DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

VOLUME III

ANNEX - X ENVIRONMENTAL IMPACT STUDY

JANUARY, 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

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Annex - X

Environmental Impact Survey

EXECUTIVE SUMMARY

This report examines the environmental consequences of the proposed Walawe Irrigation Upgrading and Extension Project (Left Bank), in keeping with government's decision to examine projects for long-term environmental stability. In brief, the project aims to upgrade the irrigation infrastructure in the developed area of the left bank (Old Area), and to provide irrigation water to a relatively undeveloped area further south (Extension Area).

Based on national policy objectives namely, (a) increasing production of basic food commodities through rehabilitation and extension of irrigation facilities, and (b) establishing agro-industries in order to increase employment opportunities and incomes, the project pursues the following strategies:

- upgrading existing irrigation facilities covering (gross) 15,000 ha in the Old Area (which is already developed), to provide an adequate, timely and equitable supply of irrigation water on a sustained basis for year-round cropping;

- constructing new irrigation/drainage systems in left bank, thereby enhancing productivity of lands presently under shifting cultivation;

- developing settlements and farm lands suitable for paddy and diversified crops;

- providing economic and social infrastructure such as potable water, health care, roads, education, and other utilities; and

- strengthening agricultural support services, particularly promoting crop diversification.

The project area lies in the Dry Zone and is in the category DL_1, in an agro-ecological classification. Rainfall is mostly from the northeast monsoon, with an average annual fall of around 1,200 mm. Annual and diurnal ranges of temperature are minimal. Wind is a factor that will have a bearing on crops and available water. Flat to rolling landscapes make up the relief of the floodplain basin which is below the southern escarpment of the central hills.

Development of the Walawe basin began in the 1960s and work concentrated mostly in the right bank. However, water resource use in this area has not been optimized and an irrigation improvement project funded by the ADB is currently involved in rehabilitating and improving irrigation facilities.

The left bank has remained quite undeveloped. Of an area of some 30,000 ha, only 5,000 ha have been brought under irrigation. The remaining land is mostly located in the Extension Area. This land is in a degraded state; been subjected to shifting cultivation over a long period. About 6,000 families live in the area, under considerable hardship, and more people operate as migrant farmers, coming into the area during the maha season.

In the yala season some water is supplied by recently rehabilitated small tanks--remnants of the past hydraulic civilization--but supply is not assured as it is dependent upon rainfall. There are numerous conflicts with wild animals to contend with, and the yala season is a very difficult period to the settlers. In addition, to settled farmers, there are many who are beneficiaries of the Janasaviya and Food Stamp programmes. Due to increasing population and land hunger, this situation of people scraping a living off an inhospitable environment, will continue in like manner into the forseable future. Income from crops is supplemented by livestock production--animals in quantity but not in quality. They too suffer during the drought.

In the Old Area, which is already developed, the project will focus on rehabilitation of existing irrigation infrastructure and about 1,000 ha of new irrigation development. Rehabilitation will result in better use of irrigation water, more land for irrigation because the water will now reach hitherto unirrigated areas, and more rational cropping based on land suitability. The Old Area is devoid of any significant wildlife habitats.

In the Extension Area, the project will, by extending the left bank main canal, provide irrigation water to some 5,400 ha of parched land. It will also provide all the basic amenities for a settled, contended life.

What this agricultural ecosystem will replace is a degraded thorny scrub vegetation, the result of shifting cultivation over long periods. Only a pocket of high forest remains at Madunagala-Karambagala. The plant species diversity does not hold rare species and even the animals have dispersed and/or have been poached. The elephant however, has held out, in numbers of 150 to 160, and lives under continuing threat. Likewise, the people also suffer at its hands sacrificing both life and property. Unless some serious thinking takes place, the conflict between man and elephant will result in a 'no win' situation for either.

To the north of the project area is the Uda Walawe National Park and to the northeast lies the proposed Lunugamvehera National Park. To the southeast is the Bundala sanctuary, where elephants are pocketed to some extent, although they do move north towards Ridiyagama, and to the eastern lowlands. The riverine forests have almost disappeared. The old tanks provide food and habitat to both resident and migratory aquatic bird species in large numbers. Forest bird species and those of the open areas also find suitable habitat, and in the case of the migratory species, the Hambantota district serves as the terminus of the Indo-Asian flyway.

Generally, project implementation causes some disruption to natural systems and to people living in such areas, especially if displaced. However, in this instance, the project focuses on, (a) an area that is developed and will benefit from improvements, and (b) an area where natural systems have been degraded, but continues to support people in large numbers amidst great difficulty.

Taking the basin as a whole, some environmental issues remain unresolved at this point of time. These relate to water quality in the Walawe river, that periodically experiences effluent discharge from the paper mill and the distillery. Fears of agricultural pollution have been made but not substantiated by analytical data.

Excessive amounts of chorine and fluorine, make well water in most places unfit for drinking. Malaria is of widespread occurrence. Insecticide poisoning and snake-bite also have proved fatal on numerous occasions.

The inadequacy of drinking water, health care and other utilities impose severe burdens on the people, who, in the Extension Area, are also dictated to by the vagaries of the weather.

Furthermore, the continuing presence of 150 to 160 wild elephants in this area, add to the chores of the people. Elephant-man conflicts if unresolved, will pose a significant threat to the viability of the project in the southern part.

The loss of habitat will not be a major impact, for the reason that, wildlife numbers are already greatly reduced, and the natural vegetation has been transformed into a non-productive type. It will affect some of the terrestrial species but there is the possibility of them moving into other areas. In the new settlements, loss of scrub jungle will be felt in the form of depleted fuelwood supply.

Towards the coastal areas of the project, impacts due to salt water intrusion and those on the Karagan Lewaya have been listed and should be looked at when more data are generated in the light of new development interests of other agencies.

Mitigation of the impacts require attention in the short-, medium- and long-term. In the short-term, and extending over the long-term, resolution of the elephant-man conflict takes precedence. It involves thorough planning, much field work, large amounts of human and financial resources and concerted monitoring. Evacuation of the elephant from in and around the project area should be done through a combination of physical and biological means. Jungle corridors and electric fencing are the major elements in a conservation programme. Evacuation is to be done eastwards into the Badagiriya-Uda Mattala forest pocket. Through the establishment of two jungle corridors; one running northwards from the northern boundary of the Bundala Sanctuary, meeting the other corridor connecting the proposed Uda Walawe - Lunugamvehera corridor, it should be possible to induce movement to the Uda Walawe National Park and to the proposed Lunugamvehera National Park. Careful monitoring of the programme over a period of two to three years and habitat enrichment in nearby protected areas, through provision of water, is recommended.

To compensate the loss of plant cover, planting of tree species along river and canal banks, in tank watersheds, school compounds and in home gardens, is recommended. The spread of aquatic vegetation should be arrested from the very outset. Resort to manual collection and use as manure seem appropriate.

Soil conservation methods should be practised from the time of land clearing. They also relate to bank erosion control along rivers and canals, and in this instance, resort to vegetational methods, will, apart from being cost-effective, have other beneficial effects as well.

Analysis of surface waters for nutrient and pesticide residues, salinity and industrial effluents should be done on a regular basis after the initial analyses have given the required baseline data.

Fuelwood availability and potable water will be two areas of significance to the new settlers, as is primary health care.

The beneficial socio-economic impacts of project implementation far outweigh those less beneficial. The impacts of the latter are categorized into high, moderate and negligible. There is also a category of 'unknowns' where data of a baseline nature are required to help decision-making. The salient beneficial impacts are listed briefly as:

- upliftment of the living standards of the farmers in the Old Area, as a result of upgrading irrigation infrastructure;

- provision of irrigation water to the Extension Area, benefitting thousands of people during two farming seasons;

- use of the small old tanks in a cascade system to optimize water use;

- provision of potable water, fuelwood, health care, education, roads, electricity, communications, marketing and other services as a part of project responsibility;

- increased water availability will enable better plant growth and more favourable habitats to certain types of wildlife, eg. reptiles, amphibians, fish, birds and some mammals, apart from the invertebrate types; and

- on the whole the project will benefit the elephant as meaningful steps will be taken to provide alternate more suitable areas and keep them away from settlements.

Coordination with respect to environmental concerns, and conscientious monitoring to ascertain the environmental health in relation to a number of factors, form important areas of project management. While implementation of the project will not cause significant environmental impacts, attention to post-project management recommendations, is considered crucial to long-term success, and avoiding damage to certain environmental qualities.

ANNEX X ENVIRONMENTAL IMPACT STUDY

Contents

List of Tables

List of Figures

ABBREVIATIONS

ADB	:	Asian Development Bank
AGA	:	Assistant Government Agent
ARS	:	Agriculture Research Station
ARTI	:	Agrarian Research and Training Institute
BOD^3	:	Biological Oxygen Demand after three days
CEA	:	Central Environmental Authority
COD	:	Chemical Oxygen Demand
DA	:	Department of Agriculture
DM	:	Department of Meteorology
DWC	:	Department of Wildlife Conservation
EC	:	Electricity Conductivity
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
GDP	:	Gross Domestic Product
HAB	:	Hambantota
HD	:	Health Department
HIB	:	Human Inhabited Zone
HIRDP	:	Hambantota Integrated Rural Development Project
HUZ	:	Human Uninhabited or Sparsely Inhabited Zone
ID	:	Irrigation Department
IRDP	:	Integrated Rural Development Programme
IUCN	:	International Union for Conservation of Nature and Natural Resources
LHG	:	Low Humic Gley (Soils)
KOISP	:	Kirindi Oya Irrigation and Settlement Project
MASL	:	Mahaweli Authority of Sri Lanka
MEA	:	Mahaweli Economic Agency
NWSDB	:	National Water Supply & Drainage Board
NPC	:	National Paper Corporation
PHI	:	Public Health Instructor
RBE	:	Reddish Brown Earths
RRS	:	Rice Research Station
SRI	:	Sugar Research Institute
SSI	:	Sevenagala Sugar Industries
TV	:	Training and Visits
WHO	:	World Health Organisation

ANNEX X ENVIRONMENTAL IMPACT STUDY

1. INTRODUCTION

1.1 Background

Since the departure of the colonial rulers in 1948, successive governments have planned and carried out economic development in different parts of the country, employing diverse models and theories. Throughout, the common goal has been the improvement of the living standards of the people, the bulk of whom lived, and still do, in relatively undeveloped rural areas. As of 1991, recipients of food stamps numbered 6.7 million, which is 40 percent of the population. Two rounds of the Janasaviya program have benefitted 258,000 families in 52 AGA divisions. People in both categories receive less than Rs 700 as monthly income, which is regarded as the poverty line.

