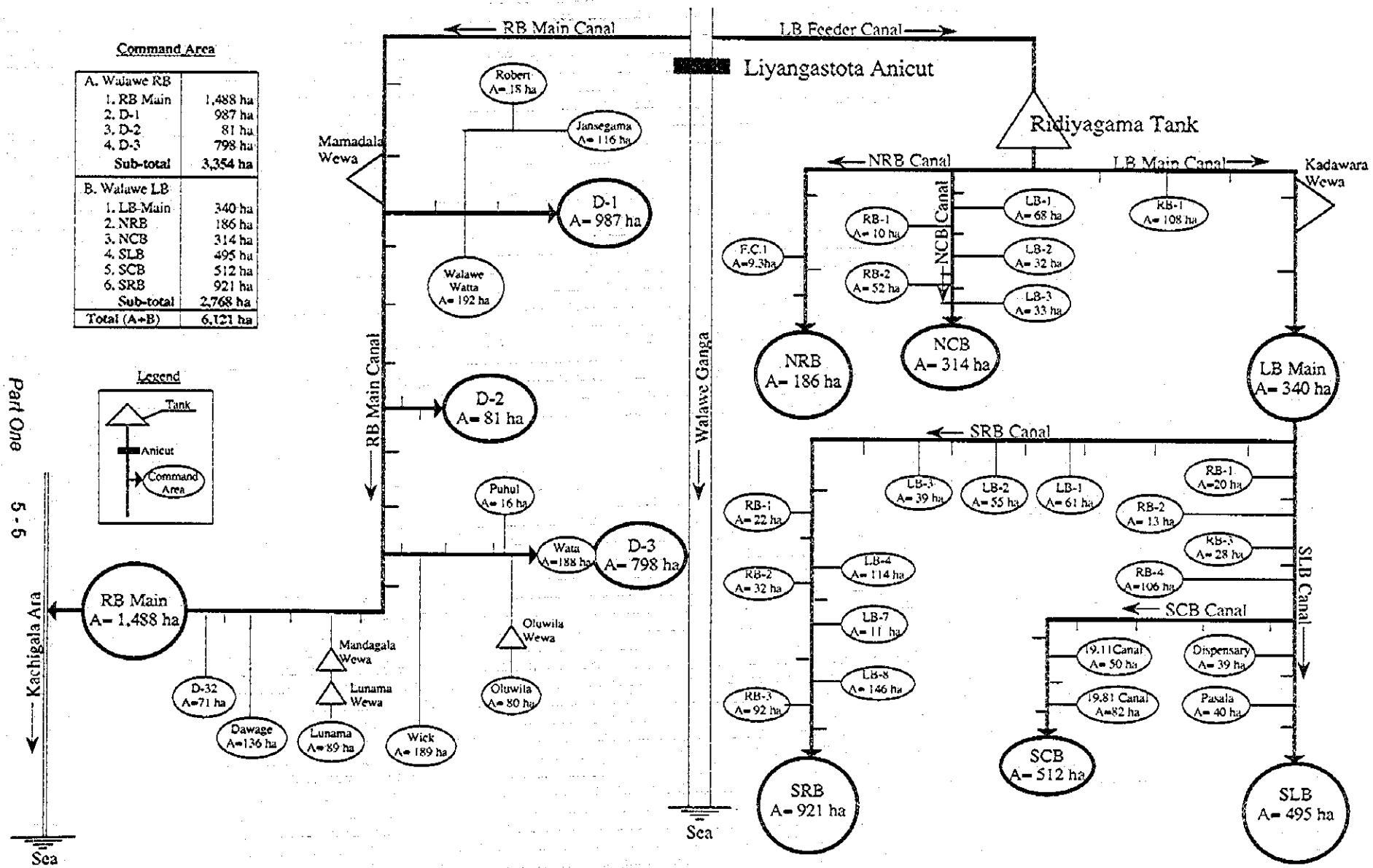
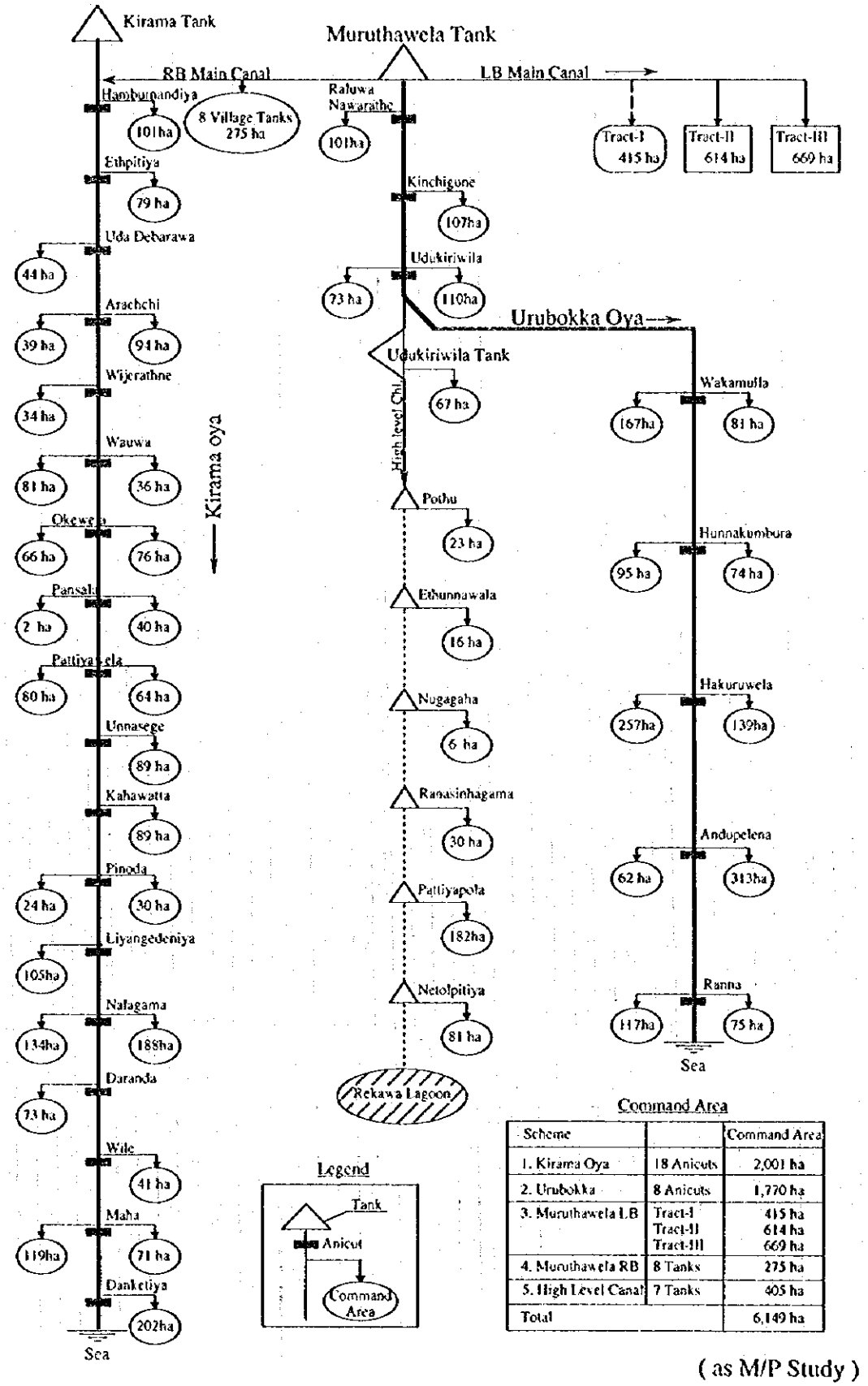



**Fig. 5.2-1 Schematic Diagram of Liyangastota Scheme** ( as M/P Study )

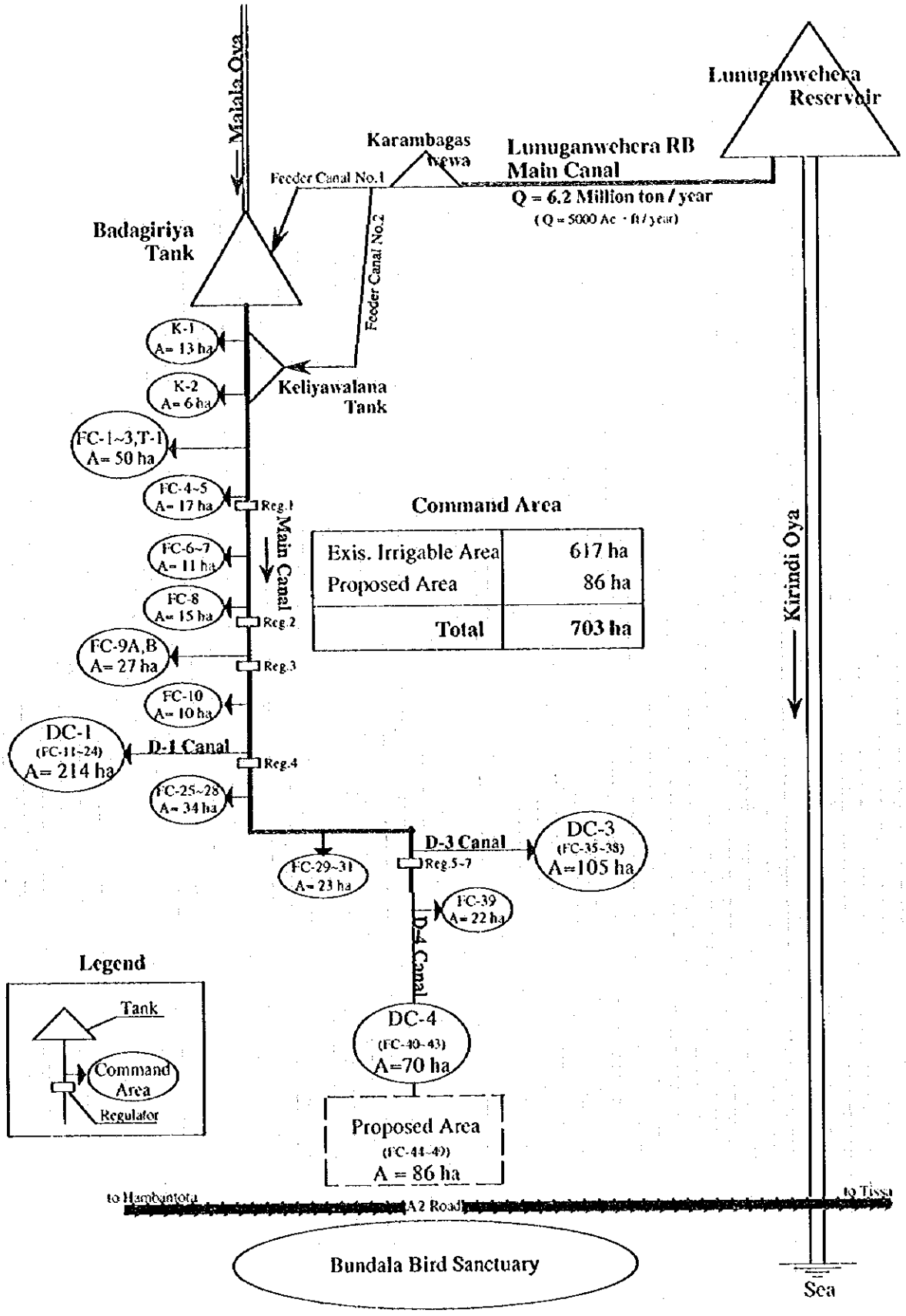



Command Area

| Scheme | | Command Area |
|---|---|---|
| 1. Kirama Oya | 18 Anicuts | 2,001 ha |
| 2. Urubokka | 8 Anicuts | 1,770 ha |
| 3. Muruthawela LB | Tract-I<br>Tract-II<br>Tract-III | 415 ha<br>614 ha<br>669 ha |
| 4. Muruthawela RB | 8 Tanks | 275 ha |
| 5. High Level Canal | 7 Tanks | 405 ha |
| Total | | 6,149 ha |

( as M/P Study )

**Figure 5.2-2 Schematic Diagram of Muruthawela Reservoir Scheme**



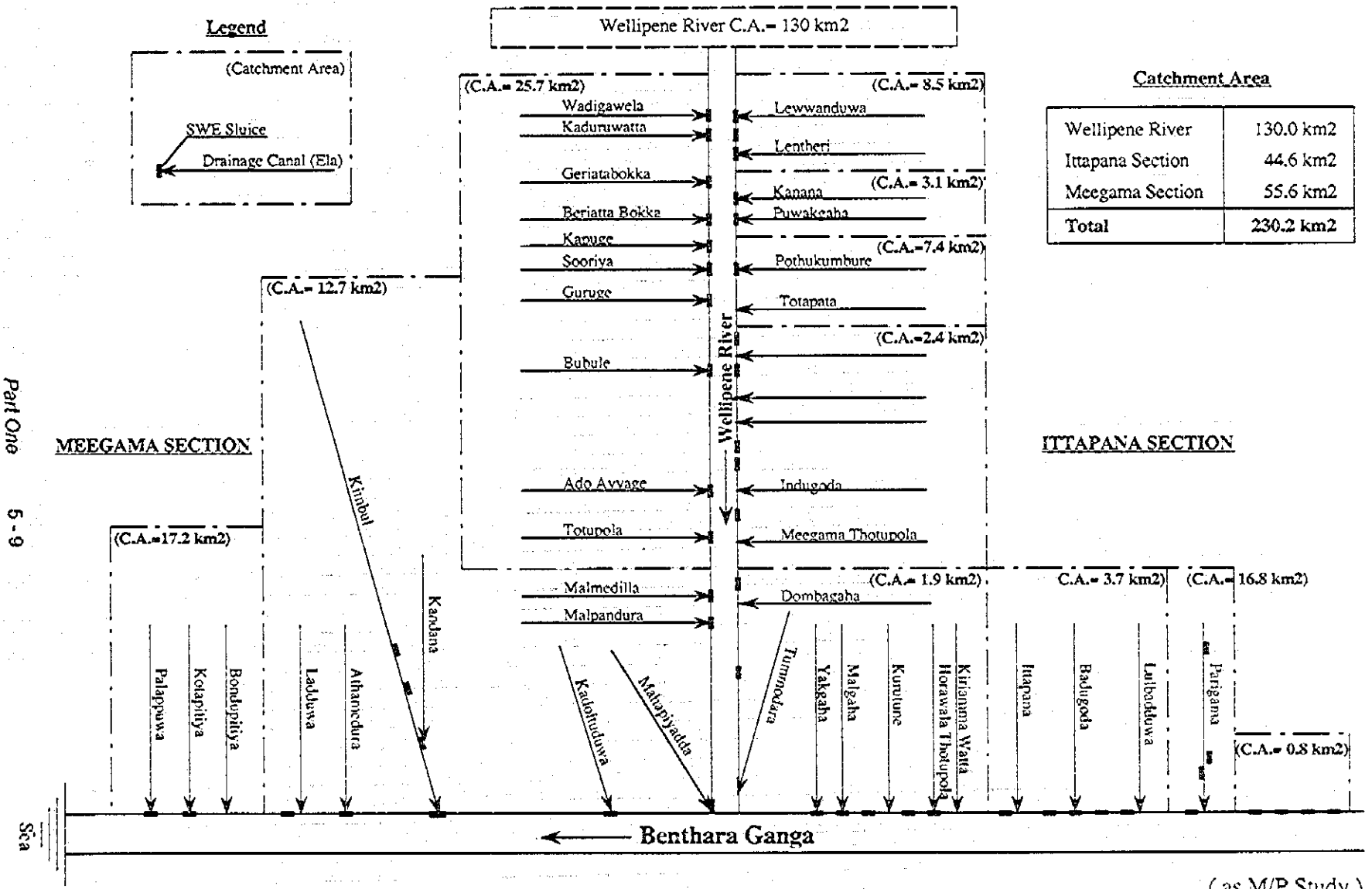

( as M/P Study )