During the post-independent era, various strategies for socio-economic development have been adopted; some receiving more emphasis than others, depending on the political philosophy of the time. The major thrust however, has been towards irrigation development, and colonization of the Dry Zone; agricultural development, primarily achieving self-sufficiency in rice and secondarily in field crops; industrialization; and agrarian reform. Additionally, social infrastructure development also received much attention.

Nearly 45 years after independence, there is yet the need to push forward on very much the same avenues of development. The country has not achieved self-sufficiency in rice consistently, due in recent times to reasons other than agronomic deficiencies. Nevertheless, agriculture continues to be the mainstay of the economy, more so in the rural areas. Industrialization has not made much of an impact in absorbing the unemployed, except in certain geographical areas.

With increasing population, there has been an increasing demand for land. The land-man ratio continued to decrease and is currently 36 ha per person. The mid-year estimated population in 1991 was 17.2 million and is expected to increase to about 20 million by the year 2000, assuming that present fertility levels will continue. The present level of unemployment is 14.4 percent.

One of the major development schemes of the early 1960s focused attention on the resources of the Walawe basin. The headworks at Uda Walawe and some of the irrigation infrastructure were completed in 1967. This was followed by the Asian Development Bank (ADB) financed Walawe Development Project in 1969, aimed at developing approximately 12,000 ha of irrigable land in the right bank. However, due to certain shortcomings in the anticipated performance, the Walawe Irrigation Improvement Project got off the ground in 1986, with the objective of rehabilitating and improving irrigation facilities.

Meanwhile, the left bank area of the Walawe River remained quite undeveloped. Of a productive potential of some 30,000 ha only 5,000 ha had been brought under irrigation. The rest of the land presently remains in a somewhat degraded state, having lost in recent times, almost all of its natural vegetation to shifting cultivation.

People who live in these areas do so under great hardship and barely eke out a living off the land. They are a much battered and bruised lot, and, for want of a better socio-economic environment, will continue to live in these hostile areas. Government is therefore, obliged to provide for these people, as stated in its policy statement, Public Investment, 1990-1994. It spells out the national economic development policy over the next five years. The main goals for the agricultural sector are:

- moving towards a higher degree of self-reliance in basic food commodities such as rice, fish, sugar, pulses and milk;

- increasing the productivity of the tree crop sector to expand export earnings; and

- promoting diversification and encouraging establishment of agro-industries and increasing income and employment opportunities in the rural areas.

The project area now being studied (Fig. 2.1-1), as a result of government proposals for development of the southern region of the country, had been home to a vibrant civilization in ancient times. It has much historical, social, cultural and geographical importance and was referred to as the Ruhunu Rata. The economic mainstay of the people then was agriculture, practiced largely with the help of Walawe water ponded in hundreds of small village tanks, scattered all over the area. R.L.Brohier in his "Ancient Irrigation Works in Ceylon" records:

"There were apparently several anicuts built in ancient times to divert the flow of this river into artificial channels which branch off on either side to the fields and storage tanks..... we might very rightly assume that the one highest up the river was located at a point where the rushing waters took a last plunge before continuing in a sluggish flow through the plains. This important amuna or dam was built across the river some distance upstream from Kaltota".

Shifting cultivation as practiced in the project area, is totally dependent on the vagaries of the weather. It was perhaps an acceptable form of land use in the early times when longer periods of fallow were permissible in the cycle. However, with the present pressure of population, a reducing land-man ratio and unemployment, this farming practice is no longer tenable. It is of little benefit either to man or to the land, and its continuation would result in further land degradation.

In 1987, the government of Sri Lanka requested technical assistance from the government of Japan to undertake a feasibility study in the Walawe left bank area in order to improve the living conditions of the people, using the natural resources available. A preliminary study was made by the Japan International Cooperation Agency(JICA) in late 1990, and the feasibility study began in 1991.

The objectives of the study are:

(i) to formulate comprehensive agricultural water resources development programs in the left bank of the Walawe River improving an area of approximately 30,000 ha of land;

(ii) to conduct feasibility studies on extension of the Walawe left bank canal to develop approximately 15,000 ha situated south of the already developed area; and

(iii) to undertake on-the-job training of government officials during the study period.

1.2 Concepts of Environmental Conservation

Historically, Sri Lanka has had a proud record of environmental conservation. There is ample evidence that both ruler and subject gave recognition to the wise use of natural resources. Different actions in this regard were complemented by religious and ethical beliefs, and contributed to a lasting culture of respect for living beings and sustainable use of all resources.

However, the sequence of events in some areas of resource use during the past century or two, shows a departure from the practices of old. Exploitation rather than conservation had been the order of the day in many areas of resource use. Ironically there are many impressive statutory provisions that explicitly control such use. (But the good intentions were confined to the statute books only). With the granting of independence, there was urgency to advance economically, to increase and be self sufficient in food, to industrialize and to enhance the living standards of the people. The growing population made increasing demands on land, food, housing and employment.

In some areas there have been economic successes as reflected in the country's physical quality of life index, which rivals those indices of developed countries. On the negative side, resource use conflicts began to appear and environmental degradation set in progressively. Economic and political decisions over the years showed a marked tendency to over-ride any serious attempts at conservation.

Since the late 1970s, with the introduction of a new accelerated economic development policy in Sri Lanka, a large number of development projects have been launched both by the public and private sectors. Many of these projects have paid little or no attention to associated environmental consequences. Project approval remained the prerogative of individual institutions responsible for the project concerned. Serious adverse environmental impacts, such as soil erosion, landslides, flooding, loss of valuable flora and fauna, and loss of historical and cultural resources have occured over the years.

Consequently, the need for integrating environmental, economic and social considerations with the planning and decision-making process was realized and the government of Sri Lanka decided to introduce Environmental Impact Assessment (EIA) of development projects as an aid to development planning, through which possible adverse environmental impacts of proposed development projects can be minimized or prevented. Accordingly, as of January 1984, by Cabinet decision, EIA was made mandatory for all development projects.

A forerunner to this enlightened decision was government's desire in the early 1980s to accord environmental management the recognition it deserved. This coincides with increasing global environmental awareness arising out of the 1972 Helsinki UN Conference on the Environment. Thus came into being an institution responsible for coordination of environmental management, and set in a motion a process, which in a stepwise manner, has given rise to present day policy actions and an institutional structure concerned with environmental issues. More importantly, a national institution was established to coordinate environmental management, public awareness in localized and national issues increased, and many concerned people grouped themselves into private voluntary organizations focusing attention on areas of their choice.

Briefly, the following events are noteworthy:

- recognizing the importance of environment in the 1978 constitution of the country: "The state shall protect, preserve and improve the environment for the benefit of the community";
- passing of the National Environmental Act (No. 47 of 1980) by Parliament;
- creating the Central Environmental Authority (CEA) in 1980 as an apex policy making and coordinating agency for a wide range of environmental subjects;
- passing of the National Environmental (Amendment) Act (No. 56 of 1988) by Parliament giving the CEA regulatory powers;
- preparing a National Conservation Strategy by a Presidential Task Force.

- elevating the subject of environment to the level of cabinet rank and making the Ministry responsible for policy decisions;
- ensuring incorporation of pollution control practices in new and existing industries;
- effecting biodiversity conservation through new policies and actions, to be supported by the Global Environmental Facility;
- recognizing environmental conservation as the other side of the development coin in Public Investment Programs;
- setting up the inter-ministerial Steering Committee on the Environment;
- improving institutional shortcomings in the field of environmental management;
- strengthening institutional capability; and
- reviewing existing environmental legislation and introducing either new legislation or amendments to existing statutes.

1.2.1 Legal requirements

Environment Impact Assessment (EIA) can play an important role in the identification of impacts, both negative and positive, as a planning tool for development, and can contribute to identifying more appropriate alternatives. EIA should be incorporated at a very early stage in the development planning process to determine management alternatives for achieving desired economic and social objectives and to assist in the formulation, design and management of projects.

With the passage of the National Environmental (amendment) Act No. 56 of 1988, project approval is a legal requirement. Approval is granted by "project approving agencies" gazetted so for the purpose. These are state agencies. The projects for which approval is required will also be gazetted and are referred to as "prescribed projects".

Part IV C of the National Environmental (Amendment) Act states:

23Z "The Minister shall by order published in the Gazette determine the projects and undertakings (hereinafter referred to as "Prescribed Projects) in respect of which approval would be necessary under the Provision of this part of this Act.

23AA (1) "Notwithstanding the provisions of any other written law, from and after the coming into operation of this Act, all prescribed projects that are being undertaken in Sri Lanka by any Government Department, Corporation, statutory board, local authority, company, firm, or an individual will be required to obtain approval under this act for the implementation of such prescribed projects.

23AA (2) The approval referred to in subsection(1) shall have to be obtained from the appropriate project approving agencies concerned or connected with such prescribed project.

Provided however, in respect of certain prescribed projects to be determined by the Minister, the project approving agency will grant its approval only with the concurrence of the Authority".

23BB "It shall be the duty of all projects approving agencies to require from any Government department, corporation statutory board, local authority, company, firm or individual who submit any prescribed project for its approval to submit within a specified time an initial environmental examination report or an environmental examination report or an environmental impact assessment report as required by the project approving agency relating to such project and containing such information and particulars as may be prescribed by the Minister for the purpose".

1.3 Current Resource Use in the Basin

The Walawe Basin covers an area of 2,442 sq.km extending from the southern escarpment of the central hills to the southern coast. The river enters the sea at Ambalantota.

1.3.1 Irrigation development

Hundreds of small irrigation tanks dot the floodplain of the river, and these bear testimony to a great, ancient hydraulic civilization. In a way, current development work here, and elsewhere in the Dry Zone of Sri Lanka, attempts to retrace the development paths taken by the ancients. For then, the plains were farmed - irrigated to a large extent - while the hills that nurtured the rivers whose waters were harnessed, were clothed in forests; and rightly so ecologically.

Recent irrigation development within the basin centres on the construction of the Uda Walawe reservoir in the 1960s, along with the power station and two main channels. Table 1.3-1 indicates some features of the dam and reservoir. The headworks were completed in 1967. But agricultural and settlement planning lagged behind.

During the 1970s, irrigation and rural development focused on developing the right bank, with emphasis on paddy, sugar cane, cotton and subsidiary crops, with project aid from the ADB. However, when the project terminated in the late 1970's it was reported that the operational performance was far from satisfactory. The ADB in its project completion report, listed the shortcomings, which covered a broad spectrum, ranging from structural and operational problems to settlement issues.

Subsequently, an improvement and rehabilitation project commenced in 1986, and is on-going, having had setbacks due to unfavorable security conditions. The benefits anticipated include an increase of the annual irrigable area from 16,000 ha to 22,000 ha; cropping intensity from 134 to 155 percent and paddy yield up from an average 4.0 to 4.5 mt/ha. An incremental yield increase of about 31,000 mt of paddy, 1,000 mt of subsidiary crops and 21,000 mt of sugar cane is anticipated. An economic internal rate of return of 35 percent has been estimated by the ADB. Some 11,000 farming families are the direct beneficiaries.

1.3.2 Samanalawewa hydroelectric project

In the upper reaches of the Walawe river, the Samanalawewa hydroelectric project is nearing completion. The facility, with a technical generating capacity of 120 MW, is to be commissioned in 1993. Table 1.3-2 indicates the salient features of the project.

1.3.3 Hambantota integrated rural development project

In the Hambantota district an Integrated Rural Development Project is underway since 1979. It focuses mainly in the restoration of minor irrigation tanks and associated settlement of people.

Employment generation and small enterprise development have also been carried out. In line with the devolution of functions, the project attempts to work closely with the Divisional Secretariats.

1.3.4 Cashew plantation

The Cashew Corporation has had intentions of opening up 1,550 ha for cashew planting, way back in 1975, in the Mirijjawila area. It appears that the Corporation is not considering this proposal anymore, as the area is now considered unsuitable. A small staff unit is located at the site and a 10 ha mixed plantation has been established.

1.3.5 Paper mill

The paper mill at Embilipitiya, on the right bank, started operating in 1978. The mill was designed to use rice straw. The mill has been experiencing effluent discharge problems as the chemical recovery plant for effluent treatment has not functioned properly.

1.3.6 Sugar industry

The Sevenagala Sugar Industries manage the sugar plantation, mill and the distillery. Both plants operate below capacity. The yield of cane has been low under rained conditions. The production in the sugar mill amounts to 9,560.

1.3.7 Southern area development plan

A number of projects are being considered for the development of the southern region. The following components have been under consideration and some of them are under implementation.

- Koggala Free Trade Zone
- Galle Port
- Matara - Kataragama Railway Extension
- Southern Province Rural Development
- Spinal Road from Colombo to Matara
- Southeast Dry Zone Projects
- Fisheries
- Tourism
- Water Resources Development

1.4 Scope of Study

The environmental study takes a holistic view of the environment in the two segments of the proposed project. viz. (a) the developed area and (b) the undeveloped area. The study has focused attention on the existing environment, gathering data on a number of ecological parameters concerning the physical, chemical, biotic and socio-economic environments. It has attempted to identify the current environmental issues within the basin and predict impacts that will come about as a result of the project being implemented. Mitigating measures to offset conflicts or adverse impacts are proposed.

1.5 Methodology

The report is based on work carried out during the period June to August, 1992, both through limited field studies and literature surveys. Of the many different methodologies available for preparing environmental impact statements, a combination of checklist and matrix methods have been used in this instance.

Field studies also included interviews with farmers, government officials and members of private voluntary organizations in the area. Data have been gathered from both primary and secondary sources. Field surveys have been conducted during a period of intense drought, when many animals species may have dispersed.

Ideally, field surveys should have covered a wet season also. Those carried out recorded the species diversity of plants and animals through sampling, direct observations and indirect methods. Field surveys also served as on-the-ground checks for information obtained from literature surveys and interviews.

Field observations were also carried out to assess possible project impacts on different ecological components, as well as evolve mitigating measures. Sampling of vegetation was carried out at randomly-selected sites representing different vegetation types.

Identification of plant species was confirmed by reference to herbarium specimens and/or literature.

1.6 Outline of Contents

The report initially provides the background to economic development of recent times in Sri Lanka. The sequence of development in the Walawe basin since the 1960s is presented along with the current status of environmental conservation in the country, describing also the legal requirements in relation to environmental impact assessment. The envisaged project is described in Chapter two, in its geographical setting, its inputs and outputs and the justification for undertaking it. The major areas of development activity are described, viz construction and operation of irrigation infrastructure, agricultural development and the benefits to the rural people who will be the beneficiaries of the project. A future situation in the area, without the project is also discussed.

In chapter three, the existing environment of the project area is broadly described under physical-chemical, biotic and socio-economic parameters. This section can be considered as a preamble to the identification and prediction of environmental impacts. The existing impacts that are off-site, but have a bearing on resource users within the project area are identified. The existing biotic environment that will be impacted by project implementation is discussed, as are the socio-economic conditions of the people in the Extension Area of the proposed project.

This chapter, also provides in brief, the urban development status and trends, industrial development and services presently available to the people. Religious and cultural resources in the area are detailed.

The significant environmental impacts that now exist in the project area, and those that can be predicted as a result of project implementation, are discussed in chapter four. These are categorized under physico-chemical, biotic and socio-economic environments.

In the chapter that follows, the mitigating measures for the significant impacts discussed earlier are presented. Proposals for coordination, monitoring and evaluation are discussed in chapter six.

The report concludes with a tentative estimate of costs and a listing of areas for further data collection and analysis.

2. PROJECT DESCRIPTION

2.1 Nature and Scope of Project

2.1.1 Area

The project area is located on the left bank of the Walawe river in Sri Lanka's Southern Province mainly, although small parts of the north lie in the Sabaragamuwa and Uva Provinces as well. It extends southeast from the Uda Walawe dam and comprises two distinct, contiguous areas, broadly equal in size (Fig. 2.1-1).

The area to the north is the developed area benefiting from Walawe waters in the left bank channel, and presently earmarked for upgrading of facilities for optimum performance. Here paddy is the predominant crop, occupying 2,880 ha or about 95 percent of the total irrigated area cultivated in both Yala and Maha seasons. Other crops include banana, chili, onion, grain legumes and vegetables. Greengram is grown extensively under rainfed conditions. Sugar cane occupies approximately 850 ha in net in the Sevenagala project area.

The area to the south, referred to as the extension area, is largely under-developed because there are no irrigation facilities except for old minor irrigation tanks dependent on rainfall. However, most of these tanks are in a state of disrepair. Farmers belong to both settled and migrant categories. More detailed information of the existing environment is provided in Chapter 3.

The total area of approximately 32,000 ha coming under the project can be divided into four distinct areas, as follows:

(i) Sevanagala sugar cane block of about 5,400 ha;
(ii) Kiri-ibbanwewa block of about 6,000 ha;
(iii) Suriyawewa block of about 5,100 ha; and
(iv) Extension Area of about 15,700 ha.

Administratively, the project lies within the districts of

Ratnapura, Hambantota and Moneragala. The Extension Area lies largely in the Hambantota district and is served by three Assistant Government Agent divisions, viz, Suriyawewa, Ambalantota and Hambantota.

2.1.2 Components

The project components relate directly to government policy, as set out in its current program, Public Investment, 1991 - 1995. Consequently, the project expects:

(i) to increase production of basic food commodities including paddy and other field crops, through rehabilitation and extension of irrigation facilities ; and

(ii) to establish agro-industries for processing in order to increase employment opportunities and incomes; through the following strategies:

- upgrading existing irrigation facilities covering 2,900 ha in the Old Area, to provide an adequate, timely and equitable supply of irrigation water on a

sustained basis for year-round cropping thereby increasing yields of paddy and field crops;

- constructing new irrigation/drainage systems in both Old and Extension Areas to provide adequate, timely and equitable irrigation water for year-round cropping, thereby enhancing productivity of lands presently under chena cultivation, increasing production of paddy and diversified crops, thereby introducing farmers into settled agriculture;

- developing settlements and farm lands suitable for paddy and diversified crops;

- providing economic and social infrastructure such as rural road network, domestic water supply, schools, medical centers, post offices, electricity, cooperatives, banks, markets and temples; and

- strengthening agricultural support services, particularly promoting crop diversification.

2.1.3 Benefits

In the Old Area, the project will be upgrading the existing irrigation infrastructure. There will also be an adjustment of cropping areas, so that more efficient use of land and water is achieved. Some of the paddy land now on permeable reddish-brown earths will be allocated to the cultivation of field crops, thereby saving on water consumption. The repair of irrigation channels and distributory canals will ensure minimum losses and enable the cultivation of a larger area. Farmers at the lower end of the block will be assured of water.

The project will completely change the existing farming systems in the Extension Area. The delivery of irrigation water will provide the hard-pressed farming community 'a new lease of life'. Cultivation will be possible in both seasons, income assured, and an improved standard of living will be the end-result. Aside from farming benefits, amenities such as potable water, health care, education, communications, transport and a variety of agrarian services will be provided. The people presently living in the Extension Area are not beneficiaries to any of these.

Economic feasibility is based on the economic internal rate of return (EIRR). A sensitivity analysis has also been made to test economic viability against changing benefits and costs. The estimated profit from agricultural production with the project and without, is summarized below:

(Unit: million Rs.)

Crop	Total Profit
Paddy	216
Big onion	143
Vegetable	48
Banana	78
Sugar cane	304
Total	789
Without project	
Paddy	105
Project benefit	684

Briefly, the project components are as follows:

(1) Upgrading in the Old Area

Extension canals	30.3 km
Canal bank protection of eroded section	10.2 km
Canal lining	132.2 km
Repair of structures	794 nos.
Replacement of structures	737 nos.