**Figure 5.2-3 Schematic Diagram of Badagiriya Scheme**

## 5.3 Drainage Schemes

Main issues affecting the irrigation schemes are as follows.

| Scheme | Area size (ha) | Problem points brought to light by Study findings |
|---|---|---|
| Bentara Ganaga Right Bank Scheme | 965 (mainly | (1) Chronic flood damage occurs due to deterioration of natrual drainage facilities. As a result 60% of the scheme area suffers damage 3~4 times per year. Flooding reaches a depth of 60 cm.<br>(2) Due to the above mentioned facility deterioration, steel flap gates and wooden sluice gates cannot function adequately, and natural drainage utilizing differential in water levels is not possible. This aggravates flooding inside the scheme area as well as causing saline intrusion.<br>(3) O&M is difficult for existing facilities |
| Polwatte Ganga Scheme | 560 (mainly | (1) Flood irrigation utilizing Ilwatta anicut is basically practiced in the scheme area; however, the anicut facility is old. Also, the relatively large gate at the facility is raised manually, making it impossible to respond quickly to changes in inside and outside water levels. This aggravates flooding inside the scheme area as well as causing saline intrusion. As a result the scheme area suffers damage 3~4 times per year. Flooding reaches a depth of 60 cm. At times, as much as 70% of the scheme<br>(2) Embankment height is insufficient in locations, and entirely lacking at some locations. This aggravates flooding of the scheme area.<br>(3) There are no drainage facilities at the downstream extremety of the scheme area. This downstream area is now abandoned farm land. |
| Tangalu Welyaya Scheme | 395 (mainly | (1) The majority of farm land in the scheme area is at an elevation roughly equivalent to less than that of average tide. As a result this area is the most difficult for natural drainage. In addition, excessive drainage from Kirama oya flows into the area further worsening the drainage situation. As a result, around 50% of the area is estimated to chronically suffer inundation damage.<br>(2) The SWE structures at the downstream extremety of the scheme area are severely deteriorated, with chronic saline intrusion observed in the area. Also, river mouth blockage is progressing at 2 locations at the extreme downstream of the drainage system.<br>(3) Facility O&M is not being carried out. |




**Catchment Area**

| | |
|---|---|
| Wellipene River | 130.0 km2 |
| Ittapana Section | 44.6 km2 |
| Meegama Section | 55.6 km2 |
| **Total** | **230.2 km2** |

( as M/P Study )

**Fig. 5.3-1 Schematic Diagram of Benthara Ganga Right Bank Scheme**

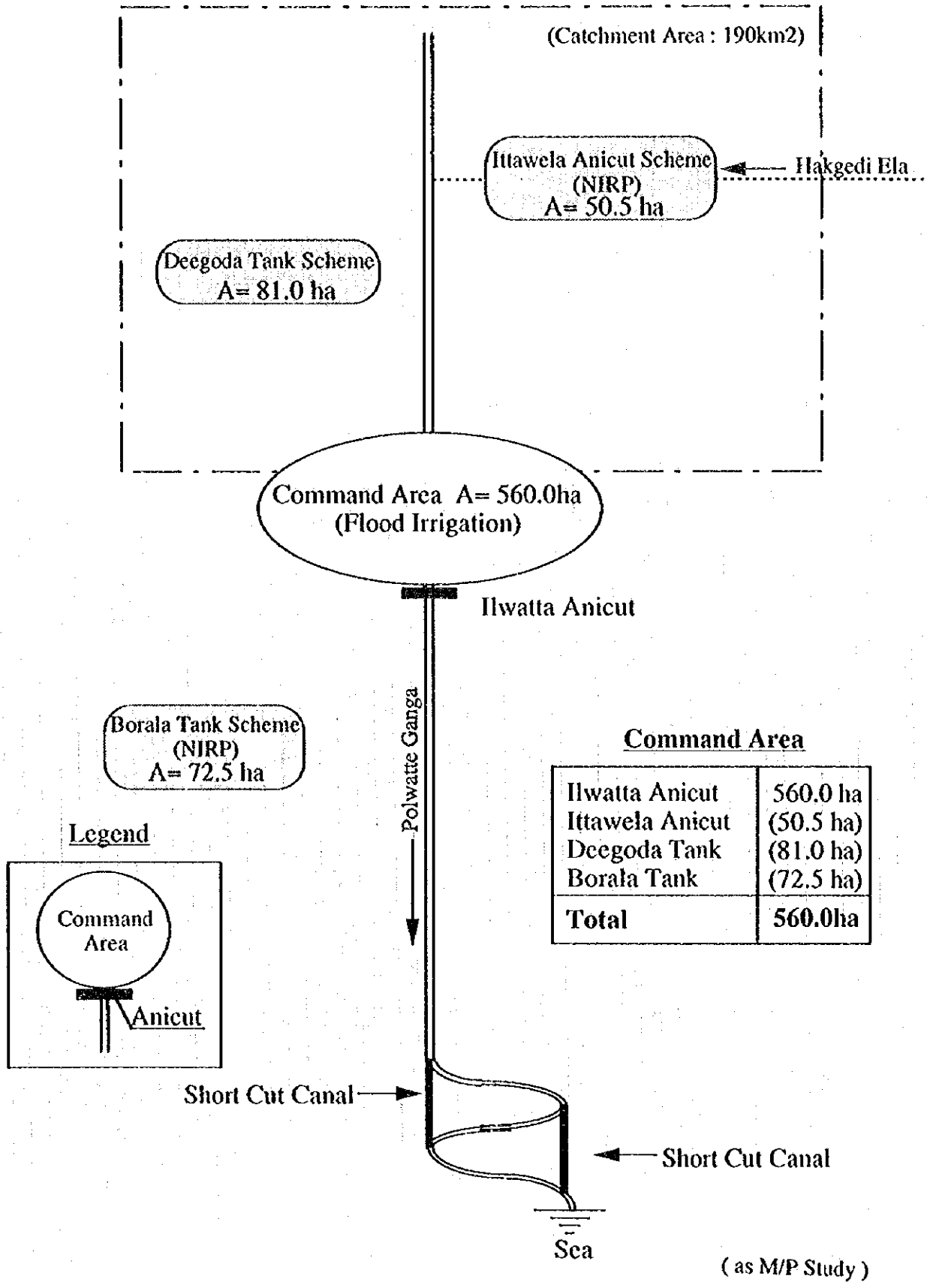


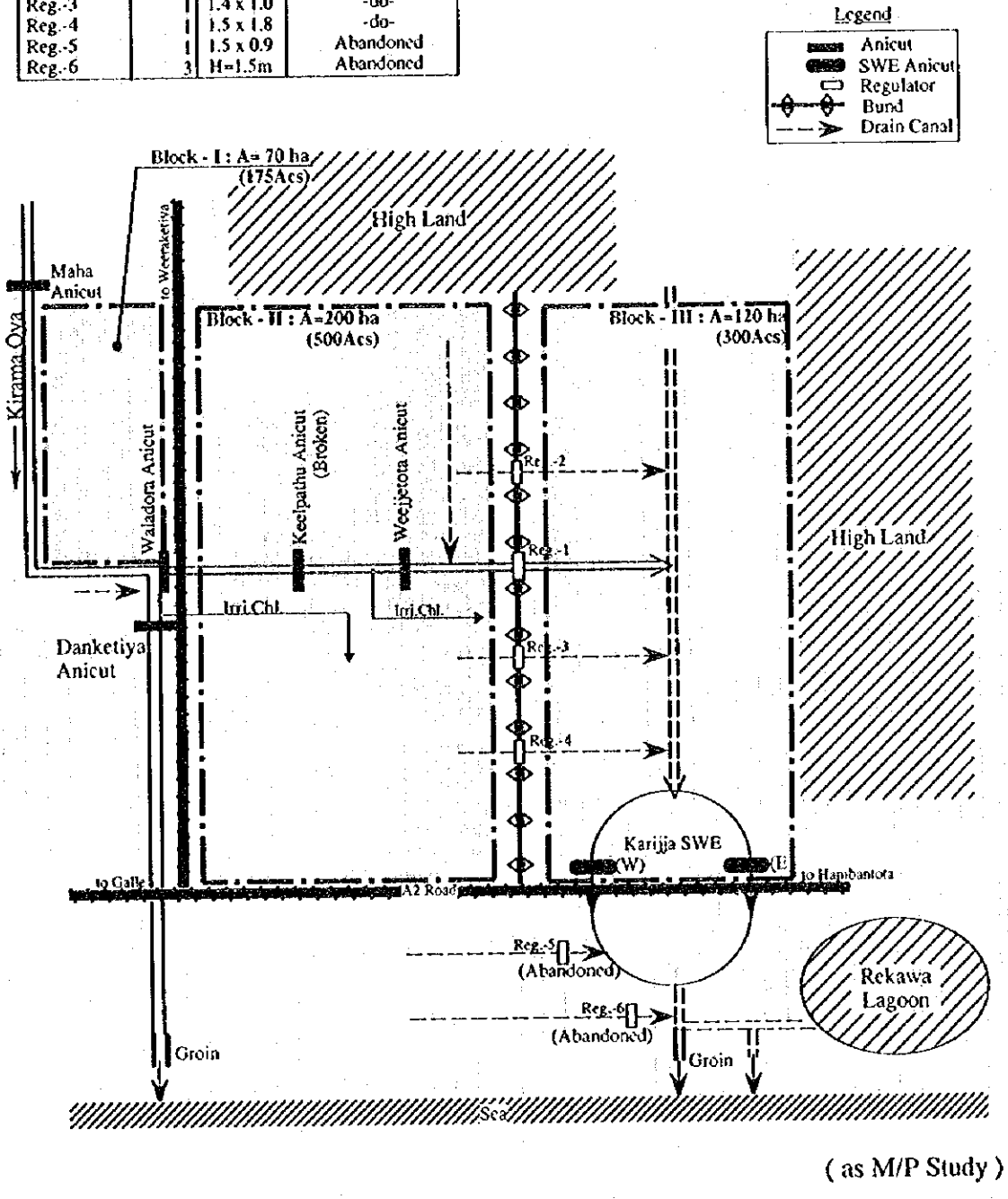

**Fig. 5.3-2 Schematic Diagram of Polwatte Ganga Scheme**

Parameters of Structure

| Anicut / Reg. | Nos. of Gate | Size of Gate(m) (B x H) | Remarks |
|---|---|---|---|
| Danketiya | 5 | 1.5 x 2.0 | Constructed in 1940 |
| Waladora | 6 | 2.0 x 2.4 | -do- |
| Keelpathu | 4 | NA | Broken |
| Weejjetota | 4 | 1.8 x 2.0 | Constructed in 1940 |
| Karijja (W) | 8 | 1.6 x 1.4 | -do- |
| Karijja (E) | 5 | 1.6 x 1.4 | -do- |
| Reg.-1 | 4 | 1.4 x 1.2 | -do- |
| Reg.-2 | 1 | 2.0 x 0.8 | -do- |
| Reg.-3 | 1 | 1.4 x 1.0 | -do- |
| Reg.-4 | 1 | 1.5 x 1.8 | -do- |
| Reg.-5 | 1 | 1.5 x 0.9 | Abandoned |
| Reg.-6 | 3 | H=1.5m | Abandoned |

Command Area

| | | |
|---|---|---|
| Block - I | 71 ha | 175 Acs |
| Block - II | 202 ha | 500 Acs |
| Block - III | 122 ha | 300 Acs |
| **Total** | **395 ha** | **975 Acs** |




( as M/P Study )

**Fig. 5.3-3 Parameters and Schematic Diagram of Thangalu Welyaya Scheme**

## 5.4 Agriculture

Agricultural conditions existing in each scheme are as follows.