(2) Extension Area

Extension of left bank canal	25.0 km
Construction of six branch canals	35.1 km
Construction of distributory canals	302.4 km
Construction of drainage channels	105.6 km
Rehabilitation of village tanks	17 nos.
On-farm works	6,380 ha.
Reclamation of farm lands	5,950 ha.
Paddy fields	1,610 ha.
Upland fields	4,340 ha.
Construction of bridge over Walawe	1 no.

(3) Rural Infrastructure

Starter facilities for settler	5,340 nos
Village facilities	22 nos.
Roads	141 km.
Drinking water	23 nos.
Schools	28 nos
Health and medical care	12 nos
Postal facilities	4 nos
Administration office	22 nos
Agro-extension facilities	6 nos
Electrification	4 nos
Telecommunication	4 nos
Development center	1 no

2.1.4 Costs

The project base cost comprising (i) upgrading and extension of irrigation and drainage systems in Old Area, and (ii) settlement and agricultural facilities in the Extension Area, is estimated at Rs. 5,483 million, of which Rs 2,954 million will be in foreign currency.

The annual operation and maintenance costs are estimated at 1 percent of direct construction cost of irrigation and drainage infrastructure.

2.1.5 Duration

It is expected that the project implementation schedule will commence about two years after completion of feasibility studies, and continue for an estimated four year period. Major works such as the canal system in the Extension Area are to be completed in four years and rehabilitation of the Old Area will require about two and half years. Settlement preparatory work will proceed simultaneously, in order to eliminate delay in issue of water after completion of headworks.

2.2 Justification

2.2.1 Priority developments needs of the country

Agricultural development has been a priority in national development planning for a long time and will continue to be so for many more years to come. In 1990, agriculture accounted for 26 percent of the total Gross Domestic Product (GDP) and employed 48 percent of the active labour force. However, the country still imports large quantities of food including flour, sugar and milk products to meet domestic demand. Rice too continues to be in the list of imports despite favourable agro-climatic conditions for its production. Only about 14 percent of the sugar consumption was met by local production in 1990.

Attempts to harness the resources of the Walawe basin began nearly 30 years ago. The right bank area has received greater emphasis over the years, in comparison to the left bank. While 12,000 ha have been developed in the right bank, only 5,000 ha of the left bank have received irrigation benefits. The proposal under study has earmarked a further 6,380 ha of land for irrigable agriculture in the Extension and Old Areas. In addition to land set apart for homesteads, 5,110 ha (4,340 ha net) are allocated for non-irrigable upland farming.

In keeping with the government's stated development objectives, the project is designed to increase agricultural production, farmers' income and employment opportunities in the left bank area. As of this writing, there are some 6,000 families living in the Extension Area and many more come into the area as migrants for cultivation during the rainy season.

2.2.2 Agricultural development

(1) Land use

The agricultural development proposals are based on government's policy of crop diversification. Accordingly, appropriate diversified cropping patterns would be implemented from the very outset. Therefore, land use planning aims at maximizing utilization of available water resources in the left bank area along with allocating crop land based on soil capability. About 30 percent of the existing paddy on porous soils will be transferred to upland crops. Only the low humic gley soils will be allocated to paddy in the Extension Area. The allocation of land is summarized below:

(Unit: ha gross)

Area	LHG (Poor)	RBE (Mod)	RBE (Well)	Total
A. Irrigation Area				
1. Kiri-ibanwewa area	1,610	640	0	2,250
2. Suriyyawewa old area	810	1,210	0	2,020
3. Extension area	0	0	0	0
Sub-total A	2,420	1,850	0	4,270
B. Possible Irrigation Extension Area				
1. Kiri-ibanwewa	0	0	0	0
2. Suriyawewa old area	520	270	440	1,230
3. Extension area	1,880	590	3,810	6,280
Sub-otal B	2,400	860	4,250	7,510
Total of A & B	4,820	2,710	4,250	11,780

Source: Interim Report
Feasibility Study on Walawe Irrigation Upgrading and Extension Project (Left Bank) JICA, March 1992.

The existing paddy fields (1,850 ha gross) on the reddish-brown earths in the old irrigation area will be considered for field crops. In the Extension Area all the paddy will be on the low humic gley soils, i.e. 2,400 ha gross. Detailed information on land use are shown in Table 3.5-3. An overall land use plan is in Table 3.5-2

(2) Cropping pattern

The cropping pattern is based on soil and agro-climate conditions, and government policies on economic development. While paddy yet remains a major component, an attempt has been made to diversify. Fig. 2.2-1 illustrates the proposed basket of crops. Briefly, the land allocation is as follows:

Crop	Extent (ha)
Paddy	4,540 each season
Sugar cane	3,000
Big onions	630 each season
Banana	610
Vegetables	500 each seasopn

(3) Marketing

Development, based on agricultural priorities is viable only with the provision of all facilities for marketing farmers' produce. A streamlined marketing service is proposed through a number of strategies. Through rational cropping an attempt will be made to avoid seasonal gluts of certain commodities that invariably make the farmers job of selling difficult. Quality improvement of farm produce and the issue of quality planting material are priority considerations. Grading packing and storage, need to be vastly improved. The current wastage of vegetables from farmgate to consumer is estimated by the Agrarian Research and Training Institute (ARTI) to be as high as 20 to 40 percent. Very little grading is presently practised.

The setting up of farmer organisations is considered a basic necessity in the development of good marketing. As marketing information is essential in planning the crop mix, and to ensure best prices to the farmer, a market information center will be established at the proposed Development Center. The radio (also transmitted from the Development Center) will be a medium of transmission, in addition to a weekly newsletter.

The Sevanagala sugar mill is expected to absorb the extra cane output. The proposed packhouse and cold chain project of a private entrepreneur will be an inducement to greater vegetable production.

2.2.3 Irrigation development

The optimum use of irrigation water is the major objective. The present water use, particularly in the right bank is excessive. Farmer's organisations, although established, have yet to make an impact. Much of the irrigation infrastructure is functioning very much below efficiency due to faulty design, excess flow and poor maintenance, amongst others.

The irrigation system in the project area will consist of the existing and extended left bank main channel, existing tanks, irrigation canals and drainage channels. The main canal is located on

the elevated part of the left bank will have buffer ponds at intervals. Runoff water will collect in the drainage channels and will flow into the next downstream tank.

It is planned to supply irrigation water on a scheduled demand basis. Continuous irrigation supply is planned for main, branch and distributory channels, while rotational irrigation will be practiced in field canals. Equitable distribution of water will be achieved through:

- provision of proportional diversion structures on the turnouts and discharge measuring devices;
- rehabilitation and construction of village tanks on drainage channels to ensure utilization of return flow within area;
- lining of distributory and field canals; and
- training of managerial staff and farmers.

As had been the practice in ancient irrigation, the tank cascade system will be adopted in the project Extension Area. Its usefulness lies in the following attributes:

- water losses due to canal seepage, system operation and poor on-farm water management can be absorbed in tanks and reused in the downstream fields, thereby increasing the overall irrigation efficiency; and
- upland crop irrigation can be carried out during the day and paddy fields at day and night time; during the night time the water for upland will be stored in the tanks.

Fig. 2.2-2 illustrates a schematic layout of a tank cascade system. With such a system it is possible to reduce overall water consumption by nearly 50 percent; from 5,137 mm/year to 2,619 mm/year.

2.2.4 Rural infrastructure

(1) Settlement

Settlements are planned in a hierarchial manner with the hamlet as the nucleus. Some 6,400 farm families and 4,600 non-farm families altogether 11,000 families or about 60,000 persons will be settled when implementation concludes.

(2) Housing

About 7,000 houses will be constructed.

(3) Drinking water

Since the non-availability of potable water is one of the biggest constraints to the people in the project area, its provision is considered a priority. Such availability will also go a along way in reducing diseases associated with poor quality water.

(4) Road network

The existing road network shown in Fig.3.5-1 is considered totally inadequate to cater to the needs of a growing agricultural settlement. The existing dry weather road from Suriyawewa to Mirijjawila will be the main road of the Extension Area. A good road network is essential to enable easy movement of produce, inputs, and people within the settlement.

(5) Education

Each hamlet will have a primary school, and primary and secondary school will be provided at village and area centers respectively.

(6) Development center

A development center is proposed for Suriyawewa. It will have facilities for training, recreation, broadcasting, library, warehousing and water treatment.

(7) Health care

Health care facilities are proposed, with a primary treatment unit for every two hamlets. Facilities will also be available at village and area centers.

(8) Supporting services

Settler assistance in the form of food, agricultural implements, planting material and, for the construction of a house, well and latrine, is offered by the Mahaweli Authority. Institutional credit is disbursed by the two state-owned commercial banks, for cultivation and purchase of machinery and equipment.

2.2.5 Alternative to development

The natural resources within the project area have been described in chapter three, which also describes the existing socio-economic situation. The area had been traditionally given to irrigated farming and the soils are deep, well drained and rich, to support a profitable farming industry. In the Old Area, already fully developed, farming is not carried out at optimum resource utilization levels due to a number of shortcomings. These are described in section 3.3.2. As a matter of concern, resource wastage is commonly encountered - evident from two examples: unscientific land use, and excessive use of water. By correcting these shortcomings, better resource use, higher yield, greater income, and an improved standard of living are anticipated. Crop diversification will open up avenues for agro-industries that will provide some opportunities for the absorption of the second and third generation labur force.

The Extension Area is largely under developed except for the small tank rehabilitation and settlement carried out recently under the Hambantota Integrated Rural Development Project. Even these tanks depend on rainfall for water storage but there is no guarantee of a good monsoon each year. The total command area of all the rehabilitated small tanks is only some 300 ha. Those settled under this program number 405. Additionally, there are a large number of people living in the proposed project area, who depend on rainfed upland cultivation. They have no amenities and they live in abject poverty-existing at the mercy of the elements, cunning middlemen and marauding wild animals. Due to land hunger in the southern province, people come into this area as encroacher, and settle down wherever their likes are, notwithstanding the hostile environment. This situation will continue unabated as population increases. The net

result, perhaps in stretching another 10 years or so, will mirror a larger population stretching available resources beyond sustainable limits, simply because better options are not available. Elsewhere in the country too, where land remains outside the major development schemes, the scenario may be similar.

Therefore, without the project benefits that are planned, the land will further deteriorate, the conflicts with the elephant will exacerbate, the existing vegetation of scrub and small forest will disappear, and devoid of social infrastructure, the people will be only leading a hand to mouth existence.

2.3 Methodology of Construction and Operation

2.3.1 Construction mode

The executing agency will be the Mahaweli Authority, which has gained experience over a long period of time in detailed design, construction of civil works and in operation and maintenance. Detailed designs and supervision of construction will be by a consulting firm on the basis of international bidding. Preparatory works will include additional surveys. Qualified contractors to undertake the civil works will be selected by international bidding. Some of the technical guidance will be by the MASL and farmer organizations will handle the on-farm work except land levelling and the more complicated work, under the guidance of MASL.

2.3.2 Technology

Technology has been selected to suit local conditions.

2.4 Resources Needed

2.4.1 Labour

The labour requirements during construction cannot be met from what is available in the project area. The skilled labour in particular, will have to be hired from outside the project area.

2.4.2 Occupational health

While it is the contractor's responsibility to provide facilities to the labour force, occupational health guidelines will be provided by the project management.

2.4.3 Material requirements

Construction materials are mostly available from local industry and include cement, high yield and mild steel, rubble, metal, sand, timber, cast iron gates, reinforced cement and concrete pipes, polyvinyl chloride pipes and pre-stressed concrete bridge beams.

2.5 Operation and Maintenance

2.5.1 Procedures

The project office of the Mahaweli Economic Agency has responsibility for the operation and maintenance of the irrigation infrastructure. This includes water management and day to day operation of the system.

The block level staff are responsible for the distribution of water below the head sluice of the branch canal. The direct off-take of the main canals is controlled and operated by the project office. Gate operators open and close canal gates on distributary canals and the daily discharge is reported to the block office.

2.5.2 Transfer of responsibility

It is hoped that ultimately farmers themselves will be responsible for operation and maintenance of the irrigation infrastructure below the block level. Farmer organisations, although formed, have not made a meaningful contribution yet.

3. EXISTING ENVIRONMENT

3.1 Physical Characteristics

The existing environment in the project area is discussed under (i) the Old Area, which is the existing developed area and (ii) the Extension Area, to the south of (i) that is in a relatively undeveloped state. In the former, three distinct agricultural components are evident, namely the Sevanagala sugar area, the Kiri-ibbanwewa area and the Snriyawewa area.

3.1.1 Topography

The project area lies in the lowest peneplain of the Island. The topography of the project area is generally flat, although there are slopes that vary from gentle to rolling, averaging 1 in 200. The altitude varies from 5 m in the south, to 75 m in the north.

3.1.2 Walawe river

The Walawe River, with a total basin catchment of 2,442.8 sq.km, originates from the mountains west of Balangoda. It has an estimated average perennial flow of 900 million cubic meters flows into the Uda Walawe reservoir which has a live storage of 240 million cubic meters. The water resources of the Uda Walawe Irrigation Project are essentially provided by the Uda Walawe Dam which controls a catchment area of 1,152 sq.km. This upper basin consists of two major branches; the upper walawe, where the Samanalawewa project is located and the Weli Oya.

Two main channels along left and right banks commenced from Walawe Dam. The right bank channel receives water from Hulanda Oya, with a catchment area of 165 sq.km controlled by the Chandrikawewa dam. The left bank canal receives water from Mau Ara, with a catchment area of 360 sq.km controlled by the small tanks of Habaralu, Kiriibbanwewa and Mahagama. At the downstream of the Walawe Irrigation Project the irrigation of Liyangahatota is fed by the runoff of Timbolkeiya with a catchment area of 270 sq Km, discharge from the spillway of the Walawe dam, Chandrikawewa and Mahagama, and the return flows of the Walawe Irrigation Project.

A large number of natural streams and channels provide a fairly good system of surface drainage and most parts of the study area are free from drainage problem. For the purpose of describing the existing environment, the project area has been considered under two components.

3.1.3 Geology

Most of the study area belongs to the Vijayan Complex and extend over a part of the coastal peneplain of Sri Lanka. Rocks of Vijayan series are mostly microcline-bearing quartzo-feldspathic rocks with layers and lense of amphibolite and/or biotite. Five main rock types underlie the area (Fig. 3.2-4). These are:

(i) Hornblende and Biotite Gneiss with associated Pegmatite and Migmatite.

(ii) Hornblende, Biotite and Charnockitic Gneiss with some Limestone and Calc-silicate rock.

(iii) Quartzo-Feldspathic Gneiss and Granulite

(iv) Predominately Charnockite

(v) Charnockite and Quartzite

The main rock types include a variety of gneisses, migmatitic and granitoid rocks including charnockitic gneisses. Migmatitic biotite gneiss covers the major part of the area. The main materials are quartz, orthoclase of plagioclase feldspar, biotite and hornblende. When the latter is present in significant quantities and migmatitic structures are absent, the rock is called hornblende biotite gneiss. The main materials of charnockitic gneiss are quartz, feldspar, biotite and hornblende, with or without hypersthene. The charnockitic gneiss occurs in bands and follows the strike trends of foliation. The charnockitic gneiss is generally more homogeneous and massive than the migmatitic gneiss and rarely shows foliation or separation of minerals in hand specimens. In some places there appears a gradation between the two rock types, which then cannot be easily distinguished specially in samples from bore holes.

Alluvium has been deposited in and around rivers and streams. The Walawe basin has alluviums of about 20 to 30 m thickness. Other alluvium deposits in the smaller basins are clayey. These clayey deposits are poorly drained and waterlogging often occurs during rainy seasons, resulting in grey soils with associated calcium carbonate deposition at variable depths beneath the surface.

3.1.4 Soils

Geologically the Dry Zone soils are younger where weathering has not been as extensive as in the wet zone. Generally the soils are high in exchangeable bases, neutral to moderately acid, and fairly rich in phosphorus and potassium. They are low in nitrogen and organic matter.

The soils in the project area occur in a catenary sequence over an undulating landscape. There are three main soil groups in the project area. These are:

(i) Reddish Brown Earths (RBE) - the well drained and imperfectly drained RBE occur on the convex uplands and mid-slopes respectively.

(ii) Low-humic Gley Soils (LHG) - the poorly drained members of the catenary sequence occur in the concave valleys and bottom-lands.

(iii) Alluvial soils - agriculturally less important alluvial soils are found in some locations along rivers and streams as narrow strips.

In the Walawe basin, soils have been developed from residual, colluvial and alluvial materials. Residual soils are those developed from parent material, derived by weathering *in situ*, of the bedrock beneath it. They predominate on the lowland plain, where they have developed as residues weathered from gneiss and (in some places) gneiss containing pegmatite and migmatite. They also predominate in the valleys and on the gentler slopes of the upland and highland areas, where they have developed in residuum weathered from several different rocks, including gneiss.

Alluvial soils are those which have developed in material that has been transported and deposited by rivers. The largest tracts of alluvial soils lie near the mouths of the Walawe river and the Kachigal Ara.

In the wetter parts of the Walawe basin, the soils have been formed under the influence of a climate which is rainy and fairly warm throughout the year. Therefore, leaching is continuous and the soils are almost permanently moist, even though there may be nothing in the texture or structure of the soil or in the slope to prevent rapid internal and external drainage. Because of this moisture regime, the sesquioxides tend to assume a hydrated form, which imparts a characteristic brown and yellowish-red colour to the soils.

In all parts of the lowland plain the thickness of the residual mantle, including both the soil profile and the weathered parent material beneath it, is normally less than 10 feet, and the thickness of the soil profile itself seldom greater than four and half feet (Canada-Ceylon Colombo Plan Project).

The RBEs consist of a sandy to sandy-clay loam surface horizon, underlain by sandy-clay loam to sandy-clay sub-surface horizons. They are well to imperfectly drained. Often there is a gravel horizon within the solum and this hinders root penetration. The soils are moderately deep and moderately fine-textured. They are hard when dry and sticky when wet. The surface soil aggregates are readily broken down. The pH is neutral to slightly acidic. The degree of base saturation ranges from 18 to 66 percent and the exchangeable sodium content is low.

The imperfectly drained soils on the mid-slopes consist of a dark- brown sandy loam to sandy-clay loam surface horizon underlain by a sub-surface soil horizon of brown to yellowish-brown sandy-clay loam to sandy-clay. This soil type is quite similar to the well- drained soils both in physical and chemical properties.

The RBEs on the upper and mid-slopes can be cultivated with a variety of crops in the wet season, with or without supplemental irrigation. In the dry season, with irrigation, crops such as chill, onion, groundnut, soybean and vegetables can be grown.

The Low Humic Gley soils in the lower slopes are slightly alkaline. They consist of dark, reddish to reddish-brown sandy-clay loam to surface horizons underlain by gleyish-red sandy loam sub-soil horizons. Given adequate drainage,they are well suited to rice cultivation. Available phosphorus and exchangeable potassium are moderate.

3.2 Climatic Characteristics

Climatically, the project area falls into the Dry Zone. The boundaries between the Dry, Intermediate and Wet Zones of the country are based on 75 percent expectancy of annual

rainfall. The major climatic zones are further sub-divided into 24 agro-ecological zones. On this basis the project area lies in the agro-ecological zone DL_1 (Fig. 3.2-1).

In the Walawe basin there are 20 hydrological data generating stations. Some are not operating. Those operating are shown in Fig. 3.2-2. Among them, 12 stations are located upstream and the other eight stations are located downstream. These hydrological data generating stations are under the purview of the Department of Meteorology (DM), Department of Agriculture (DA), Irrigation Department (ID) and different estates (Table 3.1-1).