<Irrigation schemes>

| Scheme | Area size (ha) | Problem points brought to light by Study findings |
|---|---|---|
| Liyangastota Scheme | 6,121 | (1) Land use · farm households<br>Paddy cropped area: 9,458 ha; cropping rate: 155%; no. of farm households: 4,850; average paddy field area: 1.1 ha<br>(2) Crop production cost · fertilizer application amount · yield<br>Mechanical tilling: 38% of production cost; fertilizer cost: 27% of the same; amount of fertilizer applied: 375 kg/ha;<br>(3) Animal husbandry · plantation crops<br>Nos. of livestock raised in Ambalantota D.S. division: cattle: 14,000 head; water buffalo: 18,000 head<br>Coconut cropped area: 600 ha; nos. of producing households: 5,000<br>(4) Agricultural support service<br>Agricultural extension: 2 extension workers of the Agricultural Department (central government)<br>Upland crop introduction: no plan at present |
| Muruthawela Reservoir Scheme | | (1) Land use · farm households<br>Paddy cropped area: 8,141 ha; cropping rate: 132%; no. of farm households: 7,357; average paddy field area: 0.8 ha<br>(2) Crop production cost · fertilizer application amount · yield<br>Mechanical tilling: 47% of production cost; fertilizer cost: 47% of the same; yield: 3.5 t/ha<br>(3) Animal husbandry · plantation crops<br>Nos. of livestock raised in Weeraketiya D.S. division: cattle: 9,000 head; water buffalo: 5,000 head<br>Coconut cropped area: approx. 4,000 ha; nos. of producing households: 13,000<br>(4) Agricultural support service<br>Agricultural extension: 3 extension workers of the Agricultural Department (Southern Province)<br>Project manager under the INMAS program is permanentlly assigne to the LB scheme. 2 staff assigned for farmer |
| Badagiriya Scheme | 703 | (1) Land use · farm households<br>Paddy cropped area: 239 ha in Yala season / 605 ha in Maha season; OFC cropped area: 28 ha in Yala season / 14 ha in Maha season; cropping rate: 126%; no. of no. of farm households: 594 (independent farmers); average paddy field<br>(2) Crop production cost · fertilizer application amount · yield<br>Mechanical tilling: 45% of production cost; fertilizer cost: 18% of the same; amount of fertilzer applied: 260 kg/ha;<br>(3) Animal husbandry<br>Nos. of livestock raised in Hambantota D.S. division: cattle: 17,465 head; water buffalo: 19,898 head<br>(4) Agricultural support service<br>Agricultural extension: 1 extension worker (part-time) of the Agricultural Department (central government)<br>This scheme receives agricultural support as one part of the Kirindi oya settlement project |
| Kachigala Ara Scheme | 516 | (1) Land use · farm households<br>Paddy cropped area: 103 ha in Yala season / 77 ha in Maha season; no. of no. of farm households: 594 (independent farmers); average paddy field area: 0.8 ha<br>(2) Yield: 3.0~3.2 t/ha |

<Drainage schemes>

| Scheme | Area size (ha) | Problem points brought to light by Study findings |
|---|---|---|
| Bentara Ganga RB Scheme | 965 | (1) Land use · farm households<br>Paddy cropped area: 290 ha in Yala season / 340 in Maha season; reed cropped area: 20 ha; cropping rate: 67%; no. of farm households: 1,380; average paddy field area: 0.7 ha<br>(2) Land preparation method · yield<br>Mechanical tillling: 14%; tilling manually or by beast of burden: 86%; yield: 2.5 t/ha<br>(3) Animal husbandry · plantation crops<br>Nos. of livestock raised: cattle: 356 head; water buffalo: 273 head; goat: 108 head<br>Mataguma is advantageous area for rubber cultivation<br>(4) Agricultural support service<br>Reed cultivation is supported by the district agricultural office through womens meetings and other cooperation |
| Polwatte Ganga Scheme | | (1) Land use · farm households<br>Paddy cropped area: 560 ha; cropping rate: 100%; no. of farm households: 933; average paddy field area: 0.6 ha<br>(2) Land preparation method · yield<br>Mechanical tillling: 14%; tilling manually or by beast of burden: 47%; mechanical tillling: 29% of production cost; fertilizer cost: 31% of the same; amount of fertilzer applied: 400 kg/ha; yield: 3.0 t/ha<br>(3) Animal husbandry<br>Nos. of livestock raised: cattle: 224 head; water buffalo: 112 head; goat: 36 head<br>(4) Agricultural support service<br>Agricultural extension: by the Agrarian Services Department |
| Thangalu Welyaya | 395 | (1) Land use · farm households<br>Paddy cropped area: 474 ha; cropping rate: 120%; no.of farm households: 360; average paddy field area: 1.1 ha<br>(2) Crop production cost · yield<br>Fertilizer cost: 31% of the crop production cost; yield: 3.0 t/ha<br>(3) Animal husbandry<br>Nos. of livestock raised in Tangalle D.S. division: cattle: 10,890 head; water buffalo: 16,900 head<br>(4) Agricultural support service<br>Agricultural extension: by the Agricultural Department (central government) |

## 5.5 Status of Farmer Organizations and System Management

Although there are farmer organizations in all the scheme areas of the Study area, the degree of organization and activities of the FOs vary greatly due to factors of system scale, functions performed, and organizational maturity. Organizing agencies and related programs with regards to FOs for each scheme are as follows.

***Organizing Agencies and Related Programs***

| Scheme | Sub-scheme | Organizer | Program |
|---|---|---|---|
| Liyangastota: | Walawe LB | IMD | INMAS |
| | Walawe RB | ID | MANIS |
| Muruthawela Reservoir: | Muruthawela L | IMD | INMAS |
| | Urubokka Oya | ID | MANIS |
| | Kirama Oya | ID | MANIS |
| Badagiriya: | | IMD | INMAS |
| Polwatte Ganga: | | DAS | |
| Benthara Ganga: | | DAS | |
| Thangalu Welyaya: | | DAS | |
| Kachigala Ara: | | DAS | |

ID: Irrigation Department
IMD: Irrigation Management Division
DAS: Department of Agrarian Services

### (1) Integrated Management of Major Irrigation Systems (INMAS) Program

The Integrated Management of Major Irrigation Systems (INMAS) program came about as a result of a growing awareness in the 1980's that farmer participation was essential to effective management of irrigation systems. The program is targeted at large scale irrigation systems nation-wide, from among which 35 candidate schemes were selected and the active participation of beneficiary farmers promoted through establishment of a joint farmer / government management framework for unified O&M activities under the schemes. The program aims at enhanced efficiency and sustainability of system O&M basis on organization of farmer groups. Preceding the start of the program, the Ministry of Lands and Land Development (now MIPE) established an internal Irrigation Management Division (IMD) that has functioned as the central agency for execution of the program beginning in 1984.

Organization of farmers is in accordance with the following procedure:

(i) Establishment of Field Canal Groups (FCG)

(ii) Integrating of the relevant FCGs on a distribution canal basis under D Canal Organizations (DCO)

(iii) Establishment of Sub-project Management Committees (SPMC) for a group of DCO

SPMC members comprise representative farmers of the DCOs and concerned staff of related government agencies (Irrigation Department, Agricultural Department, Agrarian Services Department, etc.)

(iv) Establishment of Project Management Committees (PMC)

The PMC acts on behalf of the entire scheme, with a Project Manager appointed by the IMD acting as the committee chairman. Other committee members comprise representative farmers from the scheme area and concerned staff of related government agencies. Regulations (under irrigation law) governing the committees call for representative farmers to account for at least 50% of the PMC members. The PMC coordinates the O&M activities for the entire scheme. The PMC meets prior to the commencement of each cropping season to discuss and decide on the following:

- First and last dates of water issue
- Start of the tilling season
- Cropping pattern for the season
- Procedures for O&M of the system for the year
- Guidelines to govern the activities of the FOs

PMCs have been established for the Badagiriya, Muruthawela LB and Liyangastota WLB schemes in conjunction with the implementation of the INMAS program. Under this framework, the FOs have functioned effectively in the area of system management.

(2) Management of Irrigation Systems (MANIS) Program

The MANIS program has been carried out by the ID targeted at medium scale irrigation schemes which do not fall under the umbrella of the INMAS program (aimed at large scale schemes). In principle, the goals of farmer organization under the MANIS program are the same as for the INMAS program; however, although SPMC level committees have been established, there are cases were PMC have not been set up. In the case of Urubokka oya and Kirama oya, level of FO development has stopped at farmer organization by anicut unit.

In the case of Badagiriya, farmer organization on a total scheme basis has been achieved. In the case of the Liyangastota and Muruthawela schemes, however, organization of farmers is according to sub-scheme, with the functions of FOs in some areas within the sub-schemes themselves (Kirama oya, Urubokka oya) not as yet fully integrated.

(3) Organizational Activities of the Department of Agrarian Services (DAS)

The INMAS and MANIS programs have carried out farmer organization on a scheme-wise basis. However, since the 1990s, organization of farmers who are not incorporated into the larger or medium scale irrigation schemes has been pursued at the Grama Niladari Division by the DAS.

This is the case of the Polwatte Ganga, Benthara Ganga RB, Thangalu Welyaya and Kachigala Ara Schemes in the Study area. Since villages and irrigation scheme areas do not necessarily coincide, in addition to the fact that the Grama Niladari level FOs are not specifically organized for the purpose of irrigation system management, they do not function at present as system management organizations.

Under the Irrigation Act of 1968, O&M of field canals under large scale irrigation systems is stipulated as the responsibility of the beneficiary farmers, with the government assuming the responsibility for O&M of main canals, tanks, anicuts, etc. As a result of amendment of this legislation in 1994, responsibility for O&M of D-canal facilities and below is to be transferred to the farmers; however, at present the system management framework in practice is that as stipulated by the 1968 legislation. With regards to D-canals, there are instances where the ID sub-contracts responsibility (labor costs) for repair and maintenance works to the FOs in order to promote farmer participation in scheme management.

In the case of the schemes under the Study, official transfer of O&M responsibilities to the farmer organizations has not as yet occurred. However, this has unofficially been done for the Badagiriya scheme.

Regarding the Muruthawela LB and Liyangastota Walawe LB schemes, water management for D-canals and below is done by the FOs. Nevertheless, transfer (unofficial) of responsibility for overall O&M has not take place as of the present.

The ID manages the major facilities under the systems and bears essentially all the O&M costs for the systems. Annual O&M cost ranges Rs 200~400 /ha depending on the scheme.

## 5.6 Environment

The natural and socio environments pertaining to each scheme are described below.

(1) Liyangastota Scheme:

There are no particular problems with regards to soil and water quality. Mangrove forest extends in the area around the Walawe oya estuary downstream of the scheme. Water for potable and domestic purposes is diverted from the Walawe ganga itself. At the upper reaches of the Walawe ganga, which is the water source under this scheme, there is a paper mill which discharges effluents into the river, however, this does not impact adversely on the quality of the river water for agricultural purposes. Small

scale, unauthorized gem mining is done along the left bank intake canal from the Liyangastota anicut and immediately downstream of Ridiyagama tank.

(2) Muruthawela Reservoir Scheme:

There are likewise no particular problems with regards to soil and water quality under this scheme. There is lush mangrove forest around the Urubokka oya estuary which is the target of a SAM (Special Area Management) project. Fishing is done at the Muruthawela reservoir, and a fish farm is located near the intake. In Tract I which comprises the upper-most stream area of the Muruthawela LB scheme, illegal water diversion is a common practice due to the fact that in the past this area has been excluded from the scheme.

(3) Badagiriya Scheme:

Field survey indicated no problems with soil quality, and a saline concentration at the water source which is within a tolerable range. The Bundala Bird Sanctuary, a registered wetland under the Ramsar Treaty, is located downstream of the scheme area and is habitat to various rare species of water fowl and other wildlife.

(4) Kachigala Ara Scheme:

Water quality at the water source exhibits no problems, although the soil in the downstream area of the scheme shows the effects of sea water intrusion. The area is one of poor drainage due to excessive inflow of discharge from Uda Walawe upstream. Kalametiya and Lunama lagoons have been designated as nature reserves and contain mangrove forest and the habitats of various rare wildlife species.

(5) Benthara Ganga Right Bank Scheme:

Soil shows the effects of sea water intrusion. Significantly poor drainage is seen in the scheme area with reed being cultivated in areas not suitable for other crops. Mangrove forest extends around the estuary area, however, rare wildlife species are not found therein. Also, there are instances where facilities such as flap gates set between canals and the river have been damaged by fishermen through efforts to allow fish into the canals. At the river mouth, a small pier has been constructed for launches carrying tourists.

(6) Polwatte Ganga Scheme:

Soil shows the effects of sea water intrusion. Evidence of sea water intrusion is confirmed to 10 km upstream from the river mouth. Biodiversity in the scheme area is low.

(7) Thangalu Welyaya Scheme:

The soil in the downstream portion of the scheme area shows the effects of sea water intrusion. The scheme area is poorly drained due to blockage of the river mouth at Rekawa lagoon. Around 285 fishermen trawl for shrimp in the Rekawa lagoon. Mangrove forest surrounds the lagoon which is designated as a SAM project area.

# *CHAPTER 6*

# *CHAPTER 6 FORMULATION OF REHABILITATION PLAN*

## 6.1 Basic Approach

Formulation of the rehabilitation plan was carried out with focus on the following points identified from experience and lessons learned from past irrigation rehabilitation projects carried out in Sri Lanka.

(1) Adoption of a participatory approach to project formulation whereby the views and aspirations of concerned Government officials and directly affected farmers in target benefit areas are carefully sounded and reflected in project planning.

(2) Need to strengthen existing farmer organizations to allow for efficient and sustainable operation and maintenance of the schemes after rehabilitation through the maximum participation of FOs in O&M activities.

(3) Upgrading of the function of deteriorated facilities to a level commensurate with the present level of demand for irrigation and drainage in the scheme areas. Likewise the system management capabilities of farmer organizations will be upgraded.

(4) Formulation of a practical, cost effective project.

## 6.2 Rehabilitation Plan for Irrigation Schemes

### 6.2.1 Engineering Aspects which Require Special Note under Project Planning

On the basis of field survey, particular attention was given to the following points in formulating the rehabilitation plan for irrigation schemes.

(1) Present Water Balance

In the case of schemes which incorporate tank facilities, the discharge observation records of the ID where applied in analyzing irrigation conditions over the past 10 years (a total of 20 cases for both Yala and Maha seasons), and the results of the same are reflected in the rehabilitation plan. The same procedure was applied to schemes which divert directly from rivers.

| | |
|---|---|
| Tank schemes (4): | Liyangastota WLB, Muruthawela LB, Urubokka Oya, Badagiriya |
| River diversion schemes (2): | Liyangastota WRB, Kirama Oya |

(2) Design Water Balance

The rehabilitation plan aims at an expanded and appropriate irrigated area size through effective utilization of the tank facilities, increased irrigation efficiency after rehabilitation, and economy of water use through the introduction of upland crops and lesser emphasis on strictly paddy production.

(3) Level of Facility Upgrade

Principal facilities under the schemes comprise tanks, discharge gauging facilities, main canals, distribution canals and field 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.

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 effect efficient and rational water use.

Main canals:

Segments of canals where discharge carrying cross-section is insufficient, and turnout facilities which have collapsed or otherwise experienced severe deterioration will be rehabilitated. Canal lining method will in principle be a combination of unlined, and lining with brick and mortar. However, where necessary, concrete and stone masonry lining will be adopted.

Distribution canals:

D-canals and equivalent branch canals will be rehabilitated to include appropriate O&M roads along the canals on the assumption that these are to be transferred under the project to the jurisdiction of the farmer organizations.

Field canals:

Rehabilitation of these is to be done by the farmers themselves, and are therefore excluded from the scope of 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.

(4) Scope of Canal Rehabilitation

Scope of canal rehabilitation is to cover main and distribution canals in line with the envisioned future O&M strategy for the schemes. Field canal rehabilitation is to be done by the farmers themselves, and these are therefore excluded from the scope of the project. Lining of rehabilitated canal segments will be by brick and mortar, and stone masonry, as these materials can be readily obtained by the farmers, and in a manner to facilitate repair and maintenance works in the future.

(5) Kachigala Ara Scheme

On the basis of discussions with the ID, it was agreed to exclude this scheme from the Project in light of the fact that it is included under the Uda Walawe development project upstream.

(6) Cost Estimate Criteria

Cost of rehabilitation works for the irrigation schemes was computed applying the following criteria.

1) Unit prices

Unit prices as determined by the ID (1994) were adopted for materials and construction quantities.

2) Direct construction cost criteria

Canal rehabilitation:

In accordance with design canal section, 7 cross-sections for brick and mortar lined segments, and 4 cross-sections for unlined canal segments were adopted for cost calculation.