In and around the study area, meteorological data are available from 6 observatories, i.e. Hambantota (HAB) Sugar Research Institute (SRI) at Sevanagala, Agriculture Research Station (ARS), Rice Research Station (RRS) at Ambalantota and MEA observatory at Embilipitiya. The HAB and SRI observatories are selected as representative of the southern and northern areas of the project. Information from the two observatories are summarised below:

(Unit: ha)

	SRt			HAB		
	Annual Mean	Mean Max.	Mean Min.	Annual Mean	Mean Max.	Mean Min.
Temperature (C)	28.2	32.6	23.6	27.2	30.2	24.1
Humidity (%)	75.6	82.8	69.2	78.9	81.3	76.8
EPT (mm)	1,871.9	195.8*	116.4	-	-	-
Sunshine (hrs.)	2,447.4	231.6*	175.6*	248.2	284.2*	17.4*
Wind velocity (km/hrs)	4.9	8.6	2.4	4.9	8.6	2.4
Rainfall (mm)	1,411.3	276.3*	28.7*	1075.5	187.5*	42.2*

*: per month

Manual gauges are used in almost all the stream gauging and rain gauging stations. Therefore, they are subject to the usual sources of operational error.

3.2.1 Rainfall

The northern and western edges of the lowland plain receive approximately 1,900 mm and the 1,900 mm isohyet corresponds closely to the boundary between the Intermediate and Dry Zones. Further south and east, the average annual rainfall decreases, and in the southeast corner of the basin it is less than 1,016 mm. This latter area receives some of the lowest rainfall recorded anywhere in Sri Lanka (Fig. 3.2-3). The highest parts of the basin, namely the main escarpment of the central highlands the Pitiyagala Ridge and western part of the Bulutota massif, receive 2,500 mm or more during an average year.

The seasonal distribution of rainfall is of much greater significance to the cultivator than the annual average. The location of the basin with respect to the main highland areas in the central part of the Island and Sabaragamuwa province is such that most of it lies more open to the influence of the northeast monsoon than to that of the southwest monsoon. Over most of it, the five southwest monsoon months contribute 15 to 20 percent of the yearly total, with proportions slightly greater than 20 percent along its western border and proportions less than 15 percent in the centre of the basin. Locations lying within a few miles of the south coast receive a greater proportion of the annual rainfall during the southwest monsoon period than places further north and in the centre of the basin, even though the actual total recorded falls are very low.

3.2.2 Temperature

The entire Walawe basin is characterised by extremely small annual and diurnal ranges of temperature. Therefore, cultivation is virtually unaffected by the slight seasonal changes in temperature. The average annual temperature in the basin is around 28°C, varying little from place to place within the basin. In general in the Dry Zone, the rainfall is clearly ineffective during the southwest monsoon season, because of a combination of low rainfall and high evapo-transpiration. Desiccating winds blow strongly throughout most of July, August and September. These winds accelerate evaporation and hence reduce to a significant degree the beneficial effects of what little rainfall comes during those months.

3.2.3 Wind

Average wind speeds in Yala are higher at 14 kmph (6.6 m/s), than in Maha at 11 kmph (5.0 m/s). Winds are strongest on the coast but can also be high in the interior, especially with the clearing of secondary jungle.

3.3 Watershed Characteristics

The Walawe River rises in the central hills and after a short course, drops to the lowland over the southern escarpment at Uggalkaltota. The river has 23 tributaries (Fig. 3.3-1) and the discharge in some of these is shown below.

3.3.1 Hydrology

Flow measurements have been carried out at 13 locations within the basin by the Irrigation Department. Of these four were on the main river and nine on its tributaries. These are summarized below:

Station	Drainage Basom (sq.km)	Annual Average (mcm)	Discharge (mm)
Belihul Oya	9	90	1,838
Samanalawewa	353	591	1,675
Werugala	261	212	812
Mawigala	23	14	609
Waguregama	99	-	-
Uda Walawe	1,155	1,018	881
Timbolketiya	269	156	581
Embilipitiya	1,580	1,417	897
Moderawana	109	34	320
Halmilaketiya	166	41	247
Mahagama	366	54	148
Liyangastota	2,284	2,697	1,181

Two of the main tributaries, the Weli Oya and Belihul Oya flow from an area which has copious rainfall, especially during the inter-monsoon and northeast monsoon periods. The main stream of the Walawe River and the tributaries entering it from the west also originate in an area of heavy rainfall which is concentrated during the inter-monsoon and southwest monsoon periods. Of all the main tributaries of the Walawe, only the Mau Ara has its headwaters in the Dry Zone lowland. This stream can therefore be expected to have an intermittent and deficient flow for many months of the year.

The river has a perennial flow throughout its length. Nevertheless, the flow fluctuates greatly from season to season and from one year to the next. In the hill country of the basin, a combination of steep slopes and high rainfall results in rapid rates of runoff and large volumes of water in the rivers. In the lowland plain, where the rainfall is lower and the slopes are mild, runoff is much less. Earlier, floods are reported to be quite frequent in the basin, but are now of little significance because there has been so little development.

Downstream of the Uda Walawe reservoir there are three major tributaries. These are: Timbolketiya river - with two major branches, Rakwana River and Andolu River joining at just upstream of Timbolketiya bridge. It is a right bank tributary of the Walawe, with a catchment area of 269 sq.km. The average annual basin rainfall is more than 2,500 mm.

Hulanda Oya - This is a right bank tributary of the Walawe River, with a catchment area of 166 sq.km and an annual basin rainfall over 2,000 mm. The annual runoff at Halmilaketiya is 41 mcm. The Chandrikawewa reservoir was constructed on the Hulanda Oya.

Mau Ara - This is a left bank tributary of the Walawe river with a catchment area of 366 sq.km and a basin rainfall below 1,500 mm. Annual runoff at Mahagama is 54 mcm. There are three tanks on the main stream and two tributaries; the Mahagama tank, Habaraluwewa and Kiri-ibanwewa. The Mau Ara normally dries from July to September. However, the flow of the Mau Ara is scarce and unreliable.

3.3.2 Recent irrigation development

Of the recent irrigation development within the basin, the first and the largest reservoir constructed has been the Uda Walawe reservoir, also generating hydroelectricity. The average annual inflow into the reservoir is 900 mcm, based on 31 year data from 1960 to 1990. The inflow is directly related to the monsoonal conditions, and is low in the months of February, June, July, August and September. The reservoir has a gross storage volume of 269 mcm and a live storage of 240 mcm. It has a catchment area of 1,152 sq.km.

Operation records indicate that a considerable amount of water is wasted during the rainy season and spills over. One way of using this water is by increasing the effective storage capacity by increasing the height of the dam. However, an assessment of such possibility has to be made after the Samanalawewa facility upstream becomes operative.

The right bank canal receives water from Hulanda Oya, controlled by the Chandrikawewa dam. The left bank canal receives water from Mau Ara, with a catchment area of 360 sq.km and is controlled by the small tanks of Habaralu, Kiri-ibanwewa and Mahagama. At the downstream of the Walawe Irrigation Project the irrigation of Liyangastota is fed by the runoff of Timbolkeiya with a catchment area of 270 Km^2, discharge from the spillway of the Walawe Dam, Chandrikawewa and Mahagama, and the return flows of the Walawe Irrigation Project.

3.3.3 Present water demand

The demand for Walawe water is from three main users, namely, agriculture, industry and domestic. Agricultural users are the most demanding while the industrial sector is not very developed in the area. It concerns mainly a paper mill at Embilipitiya and a sugar factory at Sevanagala. The total amount of water usage for industrial and domestic sector on the right bank has been assessed as 30 mcm per year.

(1) Uda Walawe scheme

The command area consists of land on both the right and left banks of the river. The right bank is presently supplied with about 450 mcm per year, being the irrigation requirements for about 8,000 ha, and industrial and domestic uses as well, Under the on-going rehabilitation programme, the irrigable area will be extended up to about 12,000 ha.

On the left bank, irrigation water amounting to 150 mcm is supplied to irrigate about 4,400 ha, the bulk of it being paddy. About 1,100 ha are in sugar cane. Some of the paddy on both left and right banks, is grown on unsuitable soil types. To achieve the objectives of the project, it is imperative that rational use be made of available water through crop diversification from paddy to upland crops, better on-farm water management and improvement of irrigation efficiency by rehabilitation of the infrastructure.

(2) Ridiyagama scheme

The total irrigation command area of about 6,100 ha. The water resource of the scheme is the Walawe river and the water is diverted at the Liyangastota anicut on the river. Most of all the area is under paddy cultivation.

(3) Kaltota scheme

With a command area of about 870 ha, this scheme is located just downstream of the Samanalawewa dam. The main crop of this scheme is paddy. The estimated water requirement is 52 mcm.

(4) Hambantota-Ambalantota water supply scheme

Demand for domestic water supply on both left and right banks is important. Uda Walawe, Ridiyagama and Kaltota schemes provide domestic water supply for these areas. The Hambantota-Ambalantota water supply scheme provides pipe-borne water to Ambalantota and Hambantota towns, obtaining water through a direct intake from the Walawe River and pumped after treatment to the respective towers at Hambantota and Ambalantota. This scheme is in operation since 1982 and design demand is 5,600 m^3/day (240 l/day/head). The treatment consists of aeration, coagulation, sedimentation, rapid sand filtration and disinfection. The scheme presently supplies about 3,400 m^3/day of treated water. By 2010, the water requirement is estimated to be 5,600 m^3/day. Considering the allowances for intake from the Walawe River, 1 mcm per month is required at the intake site of the scheme.

3.3.4 Water quality

An assessment of water quality has been made at 11 sites during the project study to determine suitability for drinking and irrigation purposes. Groundwater samples from six dug wells, surface river water samples from four locations and the waste water of the paper mill have been analysed (Fig. 3.3-2). Based on this analysis surface river water can be used for drinking and irrigation without any treatment. Water from the dug wells need to be treated when used for drinking or irrigation. In the latter electrical conductivity values are higher than the standard for irrigation water, 300 s/cm. The pH values of the samples range from 6.5 to 8.5 (Table 3.3-2).

Suspended sediment ranged from 50 to 200 mg/l, as against an allowable limit of 50 mg/l for fish and less than 100 mg/l for crops. Dissolved oxygen posed no threat to living organisms.