Structures:

These comprise 9 types, i.e. intakes, turnouts, regulators, drops, undercrossings, spillways, over bridges, parshall flumes and aqueducts. The foregoing structures were further grouped according to 2 scales of cross-section.

Anicuts:

These are divided into locations which require overall rehabilitation and locations which require only partial rehabilitation. Also, the scope of repair required for upstream and downstream embankment protection works was determined from the results of field survey. With regards to gate costs, Japanese domestic prices were applied as reference, as there are no criteria available for such prices inside Sri Lanka.

3) Indirect construction cost criteria

Rates conventionally applied inside Sri Lanka were adopted:

| | | |
|---|---|---|
| Land acquisition cost: | 0.5 | % of direct construction cost |
| Administrative cost: | 5 | % of direct construction cost |
| Engineering services: | 8 | % of direct construction cost |
| Physical contingency: | 15 | % of direct construction cost |
| Price contingency: | 10 | % of direct construction cost and the total for all of the above |

4) Others

The various programs related to rehabilitation such as staff and farmer training, etc. are not included in the Project cost. It is anticipated that these would be achieved under the on-going INMAS and MANIS programs.

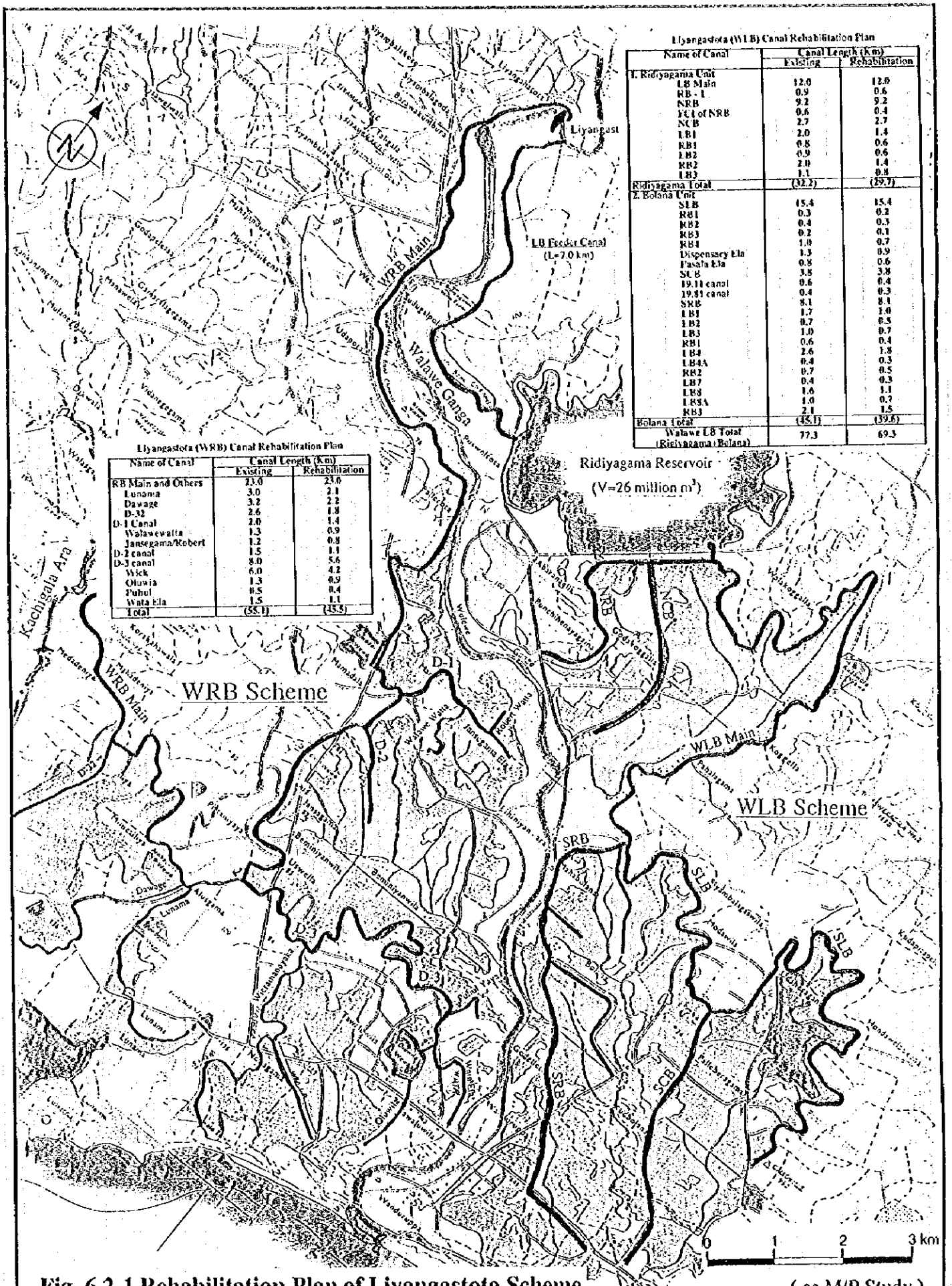
Exchange rate: US$ 1 = Rs 50

Foreign portion · local portion ratios: F/C (20%) ; L/C (80%)

### 6.2.2 Rehabilitation Plan Outline and Construction Cost

Rehabilitation plan outline and construction cost are as per below. A plan of the schemes is shown in the immediately following pages.

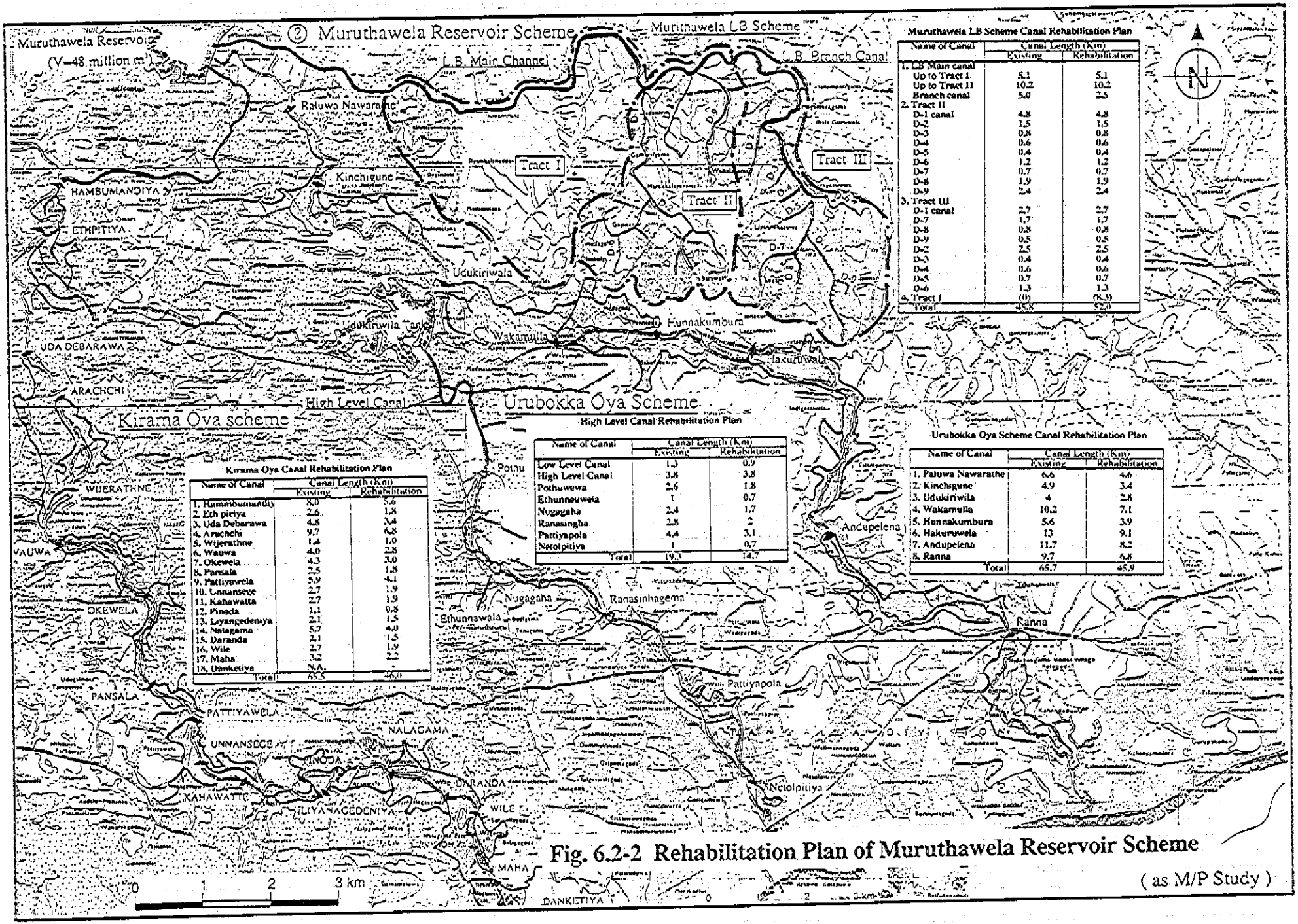
<table>
<tr><th>Scheme</th><th>Main rehabilitation works</th><th>Construction cost<br>(Rs '000,000)</th></tr>
<tr><td>Liyangastota Scheme<br>(6,049 ha)<br>WRB = 3,282 ha<br>WLB = 2,767 ha</td><td>WLB / WRB<br>(1) Rehabilitation of Liyangastota Anicut and RB, LB intake facilities<br>(2) Feeder canal rehabilitation<br>(3) Repair of Ridiyagama Tank<br>(4) Main and D-canal rehabilitation: total length = 114.8 km<br>(5) Rehabilitation of appurtenant structures: total of 725 locations</td><td>472.6<br>(US$ 1,544 / ha)</td></tr>
<tr><td>Muruthawela Reservoir Scheme<br>(6,149 ha)<br>LB Main = 1,698<br>Urubokka Oya = 2,175 ha<br><br>Kirama Oya = 2,276</td><td>LB main canal<br>(1) Rehabilitation of intake gate and installation of discharge gauging facility<br>(2) Rehabilitation of aqueducts and main canal<br>(3) Rehabilitation of D-canals and appurtenant facilities
<table>
<tr><th>Sub-scheme</th><th>Main canal</th><th>Appurtenant facilities</th></tr>
<tr><td>LB Main</td><td>51.6 km</td><td>610</td></tr>
<tr><td>Urubokka</td><td>60.6</td><td>sites</td></tr>
<tr><td>Kirama</td><td>46.0</td><td>539</td></tr>
<tr><td>Total</td><td>158.2 km</td><td>1,856 sites</td></tr>
</table></td><td>483.8<br>(US$ 1,574 / ha)</td></tr>
<tr><td>Badagiriya Scheme<br>(703 ha)</td><td>(1) Main and D-canal rehabilitation: total length = 20.6 km<br>(2) Rehabilitation of appurtenant structures: total of 725 locations<br>(3) Rehabilitation of 86 ha of farm land</td><td>52.8<br>(US$ 1,501 / ha)</td></tr>
</table>




| Liyangastota (WLB) Canal Rehabilitation Plan | | |
|---|---|---|
| Name of Canal | Canal Length (Km) | |
| | Existing | Rehabilitation |
| 1. Ridiyagama Unit | | |
| LB Main | 12.0 | 12.0 |
| RB - 1 | 0.9 | 0.6 |
| NRB | 9.2 | 9.2 |
| FCL of NRB | 0.6 | 0.4 |
| NCB | 2.7 | 2.7 |
| LB1 | 2.0 | 1.4 |
| RB1 | 0.8 | 0.6 |
| LB2 | 0.9 | 0.6 |
| RB2 | 2.0 | 1.4 |
| LB3 | 1.1 | 0.8 |
| Ridiyagama Total | (32.2) | (29.7) |
| 2. Bolana Unit | | |
| SLB | 15.4 | 15.4 |
| RB1 | 0.3 | 0.2 |
| RB2 | 0.4 | 0.3 |
| RB3 | 0.2 | 0.1 |
| RB4 | 1.0 | 0.7 |
| Dispensary Ela | 1.3 | 0.9 |
| Pasala Ela | 0.8 | 0.6 |
| SCB | 3.8 | 3.8 |
| 19.11 canal | 0.6 | 0.4 |
| 19.81 canal | 0.4 | 0.3 |
| SRB | 8.1 | 8.1 |
| LB1 | 1.7 | 1.0 |
| LB2 | 0.7 | 0.5 |
| LB3 | 1.0 | 0.7 |
| RB1 | 0.6 | 0.4 |
| LB4 | 2.6 | 1.8 |
| LB4A | 0.4 | 0.3 |
| RB2 | 0.7 | 0.5 |
| LB7 | 0.4 | 0.3 |
| LB8 | 1.6 | 1.1 |
| LB8A | 1.0 | 0.7 |
| RB3 | 2.1 | 1.5 |
| Bolana Total | (45.1) | (39.6) |
| Walawe LB Total (Ridiyagama+Bolana) | 77.3 | 69.3 |

| Liyangastota (WRB) Canal Rehabilitation Plan | | |
|---|---|---|
| Name of Canal | Canal Length (Km) | |
| | Existing | Rehabilitation |
| RB Main and Others | 23.0 | 23.0 |
| Lunama | 3.0 | 2.1 |
| Davage | 3.2 | 2.2 |
| D-32 | 2.6 | 1.8 |
| D-1 Canal | 2.0 | 1.4 |
| Walawewatta | 1.3 | 0.9 |
| Jansegama/Robert | 1.2 | 0.8 |
| D-2 canal | 1.5 | 1.1 |
| D-3 canal | 8.0 | 5.6 |
| Wick | 6.0 | 4.2 |
| Oluvia | 1.3 | 0.9 |
| Puhul | 0.5 | 0.4 |
| Wata Ela | 1.5 | 1.1 |
| Total | (55.1) | (45.5) |

**Fig. 6.2-1 Rehabilitation Plan of Liyangastota Scheme** ( as M/P Study )




**Muruthawela LB Scheme Canal Rehabilitation Plan**

| Name of Canal | Canal Length (Km) Existing | Rehabilitation |
|---|---|---|
| 1. LB Main canal | | |
| Up to Tract I | 5.1 | 5.1 |
| Up to Tract II | 10.2 | 10.2 |
| Branch canal | 5.0 | 2.5 |
| 2. Tract II | | |
| D-1 canal | 4.8 | 4.8 |
| D-2 | 1.5 | 1.5 |
| D-3 | 0.8 | 0.8 |
| D-4 | 0.6 | 0.6 |
| D-5 | 0.4 | 0.4 |
| D-6 | 1.2 | 1.2 |
| D-7 | 0.7 | 0.7 |
| D-8 | 1.9 | 1.9 |
| D-9 | 2.4 | 2.4 |
| 3. Tract III | | |
| D-1 canal | 2.7 | 2.7 |
| D-7 | 1.7 | 1.7 |
| D-8 | 0.8 | 0.8 |
| D-9 | 0.5 | 0.5 |
| D-2 | 2.5 | 2.5 |
| D-3 | 0.4 | 0.4 |
| D-4 | 0.6 | 0.6 |
| D-5 | 0.7 | 0.7 |
| D-6 | 1.3 | 1.3 |
| 4. Tract I | (0) | (8.3) |
| Total | 45.8 | 52.0 |

**Kirama Oya Canal Rehabilitation Plan**

| Name of Canal | Canal Length (Km) Existing | Rehabilitation |
|---|---|---|
| 1. Hambumandiya | 8.0 | 5.6 |
| 2. Eth piriya | 2.6 | 1.8 |
| 3. Uda Debarawa | 4.8 | 3.4 |
| 4. Arachchi | 9.7 | 6.8 |
| 5. Wijerathne | 1.4 | 1.0 |
| 6. Wauwa | 4.0 | 2.8 |
| 7. Okewela | 4.3 | 3.0 |
| 8. Pansala | 2.5 | 1.8 |
| 9. Pattiyawela | 5.9 | 4.1 |
| 10. Unnansege | 2.7 | 1.9 |
| 11. Kahawatta | 2.7 | 1.9 |
| 12. Pinoda | 1.1 | 0.8 |
| 13. Liyangedeniya | 2.1 | 1.5 |
| 14. Natagama | 5.7 | 4.0 |
| 15. Daranda | 2.1 | 1.5 |
| 16. Wile | 2.7 | 1.9 |
| 17. Maha | 3.2 | 2.2 |
| 18. Danketiya | N.A. | - |
| Total | 65.5 | 46.0 |

**High Level Canal Rehabilitation Plan**

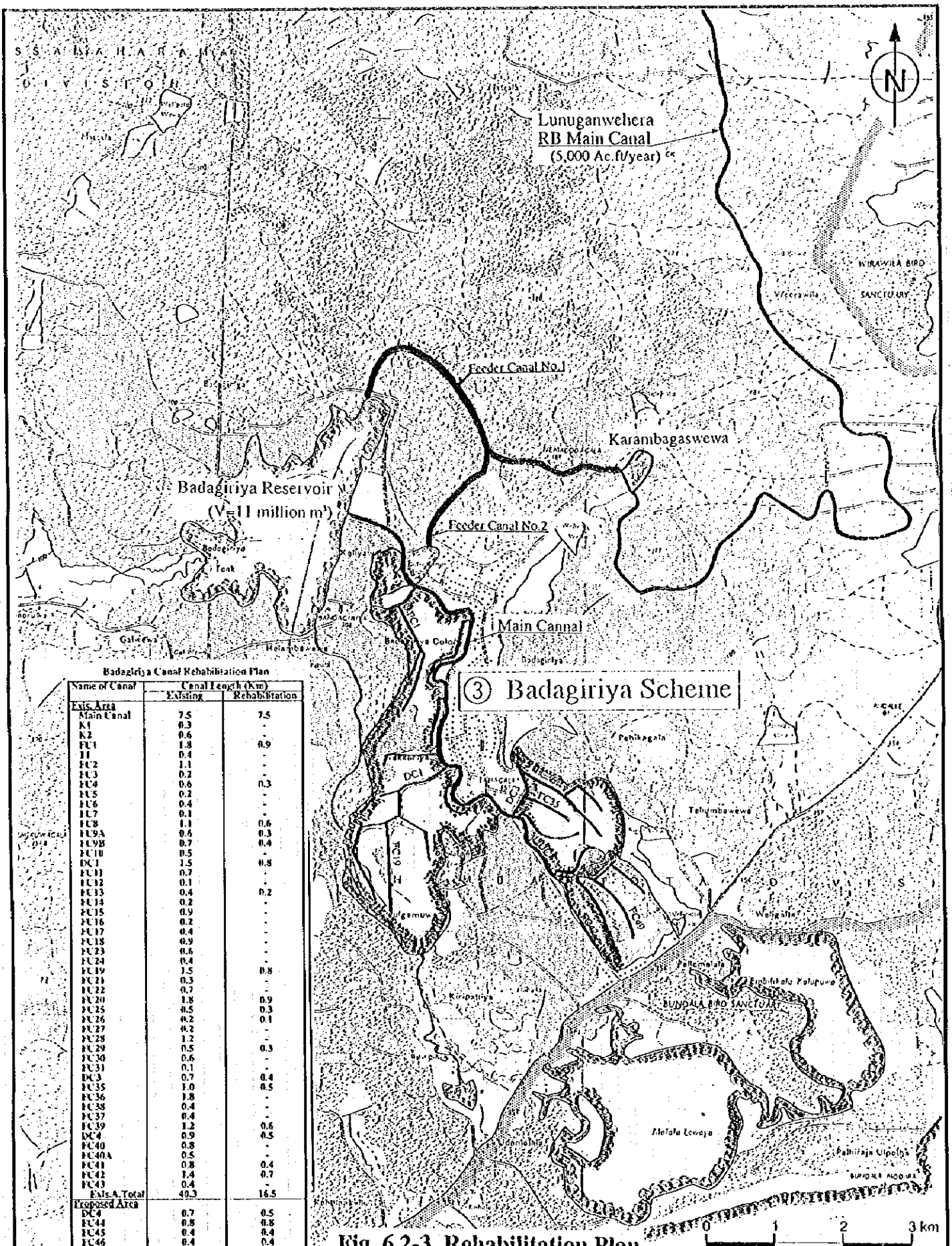
| Name of Canal | Canal Length (Km) Existing | Rehabilitation |
|---|---|---|
| Low Level Canal | 1.3 | 0.9 |
| High Level Canal | 3.8 | 3.8 |
| Pothuwewa | 2.6 | 1.8 |
| Ethunneuwela | 1 | 0.7 |
| Nugagaha | 2.4 | 1.7 |
| Ranasingha | 2.8 | 2 |
| Pattiyapola | 4.4 | 3.1 |
| Netolpitiya | 1 | 0.7 |
| Total | 19.3 | 14.7 |

**Urubokka Oya Scheme Canal Rehabilitation Plan**

| Name of Canal | Canal Length (Km) Existing | Rehabilitation |
|---|---|---|
| 1. Paluwa Nawarathe | 6.6 | 4.6 |
| 2. Kinchigune | 4.9 | 3.4 |
| 3. Udukiriwila | 4 | 2.8 |
| 4. Wakamulla | 10.2 | 7.1 |
| 5. Hunnakumbura | 5.6 | 3.9 |
| 6. Hakuruwela | 13 | 9.1 |
| 7. Andupelena | 11.7 | 8.2 |
| 8. Ranna | 9.7 | 6.8 |
| Total | 65.7 | 45.9 |

**Fig. 6.2-2 Rehabilitation Plan of Muruthawela Reservoir Scheme**

( as M/P Study )




Badagiriya Canal Rehabilitation Plan

| Name of Canal | Canal Length (Km) | |
|---|---|---|
| | Existing | Rehabilitation |
| Exis. Area | | |
| Main Canal | 7.5 | 7.5 |
| K1 | 0.3 | - |
| K2 | 0.6 | - |
| FC1 | 1.8 | 0.9 |
| J1 | 0.4 | - |
| FC2 | 1.1 | - |
| FC3 | 0.2 | - |
| FC4 | 0.6 | 0.3 |
| FC5 | 0.2 | - |
| FC6 | 0.4 | - |
| FC7 | 0.1 | - |
| FC8 | 1.1 | 0.6 |
| FC9A | 0.6 | 0.3 |
| FC9B | 0.7 | 0.4 |
| FC10 | 0.5 | - |
| DC1 | 1.5 | 0.8 |
| FC11 | 0.7 | - |
| FC12 | 0.1 | - |
| FC13 | 0.4 | 0.2 |
| FC14 | 0.2 | - |
| FC15 | 0.9 | - |
| FC16 | 0.2 | - |
| FC17 | 0.4 | - |
| FC18 | 0.9 | - |
| FC23 | 0.6 | - |
| FC24 | 0.4 | - |
| FC19 | 1.5 | 0.8 |
| FC21 | 0.3 | - |
| FC22 | 0.7 | - |
| FC20 | 1.8 | 0.9 |
| FC25 | 0.5 | 0.3 |
| FC26 | 0.2 | 0.1 |
| FC27 | 0.2 | - |
| FC28 | 1.2 | - |
| FC29 | 0.5 | 0.3 |
| FC30 | 0.6 | - |
| FC31 | 0.1 | - |
| DC3 | 0.7 | 0.4 |
| FC35 | 1.0 | 0.5 |
| FC36 | 1.8 | - |
| FC38 | 0.4 | - |
| FC37 | 0.4 | - |
| FC39 | 1.2 | 0.6 |
| DC4 | 0.9 | 0.5 |
| FC40 | 0.8 | - |
| FC40A | 0.5 | - |
| FC41 | 0.8 | 0.4 |
| FC42 | 1.4 | 0.7 |
| FC43 | 0.4 | - |
| Exis.A.Total | 40.3 | 16.5 |
| Proposed Area | | |
| DC4 | 0.7 | 0.5 |
| FC44 | 0.8 | 0.8 |
| FC45 | 0.4 | 0.4 |
| FC46 | 0.4 | 0.4 |
| FC47 | 0.6 | 0.6 |
| FC48 | 0.6 | 0.6 |
| FC49 | 0.8 | 0.8 |
| Pro.A.Total | 4.3 | 4.1 |
| Total | 44.6 | 20.6 |

**Fig. 6.2-3 Rehabilitation Plan of Badagiriya Scheme**

( as M/P Study )

## 6.3 Rehabilitation Plan for Drainage Schemes

### 6.3.1 Points of Special Note in Planning

On the basis of field survey, particular attention was given to the following points in formulating the rehabilitation plan for drainage schemes.

(1) In the case of the large drainage schemes currently on-going in the Southern Region, pumped drainage has been adopted in addition to natural drainage, requiring the construction of large scale pump systems. This places a heavy financial burden on the ID with regards to operation and maintenance costs. Furthermore, pumped drainage causes concern over impacts on fishing operations and ecosystems downstream. As a result, adoption of pumping systems will be minimized to the extent possible, and instead priority will be given to gravity drainage systems.

(2) The plan will attempt to salvage the maximum residual value of existing structures. Construction of new facilities will thus be minimized to the extent possible, and planned only where absolutely needed. The function of existing facilities will be expanded to meet the required level of function under the Project.

(3) Rehabilitation will be such that O&M of structures is facilitated, on the assumption that responsibility for operation and maintenance will be transferred to the farmers in the future.

(4) Appropriate facility scale will be determined with reference to past projects of a similar nature carried out in Sri Lanka.

(5) In determining design flood and design discharge, flood with a return period of 10 years has been applied, in light of the fact that the Project is targeted primarily at farm land, in order to avoid schemes of exaggerated scale.

### 6.3.2 Rehabilitation Plan Outline and Construction Cost

Rehabilitation plan outline and construction cost are as per below. A plan of the schemes is shown in the immediately following pages.

| Scheme | Main rehabilitation works | Construction cost (Rs '000,000) |
|---|---|---|
| Bentara Ganga Right Bank Scheme (965 ha) | Rehabilitation Plan - I<br>(1) Dredging and cross-section improvement for 17.3 km of existing irrigation cum<br>(2) New construction of 6.6 km of minor drainage canal | 173.5<br>(US$ 3,596 / ha) |
| Powatte Ganga Scheme (560 ha) | (1) Major renovation of the function of the Ilwatta Anicut. The 3 existing gates are to be made electrically operated and an operation deck installed to allow gate<br>(2) Rehabilitation of 4 anicuts and new construction of 3 anicuts<br>(3) Dredging and cross-section improvement for 12.5 km of existing irrigation cum | 163.4<br>(US$ 1,574 / ha) |
| Thangalu Welyaya Schem (395 ha) | (1) Installation of 1 unit of 0.5 m³/sec pump<br>(2) New construction of 8.6 km of main drainage canal<br>(3) New construction of 9.7 km of branch canal<br>(4) Existing SWE structures No. 8 and No. 9 | 52.8<br>(US$ 5,979 / ha) |

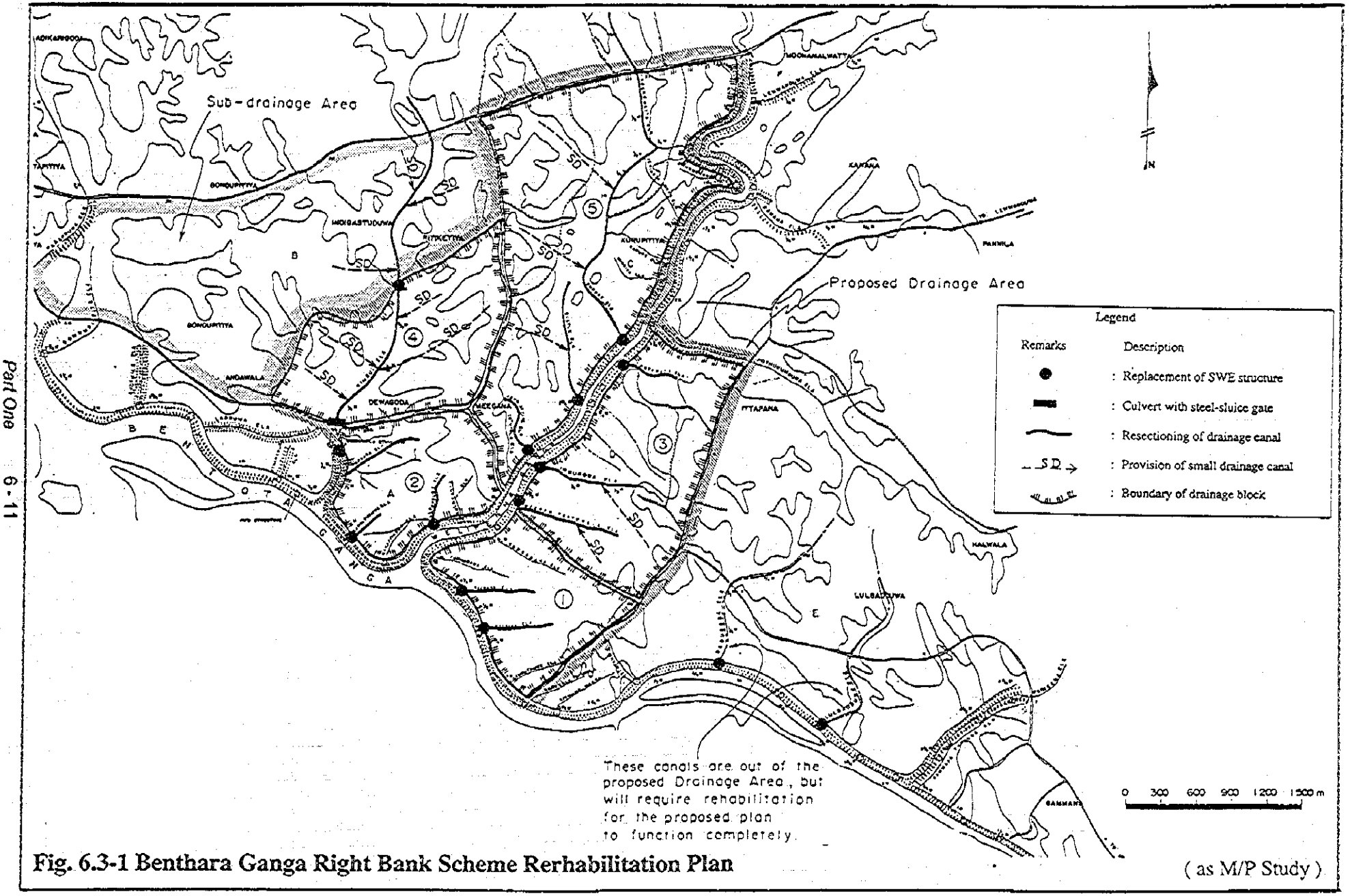



**Fig. 6.3-1 Benthara Ganga Right Bank Scheme Rerhabilitation Plan**

( as M/P Study )