Fluorine and chlorine from the dug well samples exceeded World Health Organization(WHO) standards for drinking water.

3.3.5 Ground water

Ground water is generally scarce and often saline in the south and does not hold much promise as a source for irrigation and drinking. Geological studies indicate that the basin has hard fractured rock with limited, localised ground water resources. Most areas consist of crystalline rock that is impervious and non-porous. However, these rocks are traversed by discontinuities like joints and foliation where some water is found, and ground water yield from these fractures is somewhat reliable.

The depth of water table varies from 5 m to 20 m and wells generally yield 0.08 to 1.65 liters per second. The water quality in the crystalline rocks is good except for some pockets in a deep aquifer in the southeast where the water is saline. The presence of fluoride in the northeast and iron in the southwest are noteworthy.

3.3.6 Waterlogging and salinity

In the project area detailed work has not been done and available information on waterlogging and salinization is very limited. Sodium-absorption ratios and electrical conductivity values (EC) provide some indication as to the level of salinity.

3.3.7 Flood damage

Interviews with MEA project officers in Embilipitiya and Irrigation Department officers in Ambalantota, revealed that there had been no flood damage in living memory. Therefore, it is considered that the frequency of flooding will be vary rare. It appears that a large number of natural streams and channels provide a fairly good system of surface drainage.

After completion of the Samanalawewa dam, the river waters will be controlled at two points. The probability of flood occurrence in the basin therefore will even be less than at present.

3.4 Biotic Community Characteristics

3.4.1 Plants

(1) Vegetation types

The original natural vegetation of the project area belonged to the Dry Mixed Evergreen Forest type, which can be described as a secondary climax forest that evolved following the decline of the ancient civilization. What remains now is a much degraded dry zone forest.

Under natural conditions, the Dry Mixed Evergreen Forest is fairly open and floristically poor when compared to the wet zone forests. The canopy reaches a height of 20 to 25 m and common species include *wira (Drypetes sepiaria), halmilla (Berya cordifolia)* and *kaluwara (Diospyros ebenum)*. Emergents such as *burutha (Choroxylon swietenia), milla (Vitex altissima),* and *kolon (Adina cordifolia),* rise about 3m above the canopy.

The Old area is devoid of any appreciable extent of natural vegetation as it is developed. Due to human influence the forests in this area have been degraded. Shifting cultivation has been the

main occupation of the people, supported by the husbandry of cattle and buffalo. What exists as forest vegetation can be categorised as follows:

(i) Primary dry mixed evergreen forest

The only primary forest is the Madunagala, Karambagala forest which also provides shelter to the hermitage. It lies in Mahapelessa North, east of Ridyagama tank and south of Mahawelikada Ara. The undisturbed forest is only about 140 ha in extent. The canopy is 20 to 25 m high and there is a 3 to 5 m shrub layer. In most places it is an open canopy. The trees are stunted where the land rises and is rocky. Species exhibit xeromorphic features. The canopy species include *halmilla, kaluwara, milla,* and *wira, palu Manilkara hexandra) buratha* and *kolon* are some of the emergents.

(ii) Degraded secondary forest

To the east of the Suriyawewa-Mirijjawila road, are degraded secondary forests. The other boundaries roughly are the Andarawewa Maha Ara area in the north, the project boundary on the east and a few kilo meters to the north of Arabokka on the southern side. Degradation has been to various extent depending on exploitation shifting cultivation, timber, fuelwood and homesteads.

This forest zone can be sub-divided into a very arid region lying northwards of Bellagaswewa and Kattanawewa(SFZ-A) and a less dry verdurous region (SFZ-V) lying south and southeastward of it. In both regions, the matrix is shrub jungle of 3 to 4 m, with scattered trees, shrubs are represented by *katupila (luegga leucopyrus) kapukinissal (Hibiscus sp)* and maila (Bahunia racemosa). The tree species are *divul (Feronia limonia), ehela (Cassia fistula), wira, palu burutha* and *kohomba (Azadirachta indica).* In the SFZ-V region, the forest is greener and has more trees per unit area than the SFZ-A region.

(iii) Scrub jungle or thorn scrubland

Except for the vegetation types described above, scrub jungle or thorn scrubland is the general matrix of terrestrial vegetation throughout the Extension Area. Extensive shifting cultivation has had its toll on the natural forest vegetation and scrub is the result.

Species exhibit xeromorphic characteristics and are 2 to 5 m is height. An undergrowth of grass is sometimes seen. Common species are *katupila*,the endemic *eraminiya, (Zizyphus napeca, andara(Dichrostachys cinerea) karamba (Carissa spinarum), habara (Diospyros sp.)* and *katuandara(Acacia levcophloea).*

Most species shed the leaves during the dry season. Occasional trees of *burutha, wira, divul, weliwenna, maila,* and *ehela* are scattered all over the area. Stump regeneration of *burutha* is taking place in the northern parts.

Towards the southern coastal belt, the common tree species are *divul, ehela, ingini(Strychnos potatorum)* and *kohomba.* Succulents such as *daluk (Euphorbia antiquorum), komarika (Aloe vera)* and *heeressa (Cissus quadrangularis)* are also abundant.

(iv) Aquatic vegetation

The low lying land on the edges of the tanks support a variety of marshy vegetation. A large extent of marsh is found on the southern and western borders of Udaberagamawewa, extending over about 20 ha. Species include *Eichhornia, Salvinia, Pistia, Marselia* and *Ludwigia.*

Aquatic weeds are found in many tanks, canals and even paddy fields. *Eichhornia* is present in large extent in Kadawarawewa, Mahagamawewa and Udaberagamawewa. The canal leading water out of Udaberagamawewa is completely choked with weeds, mostly *Eichhornia* and *Salvinia.*

Phytoplankton is found in the waters of tanks and canals and in paddy fields. The samples examined did not show the presence of species such as *Microcystis* and *Spirulina*, which are usually associated with polluted waters.

(v) Riverine vegetation

Riverine vegetation usually is characteristic of its own due to the favorable moisture regime all through the year. The trees are taller than on more well drained sites and species not normally associated with this agro-ecological zone can be found along rivers and streams. The height of trees will decrease moving away from the bank. Ecologically, riverine vegetation serves the very useful purpose of preventing bank erosion and permitting a smoother river flow. Such areas are also habitat for burrowing animals, reptiles, amphibians, small mammals and birds. This type of vegetation is found only in small patches.

(2) Productivity

The existing forest vegetation can be divided into the following timber yield classes:

(i) Low-yield vegetation

Most of the primary forest is of this class. The trees are abot 15 m in hight. The crowns are small and it is an open forest. Common species include *wira, kaluwara, palu, milla* and relatively small numbers of other speices such as *helamba,(Mitragyna* and *parvifolia) halmilla.*

(ii) Non-productive vegetation

The main canopy is less than 6 m in height. Crowns are small. Canopy density varies from low, open shrub to a close, smooth surface. This class does not bear species of economic value. However, it provides fuelwood. Predominant tree species are *wira, weliwenna,* and *panakka (Pleurostylis opposita).* Other species described above occur as widely scattered isolated trees. Approaching the coastal belt tree species such as *kohomba, maila, wira, palu* and *ranawara (Cassia auriculata)* are more abundant.

Crossing into the Arid Zone to the southeast the vegetation shows a distinct change. It is a low,open,thorny scrub with isolated trees. All the species have thick, small leaves, thorns and shiny leaf surfaces. Common species are *heen karamba (Carissa spinarum), Zizyphus spp, Acacia spp, andara, maliththan (Salvadora persica), palu* and *wira.*

(3) Introduced tree species

(i) In the southeast corner of the project is a Forest Department plantation of *Eucalyptus camaldulensis*, extending over 1,493 ha, varying in age from 11 to 16 years. The plantation extends outside the project boundary eastwards.

(ii) At Mirijjawila is the 5 to 10 ha cashew plantation - alll that has been achieved of the 1975 proposal to have a 1,550 ha plantation.

3.4.2 Animals

(1) Habitats and their present status

(i) The Old Area does not contain natural habitats for wildlife. This and some parts of the Extension Area are inhabited by farmer families practising either settled types of agriculture or shifting cultivation. This area is referred to as the Human Inhabited Zone (H1Z) (Fig. 3.4-1).

(ii) The Extension Area is for the most part covered with secondary forest and grassland, consequent to shifting cultivation and is referred to as the Human - Uninhabited or sparsely inhabited Zone (HUZ). Despite the degraded condition this area serves as reasonably good wildlife habitat, sustaining a diversity of animals ranging from invertebrates to fish, amphibians, reptiles, birds and mammals.

The Madunagala forest of limited primary vegetation and its associated secondary jungle, is a reasonably good wildlife habitat and merits proper management to benefit its flora and fauna. The wildlife habitats of the Extension Area can be zoned using the Suriyawewa-Mirijjawila road (100 foot road) as a landmark boundary of convenience.

The area west of the "100 foot road" has been subjected to shifting cultivation in the not-too-distant past and the vegetation is in a successional stage, comprising ill-developed and sparse secondary forests and grasslands that cannot be considered as good wildlife habitat. The same is true for a strip of land oriented parallel to, and immediately eastward of, the "100 foot road".

Between this strip and the eastern boundary of the Extension Area is a zone of secondary forest that supports a diversity of wildlife. A sub-division of this zone will demarcate a very arid area (SFZ-A) lying northward of Nellegaswewa/Kattanawewa, and a more verdurous secondary forest area (SFZ-V), southward and northeastward of it. There are settled families around Bellegaswewa and Kattanawewa. The zone described above adjacent to the eastern project boundary is a better endowed wildlife habitat.

The aquatic habitats can be broadly categorised into two: the flowing waters of the Walawe and its tributaries and canals and the still waters of tanks and waterholes. The aquatic environment also contain other localised habitats such as swamps and lagoons, containing fresh or saline waters. The habitats experience fluctuating water levels depending on water input and output, which in turn is linked to seasonal weather patterns and water issues from the Uda Walawe and other reservoirs. During the rainy season, most of the habitats are inter-connected while during the dry season, some of the habitats such as tanks and waterholes, completely dry out.