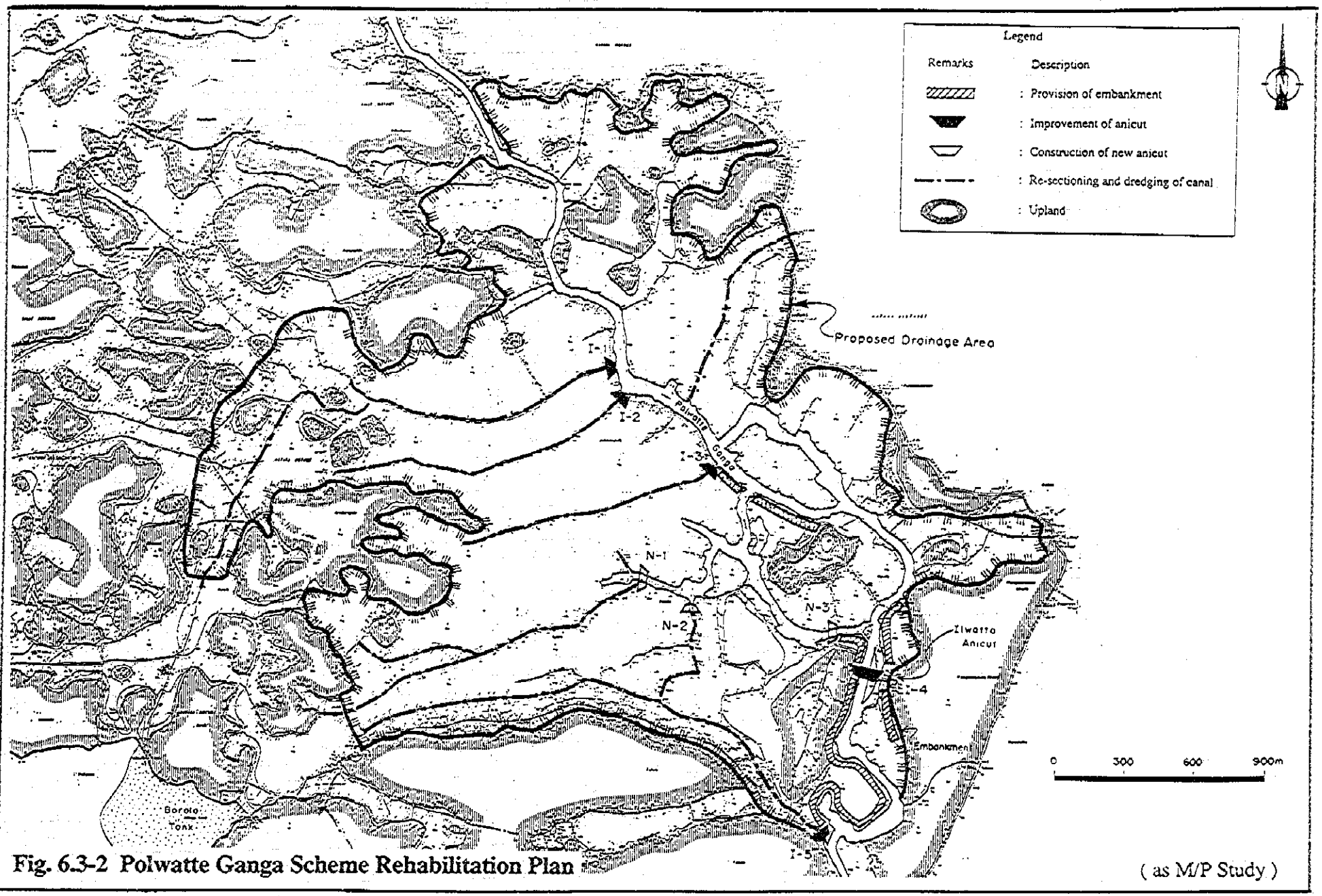



**Fig. 6.3-2 Polwatte Ganga Scheme Rehabilitation Plan** ( as M/P Study )

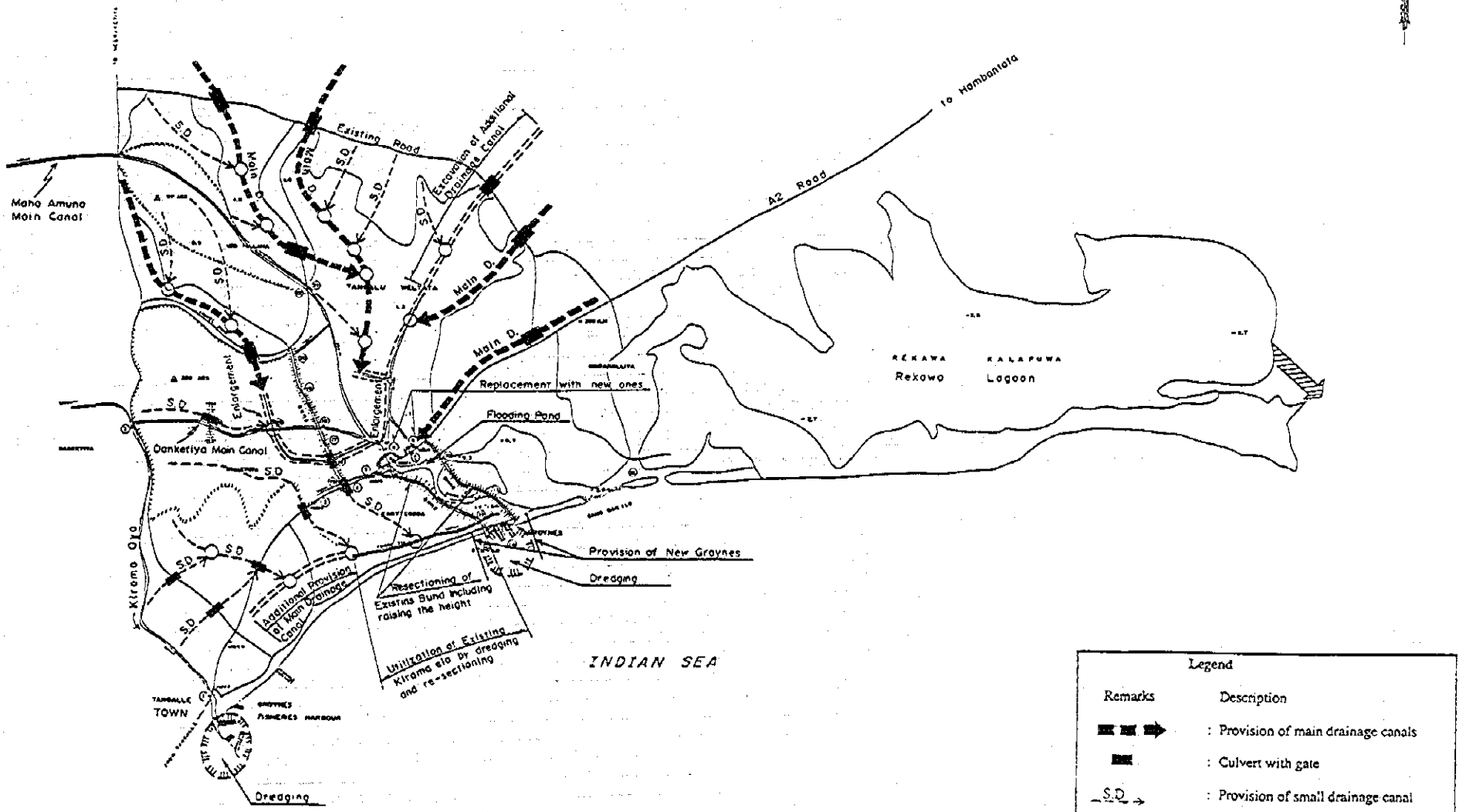



**Fig. 6.3-3 Thangalu Welyaya Scheme Rihabilitation Plan**

( as M/P Study )

## 6.4 Agricultural Development

### 6.4.1 Basic Concept

As a result of analysis of the constraints and development potential of each scheme, farmers and extension works in the major scheme areas of the Study area expressed low interest in altering cropping patterns through the introduction of OFCs. However, in the case of the Badagiriya and Muruthawela schemes which suffer from chronic water shortage, the possibility of realizing a structural modification of the cropping pattern is high.

Accordingly, consideration was given the following factors in formulating the basic strategy for agricultural development, i.e. (i) promoting increased production of paddy which accounts for the great majority of the cultivated area under the schemes, (ii) introduction of OFCs in accordance with conditions prevailing in specific scheme areas, (iii) selection of appropriate OFC types and (iv) establishment of effective agricultural extension.

(1) Increased production of paddy

Availing of improved water management, irrigation and drainage at the field level, unit paddy yield is planned to increase by 50% utilizing good quality seed and efficient fertilizer application.

(2) Introduction of OFCs in accordance with conditions prevailing in specific scheme areas

1) The Badagiriya and Muruthawela LB scheme areas suffer from chronic water shortage, and the farmers in these areas not only have had experience with OFCs in the past but show a keen interest in the further introduction of OFCs. Accordingly, a large scale introduction (over 30% of annual cropping rate) of OFCs into this areas is considered possible. The majority of farmers in the areas are independent farmers, and paddy holdings are large at 1 ha per household. Level of farmer organization development, and agricultural support and extension set up for these areas is superior than that of other schemes under the Study.

2) Water supply is relatively ample in the case of other schemes (Liyangastota, Urubokka, the upper basin of Kirama Oya). Tenant farming is common in these areas, and paddy holdings are small at 0.4 ha per household. As a result of these factors, farmer interest in the introduction of OFCs is low. Furthermore, level of farmer organization development, and agricultural support and extension set up for these areas is also low. In the surrounding area, some chena cultivation of OFCs is observed. Introduction of OFCs into these scheme areas would be anticipated to be to a level below 10% of annual cropping rate.

3) In the case of the drainage schemes (Benthara RB, Polwatte, Thangalu), introduction of reed into inundated paddy field areas would be possible drawing on the experience in the Benthara area. However, an appropriate target for cropping scale is 5% of annual cropping rate given factors of marketability, etc.

(3) Selection of appropriate OFC types

Chilies, onions, vegetables, pulses, maize, sesame, etc. are the OFCs generally mix-cropped with paddy. Unit yields for such OFCs as pulses (cowpea, green gram, soy bean, peanuts), maize and sesame are less than half that for paddy. Favorable yields are limited to chilies, onions and some vegetables. The foregoing crops also have the problem of being labor intensive. The greatest constraint on the introduction of onion and vegetables is the instability of market prices.

Accordingly, chilies are planned as the dry season OFC to be introduced under the Project. The market price for chilies is stable, and farmers show a keen interest in its cultivation. It is recommended that the Ruhunu variety be promoted as it is a local variety unique ot the Southern Province region and has high resistance to viral infection.

In recent years, there has been increased introduction of banana into the Uda Walawe and Kirindi oya project areas, which have suffered from water shortage, as a perennial upland crop. The possibility of similar introduction into the scheme areas under the Study should be further investigated in detail at the feasibility study stage.

(4) Reorganizing the extension set-up

In the case of all the schemes, agricultural extension is the responsibility of AIs (agricultural instructors). However, area of responsibility per single AI reaches up to 2,000 ha, and in some cases the AIs are part-time. It is thus necessary under the Project to assign a full time AI to each scheme area to operate out of each Project Manager's office.

### 6.4.2 Present and Design Cropping Pattern

The currently farmed 3.5 month variety of paddy is to continue to be cultivated under the Project. Some 4~4.5 month variety paddy would be promoted for Maha season cultivation in the Liyangastota, Muruthawela and Badagiriya scheme areas. OFCs would primarily comprise chilies. The present and design cropping patterns are indicated below.

| Scheme | | Present (ha) | | Design (ha) | |
|---|---|---|---|---|---|
| Liyangastota Scheme | Paddy | 9,458 | (155%) | 11,630 | (190%) |
| | OFC | -- | | 612 | (10%) |
| | Total | 9,458 | (155%) | 12,242 | (200%) |
| Muruthawela Reservoir Scheme | Paddy | 8,141 | (132%) | 10,310 | (168%) |
| | OFC | -- | | 1,080 | (17%) |
| | Total | 8,141 | (132%) | 11,390 | (185%) |
| Badagiriya Scheme | Paddy | 844 | (120%) | 984 | (140%) |
| | OFC | 42 | (6%) | 422 | (60%) |
| | Total | 886 | (126%) | 1,406 | (200%) |
| Benthara Ganga RB Scheme | Paddy | 630 | (65%) | 1,255 | (130%) |
| | OFC | 20 | (2%) | 48 | (5%) |
| | Total | 650 | (67%) | 1,303 | (135%) |
| Polwatte Ganga Scheme | Paddy | 560 | (100%) | 840 | (150%) |
| | OFC | -- | | 28 | (5%) |
| | Total | 560 | (100%) | 868 | (155%) |
| Thangalu Welyaya Scheme | Paddy | 474 | (120%) | 671 | (170%) |
| | OFC | -- | | 20 | (5%) |
| | Total | 474 | (120%) | 691 | (175%) |

note: ( ) indicate cropping rate

### 6.4.3 Design Cultivation Method

(1) Inspected seed is to be used.

(2) Application amount for fertilizer to achieve unit yield of 5~5.5 t/ha is 450 kg/ha.

### 6.4.4 Target Yield and Production

(1) Target yield for the Liyangastota, Muruthawela and Badagiriya schemes is a year round 5.5 t/ha, and the same for the Benthara, Polwatte and Thangalu schemes is 5.0 t/ha.

(2) Chilies is selected at the OFC under the Project, and target yield is 1,000 kg/ha with the project as opposed to 450 kg/ha without the project.

(3) Target production amounts are indicated below.

| Scheme | Benefit area | Without project | | With project | |
|---|---|---|---|---|---|
| | | Cropped area | Production | Cropped area | Production |
| (1) Liyangastota | | | | | |
| Paddy | 6,121 ha | 8,985 ha | 27,494 t | 11,630 ha | 63,965 t |
| OFC | | | | 612 ha | 612 t |
| (2) Muruthawela | | | | | |
| Paddy | 6,149 ha | 7,734 ha | 24,362 t | 10,310 ha | 56,705 t |
| OFC | | | | 1,080 ha | 1,080 t |
| (3) Badagiriya | | | | | |
| Paddy | 703 ha | 802 ha | 2,598 t | 984 ha | 5,412 t |
| OFC | | 40 ha | 18 t | 422 ha | 422 t |
| (4) Benthara | | | | | |
| Paddy | 965 ha | 599 ha | 1,378 t | 1,255 ha | 6,275 t |
| Reeds | | 20 ha | 80 t | 48 ha | 192 t |
| (5) Polwatte | | | | | |
| Paddy | 560 ha | 532 ha | 1,436 t | 840 ha | 4,200 t |
| Reeds | | 0 ha | 0 t | 28 ha | 112 t |
| (6) Thangalu | | | | | |
| Paddy | 395 ha | 450 ha | 1,215 t | 671 ha | 3,355 t |
| Reeds | | 0 ha | 0 t | 20 ha | 80 t |

(4) Yields are compared in the table below.

***Comparison of Yields***

(unit: t/ha)

| Yield | Present | Without project | With project |
|---|---|---|---|
| 1. Paddy yield | | | |
| (1) Liyangastota | 3.40 | 3.06 | 5.50 |
| (2) Muruthawela Reservoir | 3.50 | 3.15 | 5.50 |
| (3) Badagiriya | 3.60 | 3.24 | 5.50 |
| (4) Benthara Ganga RB | 2.50 | 2.30 | 5.00 |
| (5) Polwatte Ganga | 3.00 | 2.70 | 5.00 |
| (6) Thanagalu Welyaya | 3.00 | 2.70 | 5.00 |
| 2. Chili yield | | | |
| (1) Liyangastota | -- | -- | 1.00 |
| (2) Muruthawela Reservoir | -- | -- | 1.00 |
| (3) Badagiriya | 0.50 | 0.45 | 1.00 |
| 3. Reed yield | | | |
| (1) Benthara Ganga RB | 4.00 | 4.00 | 4.00 |
| (2) Polwatte Ganga | -- | -- | 4.00 |
| (3) Thanagalu Welyaya | -- | -- | 4.00 |

(Reference material : Paddy target yield)

Uda Walawe Irrigation Development Project (target yield) 5.5 t/ha

Mahaweli System H (1991/92 target yield) 5.5 t/h

Mahaweli System G (1991/92 target yield) 5.5 t/h

Agricultural Implementation Programme (Hambantota district 1994/95 target yield) 4.3~4.9 t/ha

(5) Cropping rates are as shown below.

***Comparison of Cropping Rates***

| Scheme | Crop | Season | Present (ha) | | Without project (ha) | | With project (ha) | |
|---|---|---|---|---|---|---|---|---|
| (1) Liyangastota | Paddy | Maha | 5,786 | (95%) | 5,497 | (90%) | 6,121 | (100%) |
| | | Yala | 3,672 | (60%) | 3,488 | (57%) | 5,509 | (90%) |
| | | Total | 9,458 | (155%) | 8,985 | (147%) | 11,630 | (190%) |
| | Chili | Yala | -- | | -- | | -- | |
| | Total | | 9,458 | (155%) | 8,985 | (147%) | 11,630 | (190%) |
| (2) Muruthawela | Paddy | Maha | 5,076 | (82%) | 4,794 | (78%) | 5,824 | (95%) |
| | | Yala | 3,095 | (50%) | 2,940 | (48%) | 4,486 | (73%) |
| | | Total | 8,141 | (132%) | 7,734 | (126%) | 10,310 | (168%) |
| | Chili | Maha | -- | | -- | | 326 | (5%) |
| | | Yala | -- | | -- | | 754 | (12%) |
| | | Total | -- | | -- | | 1,080 | (17%) |
| | Total | | 8,141 | (132%) | 7,734 | (126%) | 11,390 | (185%) |
| (3) Badagiriya | Paddy | Maha | 605 | (86%) | 575 | (82%) | 492 | (70%) |
| | | Yala | 239 | (34%) | 227 | (32%) | 492 | (70%) |
| | | Total | 844 | (120%) | 802 | (114%) | 984 | (140%) |
| | Chili | Maha | 14 | (2%) | 13 | (2%) | 211 | (30%) |
| | | Yala | 28 | (4%) | 27 | (4%) | 211 | (30%) |
| | | Total | 42 | (6%) | 40 | (6%) | 422 | (60%) |
| | Total | | 886 | (126%) | 842 | (120%) | 1,406 | (200%) |
| (4) Benthara Ganga RB | Paddy | Maha | 340 | (35%) | 323 | (33%) | 676 | (70%) |
| | | Yala | 290 | (30%) | 276 | (29%) | 579 | (60%) |
| | | Total | 630 | (65%) | 599 | (62%) | 1,255 | (130%) |
| | Reed | Perennial | 20 | (2%) | 20 | (2%) | 48 | (5%) |
| | Total | | 650 | (67%) | 619 | (64%) | 1,303 | (135%) |
| (5) Polwatte Ganga | Paddy | Maha | 336 | (60%) | 319 | (57%) | 504 | (90%) |
| | | Yala | 224 | (40%) | 213 | (38%) | 336 | (60%) |
| | | Total | 560 | (100%) | 532 | (95%) | 840 | (150%) |
| | Reed | Perennial | -- | | -- | | 28 | (5%) |
| | Total | | 560 | (100%) | 532 | (95%) | 868 | (155%) |
| (6) Thangalu Welyaya | Paddy | Maha | 198 | (50%) | 188 | (48%) | 316 | (80%) |
| | | Yala | 276 | (70%) | 262 | (66%) | 355 | (90%) |
| | | Total | 474 | (120%) | 450 | (114%) | 671 | (170%) |
| | Reed | Perennial | -- | | -- | | 20 | (5%) |
| | Total | | 474 | (120%) | 450 | (114%) | 691 | (175%) |

note: ( ) indicate cropping rate

## 6.5 Plan to Strengthen Farmer Organizations and Improve Management System

### 6.5.1 Level of Farmer Organization

Farmer organizations in the scheme areas have been classified on the basis of an analysis of the degree of organizational maturity and nature of group activities. FO nature and activities in the most developed areas of Sri Lanka were applied as a criteria in dividing the said level of FO development in the Project area into 5 classifications. In line with these levels, mid-term goals (3~5 years) for specific strengthening and improvement of FOs were set.

***Classification Criteria for Farmer Organization Level***

| Item / Level: | 1 | 2 | 3 | 4 | 5 | Remarks |
|---|---|---|---|---|---|---|
| 1) % of farmer participation in OF | ~90 | ~70 | ~60 | ~50 | 50 or less | |
| 2) Degree of overall scheme organization | O | O | | | | |
| Degree of overall sub-scheme organization | | | O | Δ | | |
| 3) Agrarian Service Act | | | | | | |
| Registration | O | O | O | O | O | Section 56A |
| Project approval | O | | | | | Section 56B |
| 4) Existing and active PMC | O | O | O | | | |
| 5) Transfer of responsibility for D-canals and below | | | | | | |
| Official transfer | O | | | | | |
| Unofficial transfer | | O | | | | |
| 6) Input ~ output support service | O | O | | | | Purchase of fertilizer, agrochemicals; support in marketing of farm products |

O Achieved
Δ Partially achieved
× Unachieved

On the basis of the above criteria, each scheme (sub-scheme) is classified by level as follows:

Level 1 : no scheme applicable in the Study area
Level 2 : Badagiriya
Level 3 : Muruthawela LB, Liyangastota WLB, Liyangastota WRB
Level 4 : Urubokka Oya, Kirama Oya
Level 5 : Polwatte Ganga, Benthara Ganga RB, Thangalu Welyaya

### 6.5.2 Targets under Strengthening of Farmer Organizations

The mid-term objective for strengthening of FOs in each scheme area is to upgrade these to level 1 over a 3~5 year period.

(1) Level 5 Group

All the drainage scheme areas fall within this group. In contrast to the irrigation schemes aimed at water distribution, the delimitation of benefit areas is not so clear and a communal consciousness towards the systems on the part of the beneficiary farmers is not well developed. As a result, farmer organization at the scheme level has not yet occurred. A joint management program between the relevant government agencies and the FOs has as yet not been planned. At present, the facilities are operated and managed by the ID; however, facility deterioration, budget constraints and lack of farmer participation have created a serious situation. It is accordingly essential to organize farmers in the target areas and upgrade these FOs to level 4 even before rehabilitation works under the envisioned Project commence. This will require formulation and implementation by the government of a joint management program for the drainage schemes.

(2) Level 4 Group

The Urubokka Oya and Kirama Oya sub-schemes of the Muruthawela Scheme belong to the level 4 group. Both sub-schemes draw water directly from the river, and operate essentially as independent systems. Although the ultimate future goal in order to maximize all water use in the Muruthawela Scheme would be to integrate all the FOs of the scheme area over the long term, a more immediate goal is to first integrate the FOs on a sub-scheme basis, and establish PMCs at this level. Joint meetings between the PMCs twice yearly at each planting season would start the road toward eventual integration at the entire scheme level.

In the Urobokka Oya sub-scheme area, there are 23 FOs organized on a anicut~canal system-wise basis. There are 22 such FOs in the Kirama Oya sub-scheme area.

Common problem in both sub-scheme areas is that the activities of the individual FOs drawing from the same river source have not been integrated. There is no communication between the separate FOs, and no PMC has been established. At present, the diversion systems upstream naturally enjoy priority of water use. In order to effect efficient water use throughout the entire sub-scheme area, a PMC should be set up for each source river which would thereby immediately upgrade the sub-schemes to the level 3 group. It is recommended that this be done under the present MANIS program.

(3) Level 3 Group

PMCs for overall scheme areas have not been established yet for the Muruthawela and Liyangastota schemes. In the case of the Muruthawela scheme, as discussed above, PMCs for sub-schemes have not been set up either. However, in the case of the Walawe LB and Walawe RB sub-schemes of the Liyangastota scheme, PMCs have been established and although they do not conduct joint meetings at present, inauguration of such meetings would in effect mean the integration of the sub-scheme FOs and preparations to effect this are now in progress. On the other hand, as discussed earlier, integration of FOs in the Kirama Oya and Urubokka Oya sub-schemes has not been done at the sub-scheme level, and establishment of PMCs for each sub-scheme area and setting the activities of the same on track is a primary goal to be pushed for over the mid-term.

Simultaneous to upgrading the level of farmer organization to level 3 for the entire scheme area as discussed above, the commencement of agricultural cooperative activities by FOs including the procurement of farm inputs and support in marketing of farm products and strengthening of the FO financial base would open the road to the elevation of the schemes to the level 2 group.

(4) Level 2 Group

There are not level 1 scheme areas in the Study area; however, the Prarakrama Samudra (10,000 ha), Minneriya (9,000 ha) and the Kandulla (5,000 ha) schemes of the North Central Province have achieved this status. In these areas, the FOs have entered into official contract with the ID for O&M of D-canals and below. Furthermore, the FOs have been granted in effect corporate status under the Agrarian Service Act to carry out various agricultural cooperative activities on an entrepreneurial basis.

Applying the above as reference, the services by FOs in the Badagiriya scheme area with regards to purchase of inputs and support in the marketing of farm products, and the FO financial base are to be further strengthened and the O&M responsibility for D-canals and below officially transferred to the FOs.

Although the ultimate long term goal is to upgrade all schemes to the level 1 group, the immediate procedure under the Project would be to improve the FOs on a stage-wise basis as discussed above.

The above FOs strengthening is premised on a continuation of the INMAS and MANIS programs. To augment this, new programs must be implemented in the scheme areas not covered under the foregoing 2 programs.

### 6.5.3 Improvement of System Management

The level of government spending on operation and maintenance of irrigation and drainage facilities has remained fixed, and in effect has steadily decreased in real terms year by year. As national policy, it is thus highly desirable that responsibility

for D-canals and below be transferred to the FOs. To achieve this, the strengthening of farmer organizations as discussed in the previous section is essential.

At present, all facilities with the exception of field canals are managed by the ID. However, budget and manpower constraints have resulted in deterioration of schemes as a result of reduced capacity of canals to carry discharge (sediment buildup in canals, vegetation growth on the inner side of canal embankments, embankment collapse in some locations, etc.). Also, access along O&M roads is often poor.

The facilities currently under the responsibility of the ID have been maintained by permanently employed labor staff; however budget constraints have prevented maintaining adequate numbers of personnel, vehicles and equipment to efficiently carry out the required O&M works. Accordingly, as a long-term future goal, it is necessary to restructure the system management capacity of the ID. To achieve this, it is planned that the current O&M structure at the individual scheme level be improved, and a management unit established at the district level to manage the efficient deployment of equipment and personnel for O&M works on a priority basis. As a long term goal, dispatch of material and staff from the management unit would be on a request basis by the FOs, with the FOs bearing such costs as that for required labor and fuel in order to support the sustainability of the unit.

## 6.6 Environmental Conservation Plan

### 6.6.1 Basic Approach

The environmental conservation plan has been formulated in line with the following basic strategy:

1) Alleviation of poverty
2) Preservation of biodiversity
3) Effective use of land resources
4) Maximum farmer participation in project implementation and upgrading of awareness of environmental safety
5) Women in development

(1) Alleviation of poverty

Alleviation of poverty through the rehabilitation project is necessary as well from the standpoint of improving the social environment.

Under the Muruthawela LB irrigation sub-scheme, Tract-I at the extreme upstream of the system, although originally intended to be included in the scheme, has in effect been excluded over the past 25 years due to various land ownership issues, etc. As a result, illegal diversion of irrigation discharge along the main canal of the scheme has continued over the years in Tract I. By effectively incorporating Tract I within the scheme under the Project, cohesiveness of the area community would be promoted and poverty alleviated through the increased agricultural production as a result of the rehabilitation works.

Approximately 80 ha of abandoned farm land exists at the extreme downstream part of the Badagiriya scheme area. Since its settlement 1958, the scheme area has suffered chronic water shortage (which was addressed in 1986 by commencement of supplemental water supply via the Kirindi Oya RB main canal) resulting in the abandonment of the aforementioned downstream area. Rehabilitation under the Project would allow this area to be revived as farm land, and the increased farm production in the scheme area would contribute to alleviation of poverty in the area.

(2) Preservation of biodiversity

The area downstream of the Badagiriya scheme is registered under the Ramsar Treaty, and officially designated as a bird sanctuary. The Project will be formulated to avoid impacts to this area. In this regard, careful attention will be given to appropriate application amounts of fertilizer during cultivation after project implementation. Careful attention as well will be given in planning to any possible impacts to the downstream preserve as a result of increased drainage volume from the scheme.

(3) Effective use of land resources

Rather than relying on the exploitation of new resources to expand productivity, this goal is to be achieved under the Project through the upgrading of the yield of existing farm land under cultivation through the application of modern farming technologies. Rehabilitation works as well will in principle be directed at existing structures with minimal use of new land for facilities sites or canal alignments.

(4) Maximum farmer participation in project implementation and upgrading of awareness of environmental safety

Through active participation of the beneficiary farmers in the planning and implementation of the rehabilitation works, it is intended to instill in the same a heightened awareness of the important role of irrigation and drainage facilities as rural infrastructure. Also, the awareness of farmers regarding the need for care in the use of canal water for miscellaneous domestic purposes (laundry, utensil washing, etc) as this common practice in the scheme areas can be a source of spread of various water borne diseases.

(5) Women in development

More active participation of women in farmer groups is to be promoted under the Project. Further to this, awareness of the community with regards to the need to reduce the heavy labor burden on women needs to be heightened, and the consciousness of young female homemakers needs to be strengthened with regards to the dangers of unsanitary and unsafe practices in domicile maintenance.

### 6.6.2 IEE (Initial Environmental Examination)

The IEE was carried out by the checklist method for each scheme in order to identify present conditions in the areas and reflect this in project planning. The evaluation is carried out according to the 5 factors of (i) environmental factors due to site situation, (ii) environmental factors from oversights in planning and design, (iii) problems during construction stage, (iv) problems in operation, and (v) overall environmental review criteria. The IEE was carried out in accordance with the National Environment Act No. 47 (1980), and the regulations of the CEA with regards to IEEs / EIAs.

***RESULTS OF IEE***

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

Legend

| | | | |
|---|---|---|---|
| Liy | ; Liyangastota Scheme | ns | : No Significance |
| Mur | ; Muruthawela Reservoir Scheme | 1 | : Small Significance |
| Bad | ; Badagiriya Scheme | 2 | : Moderate Significance |
| Kch | ; Kachigala Ara Scheme | 3 | : Major Significance |
| Ben | ; Benthara Ganga Right Bank Scheme | - | : Negative Impact |
| Pol | ; Polwatte Ganga Scheme | + | : Positive Impact |
| Tha | ; Thangalu Welyaya Scheme | | |

### 6.6.3 Environmental Conservation Plan

The environmental conservation plan is as follows in terms of (i) agency jurisdiction, and (ii) measures on a scheme wise basis. (note: G = responsibility of the relevant Sri Lankan government agency; P = responsibility of executing agencies under the Project)

(1) Environmental conservation activities by agency jurisdiction:

1) Basin conservation

- Protection of bare land during rubber plantation replanting (G)
- Controls on chena cultivation (P)
- Strengthening of legal controls on unmanaged gem mining

2) Biodiversity

- Monitoring of impact on downstream wetlands of drainage discharge from the schemes containing agro-chemical and fertilizer runoff (P)
- Check and mitigating measures for impacts from effluents discharged from paper mill (G)
- Preservation of mangrove forests adjacent to schemes (G, P)

3) Soil salinity

The Project will, through facility rehabilitation, reduce sea water intrusion. However, further to this, the following will be studied:

- Introduction of salt resistant crop varieties (P)
- Modification of land use in areas where saline intrusion is severe (P)

4) Contamination of water areas by agro-chemicals and fertilizers

- Monitoring including collection of base data (G, P)
- Instruction and training in appropriate use of agro-chemicals and fertilizers

5) Impacts during Project construction

6) Monitoring (G, P)

- Monitoring is to be carried out in 3 stages, i.e., before construction, during construction, and after construction

(2) Scheme-wise environmental conservation plan:

The following plan has been formulated from the findings of the IEE.

Liyangastota scheme

- Conservation of the socio-economic environment through recovery of the intended function of deteriorated irrigation facilities
- Effluent (black liquor) treatment and establishment of wastewater standards for the discharge from the upstream paper mill, in order to control river water contamination (G)

Muruthawela Reservoir scheme

- Incorporation of Tract-I into the scheme (P)
- Preservation of mangrove forest around the Kirama oya estuary (G)

Badagiriya scheme

- Monitoring ot impact of drainage discharge on the downstream Bundala National Park (bird sanctuary) (P)
- Integration with legally recognized agricultural schemes downstream (P)

Benthara Ganga RB scheme

- Flood control (P)

Polwatte Ganga scheme

- Control of flooding and sea water intrusion (P)

Thangalu Welyaya scheme

- Management and water quality monitoring of drainage discharge into Rekawa lagoon (G)
- Preservation of mangrove forest (G, P)

## 6.7 Project Evaluation

Under economic evaluation of the Project, profitability of each scheme was assessed according to the 3 criteria of net present value, benefit / cost ratio and internal rate of return (IRR). The financial evaluation centers on analysis of the farm economy.

Base conditions of Project evaluation are as follows:

(1) Under the future-without-project case, it is assumed that operational condition of existing irrigation facilities will progressively decline, resulting in increased deterioration of the facilities and increased irrigation conveyance losses in turn causing a decrease in cropped area and unit yield. This period is assumed to begin from the 10 year (including the construction period) from commencement of the Project.

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

(3) Financial prices of traded goods are based on 1994 domestic market prices, while international market prices for the year 2000 (based on World Bank forecasts) are adopted for economic prices. Farm gate prices of paddy and fertilizer are computed after eliminating transfer payments and applying an appropriate conversion factor.

(4) An estimated value of 10% is applied as the opportunity cost of capital.

(5) The official exchange rate as of December 1994 of US$ 1 = Rs 50 is adopted.

(6) Operation and maintenance costs are assumed at Rs 300 / ha for all three cases of present, future-without-project, and future-with-project; however, in the case of the pump scheme under the Project, pump operating cost has also been included.

On the basis of the above, the EIRR for the Liyangastota, Muruthawela and Badagiriya schemes is above 20%, indicated a high degree of economic viability. Sensitivity analysis for the same 3 schemes indicates as well that their economic robustness is not significantly affected by reasonably anticipated increase in project costs or decline in benefit.

***PROJECT EVALUATION INDICATORS***

(unit: Rs. 1,000)

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

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

Farm economy analysis aims to calculate the annual income increase for both land owner cultivators and tenant cultivators in the case of project implementation. The cost amounting to Rs100/ha for O/M of irrigation facilities after rehabilitation are taken into consideration in computing farm income. Accordingly, incremental incomes for owner cultivators are estimated to range between 2.3 and 7.5 fold over present levels, of which those for paddy cultivation range from 1.5 and 3.5 fold. In the case of tenant cultivators, there are two types of tenancy contract: (i) where the tenant turns over 25% of total rice production to the land owner, and (ii) where the

tenant turns over 10 bushels/ac (Kalutara, Galle and Matara districts) or 14 bushels/ac (Hambantota) of rice to the land owner, based on the Agrarian Services Act. Applying these as analysis criterion, annual incremental income of the tenant cultivators is also anticipated to increase significantly from the present situation.

# *Chapter 7*

# *CHAPTER 7 SELECTION OF THE SCHEMES*

## 7.1 Criteria for Selection of the Schemes

Schemes to be the subject of feasibility study were selected according to the following 3 criteria.

(1) Degree of Farmer Organization

Based on a realization that the active participation by farmer organizations at both planning and construction stages is the corner stone in effectively implementing a participatory type rehabilitation project, each scheme area was classified according to level of FO development as discussed in Chapter 6. Schemes belonging to the lowest level (level 5) were subsequently eliminated from consideration for feasibility study on the conclusion that farmer organization development was too immature to participate effectively at the project planning stage.

Accordingly, only schemes with FO development at level 4 or above would be eligible for consideration for feasibility study.

(2) Economic Viability

Schemes with EIRR of 15% or more would be eligible for consideration for feasibility study.

(3) Size of Benefit Area

It is desirable that under the Project the maximum agricultural production base is established. Based on Sri Lanka's past experience with assistance from international donor agencies, etc., schemes to be considered to for feasibility study should have a total benefit area of 10,000 ha or more.

## 7.2 Ranking of the Schemes

(1) Degree of Farmer Organization

The level of FO development is ranked as follows. In line with the previous section, level 5 schemes are eliminated from consideration for feasibility study.

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

(2) Economic Viability

Schemes are ranked as indicated below on the basis of economic evaluation. Schemes ranked 4, 5 and 6 have been eliminated from consideration for feasibility study due to significantly low EIRR.

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

(3) Benefit Area

Total benefit area of the schemes selected on the basis of (1) and (2) above is as shown below, and meets the selection criterion of being at least 10,000 ha or more.

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

## 7.3 Schemes Selected for Feasibility Study

On the basis of the above, the following schemes have been selected for feasibility study:

(1) Badagiriya Scheme

(2) Liyangastota Scheme

(3) Muruthawela Reservoir Scheme

# *CHAPTER 8*

# *CHAPTER 8 CONCLUSION AND RECOMMENDATIONS*

(1) The Study area has the potential to play a major role in the modernization of the agricultural sector in southern Sri Lanka. The accelerated regional economic growth and expanded production activities that would result from the Project can be expected to contribute significantly to rectifying skewed levels of development between sectors and regions, and to the alleviation of poverty of the area.

(2) 25~100 years have elapsed since construction of the irrigation and drainage facilities in the Study area, during which period the Sri Lanka government has undertaken to operate and maintain the same. However, against the background of a trend, not only in Sri Lanka but world-wide as well, to cut back on agricultural subsidies and encourage the beneficiaries themselves of agricultural development projects to bear an increasing share of the cost and responsibility for the success of such projects, it is necessary to strengthen the function of the 180 farmer organizations in the Study area, and instill a spirit of self-help and self-reliance in the farmers towards achieving sustainable and stable agriculture in the area.

(3) A facility rehabilitation project fits well within the context of the Sri Lankan government's environmental strategy in that it is aimed at the upgrading, through the application of modern agricultural technologies, of the productivity of existing land under cultivation rather than the exploitation of new water and land resources. This contributes to the avoidance of sacrificing additional natural resources to meet increased food consumption as a result of population growth.

(4) With regards to the 3 drainage schemes under the Master Plan which were not taken up for feasibility study, it is considered appropriate that these would be incorporated into the Shared Control of Resources (SCOR) program targeted at all the basins of the country.

# *Part 2: Feasibility Study*

# *Chapter 1*

# *CHAPTER 1 INTRODUCTION*

## 1.1 Study Objective and Scope

Based on the Scope of Works signed between the governments of Sri Lanka and Japan in September 1994, the JICA Study Team carried out a Master Plan Study (Phase I) during January~April, 1995, on the basis of which schemes were selected for subsequent Feasibility Study. This Main Report comprises the Final Feasibility Study Report for the foregoing, and compiles the findings of field survey (Phase II) and related home office works.

The Phase II study works were aimed at survey of the 3 irrigation schemes (total benefit area: 11,165 ha) proposed for feasibility study under the Master Plan, comprising the following study area.

| Scheme | Sub-scheme | Benefit area (ha) | District |
|---|---|---|---|
| Liyangastota | Walawe RB | 2,454.0 | Hambantota district |
| | Walawe LB | 2,553.4 | |
| | Sub-total | 5,007.4 | |
| Muruthawela Reservoir | LB Main | 1,700.1 | Hambantota district |
| | Urbokka Oya | 2,261.9 | |
| | Kirama Oya | 1,510.5 | |
| | Sub-total | 5,472.5 | |
| Badagiriya | Badagiriya | 686.0 | Hambantota district |
| | Sub-total | 686.0 | |
| Total | | 11,165.9 | |

## 1.2 Description of Phase II

Field Survey (January~April, 1996)

(1) Irrigation and drainage facility survey

1) Damage survey of irrigation and drainage canal facilities

2) Assessment survey in the field of major facilities requiring rehabilitation based on topomapping prepared by the JICA Study Team during June~October 1995.

3) Location survey of facilities to be rehabilitated and survey of scope of rehabilitation

4) Rehabilitation design criteria survey

(2) Agricultural sector survey

1) Present cropping pattern: Study on type of farm management, differentials in crop yields, crop diversification and introduction of new varieties.

2) Survey of current status future planning with regards to agricultural related agencies and research entities

(3) Farmer economy survey

1) PRA (Participatory Rural Appraisal) of farmer organizations in the 3 target scheme areas

2) Distribution and marketing system

3) Economic survey for project evaluation

(4) Operation and maintenance survey

1) Detailed survey of attitudes and intentions of area farmers and related government agencies, and status of collection of water use tariffs as a basis for formulating an sustainable system O&M framework

2) Survey of above in other on-going project areas

3) Survey of farmer organization activities

4) Survey of present irrigation ordinance, management set up of the Irrigation Department (ID), level of O&M know-how and technology, and content of training programs in this regard

(5) Environmental survey

1) As a basis for formulating an environmental conservation plan, survey of agricultural drainage (fertilizer and agro-chemical runoff etc.), water borne diseases, impacts on natural parks, soil erosion, sanitation, etc. of the Project area

2) Survey of status of environmental protection programs in progress in areas in the vicinity of the Project area

3) Survey of officially required procedure for IEE / EIA in the F/S scheme areas and confirmation of the necessity for implementing the same

Home office works (May~July, 1996)

The following plans were formulated on the basis of the results of Phase I (Master Plan study) and Phase II (January~April, 1996) study.

(1) Rehabilitation plan for irrigation and drainage related facilities

(2) Operation and maintenance plan

(3) Agricultural development plan

(4) Environmental conservation plan

(5) Project implementation plan

(6) Project monitoring and impact evaluation plan

## 1.3 Study Execution Schedule

The Study was carried out according to the following schedule.

Phase I study (Master Plan Study)

| | | | |
|---|---|---|---|
| (1) | Phase I field survey | : | January 25 ~ April 12, 1995 |
| (2) | Phase I home office work | : | April 13 ~ June 12, 1995 |
| (3) | Interim Report submittal and approval | : | June 19~27, 1995 |
| (4) | Topomapping preparation | : | June 19 ~ October 16, 1995 |

Phase II study (Feasibility Study)

| | | | |
|---|---|---|---|
| (1) | Phase II field survey | : | January 21 ~ April 19, 1996 |
| (2) | Phase II home office work | : | May 3 ~ July 6, 1996 |
| (3) | Draft Final Report submittal and approval | : | July 15 ~ July 23, 1996 |
| (4) | Submittal of Final Report | : | September 1996 |