The flowing waters can be further stratified into habitats such as deep pools (habitat for large fish and crocodiles), waters with sandy or slightly muddy bottoms (habitat for aquatic insect larvae and bivalve mollusca respectively), waters with pebbles and boulders on the bed (habitat for loach-like fish and gastropod mollusca), shallow edges (habitat for fish larvae and aquatic invertebrates) and waters containing detritus mixed vegetation (habitat for shrimp and insect larval forms).

(2) Species diversity and current conflicts

(i) General

Until recent times, the area supported a rich diversity of wild animals, including a large elephant (*Elephas maximus*) population. Water buffalo, (*Bubalus bubalus*) sambur (*Cervus unicolor)* spotted deer (*Axis axis ceylonensis)*, red deer (*Munticus muntjak mousedeer (Tragulus meminna)*, wild boar (*Sus srofa*), leopard (*Panthera pardus)* bear (*Melursus ursinus inornatus*) grey langur *(Piesbytis entellus*) toque macaque (*Macaca sinica*) flying squirrel (*Petinomys fuscocapillus layardi)* rock squirrel (*Ratufa macroura dandolena)*, civet cat *(Viverricula indica mayori)* and black-naped hare(*Lepus nigricollis)* were common. In the past 15 to 20 years, these species have got almost completely wiped out from the area, mostly at the hands of poachers. The elephant however, has managed to hold out amidst great odds. It has not been possible to ascertain population densities. It is conceded that some species may not be found in the area due to habitat destruction and poaching. Other species included, species of mongoose, cat, bat, shrew and rat, the porcupine and pangolin. More information on species present is in Table 3.4-1.

(ii) Elephant

Traditionally, elephants in large numbers have inhabited the lower Walawe basin from ancient times. Ptolemy (circa 150 - 175 AD) in his account of Ceylon, had identified "the feeding grounds of elephants" southward of the central mountain massif. It is therefore considered useful to trace the recent development efforts vis-a-vis elephant conservation.

The elephants lived in this area in large numbers until their habitat was opened up under the Walawe scheme in the 1960s. As the habitat became fragmented by various developments on the left and right banks, the elephant population too become dispersed. Herds were pushed northward into the Hambegamuwa forests, south and southeastwards to the Ridiyagama-Gonnoruwa - Wirawila forests and southwestward to the Ranna-Bata-ata jungle pocket. Those that moved northward found accommodation in the Uda Walawe National Park, which was established in 1973, while those trapped in the right bank command area were either captured and domesticated or were driven to the safety of the Ridiyagama- Gonnoruwa forests. However these forests too have come under development over the years, increasing the conflicts of man and elephant, and putting under threat the future of some 150 or more animals.

The development of the right bank command area south to Ranna and the left bank command area southeast to Suriyawewa, effectively prevented the elephants isolated in Ridiyagam-Gonnoruwa-Mattala, moving north to Uda Walawe or west across the river. But they had a wide range that linked with the Yala National Park - through the Mattala - Lunugamvehera gap on the Hambantota - Wellawaya road in the northeast. These elephants, numbering

over 150, moved in small family groups from one village tank to another, feeding in the scrub, as well as in the *hennas* and home gardens.

The Ridiyagama livestock farm was regularly visited by large herds to forage on the lush pasture and herds took refuge in the (1,500 to 2,000 ac) 607 to 809 ha. block of forest reserved for possible extensions to the livestock farm. Later, with humans taking over the forest reserve for cultivation, the herds sought refuge during day time in the Madunagala and Karambagala forest pockets.

In the 1980s, the Hambantota Integrated Rural Development Project completed the rehabilitation of some 20 village tanks in Gonnoruwa, Weliwewa and Mattala, and this further restricted elephant movement.

Furthermore, with the development of the right bank command area of the Kirindi Oya Irrigation Settlement Project (KOISP), the plight of the elephants pocketed between Ridiyagama and Wirawila/Mattala, became worse. The KOISP swallowed a large chunk of elephant habitat, including the Wirawila Sanctuary of 4164 ha. It also blocked their only escape route northeastwards past Kirindi Oya to the Yala National Park.

As their range dwindled and access to feeding grounds and watering points became more and more difficult, human-elephant confrontations increased to serious proportions in and around Mattala, Badagiriya, Gonnoruwa, Hambantota and Ridiyagama.

The commissioning of the KOISP right bank canal brought about the curious situation where elephants had ample water from the main canal and food (paddy) across it! When chased by the farmers and departmental staff, they move towards the village tanks in Mattala, Gonnoruwa and Ridiyagama. Since the area between Gonnoruwa-and Ridiyagama tank is sparsely populated, herds are not exposed to such severe disturbance as in the Gonnoruwa-Badagiriya-Mattala area. The Ridiyagama livestock farm inspite of its degraded nature is still an attractive resource point.

In 1991, the Department of Wildlife Conservation (DWC) made an unsuccessful attempt to drive and evacuate the trapped elephants across Kirindi Oya, northeastwards past Lunugamvehera and Menik Ganga into the Yala National Park. It is reported that only some 50 animals were driven to the Lunugamvehera forests, and within a week these animals back-tracked to their old haunts. In the past two years the Department has also captured and removed some elephants to the Yala National Park.

Presently there are around 50 to 75 elephants in herds, and 5 to 6 loners, concentrating in and around the project Extension Area. During the wet months, they move in family groups of 10 to 20 animals, while in dry weather, these groups coalesce into herds of about 30 to 50 animals, around Ridiyagama tank and the livestock farm. Madunagala and Karambagala forest pockets are also favorite refuges during periods of drought.

Conflicts between man and elephant have accentuated around the Ridiyagama livestock farm, Mahapelessa, Andarawewa, Gonnoruwa, Arabokka, Keligama and in the KOISP right bank area between Badagiriya and Mattala - Weligatte. Here the loners are particularly problematical. Incidence of crop damage is high and a number of elephant and human deaths have been reported within the project area. A 1988/89 study by the Elephant Conservation Unit of the DWC,

revealed the presence of 150 to 160 elephants in the area between Ridiyagama and Mattala.

(3) Migratory species

The project area serves as the wintering grounds for a variety of birds coming from in large numbers from as far away as northern Siberia. Over 150 species are known to be annual winter visitors. All of them continue to stay in Sri Lanka during the winter months. There are no "passage-migrants". They arrive by mid-August through late-November and leave by March/April/May. Species include dwellers of the forest, grassland, sea shore and aquatic habitats. Thousands are seen in the lewayas and open grassland and scrub jungle during these months, where they find the warm climate with plentiful supplies of food very attractive. Some of the species are listed in Table 3.4-1. Some species may not leave when the time comes, for various reasons, one of which may be lack of energy. The Blue-tailed Bee-Eater (*Merops philippinus philippinus*) is a species known to have changed its status from being a regular migrant to a breeding resident.

(4) Rare/threatened/endangered/endemic species

The wild elephant population is highly endangered all over Sri Lanka due primarily to habitat depletion and settlement schemes that have been established in its territory. In the Extension Area, there are an estimated 150 to 160 elephants roaming over a vast area east of Ridiyagama.

3.5 Socio-economic Characteristics

3.5.1 Demographic data

At the last population census in 1981, Sri Lanka had a total population of 14,850,100, of which 3,194,900 or 21.5 percent constituted the urban population. The rural population was 10,721,700 or 72.2 percent and a small estate population comprised 933,500 or 6.3 percent.

In comparison, Hambantota district, within which bulk of the project area lies, had a total population of 424,100, made up of 89.9 percent (41,400) rural, 9.8 percent (11,400) urban and 0.3 percent (1,500) estate. The large segment is rural.

The estimated mid-year population of the country in 1989 was 16,806,000. That of Hambantota district was 502,000, and of Monaragala and Ratnapura districts, into which parts of the project area also falls, 339,000 and 911,000 respectively. The density per square kilometres is shown below.

(Unit: '000)

District	Population (1981)	Density per sq.km (1981)	Estimated Population (1989)	Estimated Density per sq.km (1989)
Hambantota	424	164	502	195
Monaragala	274	49	339	61
Ratnapura	797	243	911	273

Source: Department of Census and Statistics

The recent estimate of total population in the project area both old and new shown in the Table 3.5-1. It is observed that in the Extension Area most people live in and around villages. There is also a migrant population. Migrant families live and grow paddy or upland crops during the maha season. The population in the Extension Area however, fluctuates sharply

through the year. Furthermore, along the canal maintenance road of Ridiyagama on the southwestern boundary, are farmers who cultivate paddy under the Ridiyagama scheme.

A survey conducted by the MEA, in the Extension Area in 1992, revealed the presence of 6,018 households made up of 26,865 people. The distribution in the three divisions and Grama Niladari divisions within, each AGA division is shown below.

Division	No. of Families	Population
1. Hambantota, AGA Division		
1. Sisilasagama	508	2,308
2. Mirijjawila	338	1,489
3. Siribopura	365	1,564
4. Samodagama	188	889
5. Galwewa	224	1,070
6. Bellagaswewa	391	1,766
7. Siyagalagasvila South	253	1,130
8. Uda, Baragama	81	333
9. Arawanamulla	157	713
10. Pahala Baragama	233	1,)50
11. Managgawa	135	653
12. Badhigantota	271	1,206
Sub-total	3,144	14,171
2. Suriyawewa, AGA Division		
13. Mahawalikadara	373	1,476
14. Namadagaswewa	517	2,158
15. Andarawewa	234	981
Sub-toal	1,124	4,615
3. Ambalantota, AGA Division		
16. Godakoggalla	298	1,023
17. Koggalla	243	1,101
18. Habarattewala	339	1,574
19. Modarapiliwala	195	920
20. Siyambalagasvila North	175	830
21. Wadiwewa	299	1,377
22. Liyangastota	291	1,281
Sub-total	1,840	8,106
Total	6,108	26,892

3.5.2 Land use

(1) Old Area

In the Old Area which is developed, three distinct cultivated areas are evident. These are:

i) Sevanagala sugar cane area of about 5,400 ha;
ii) Kiri-ibbanwewa block of about 6,000 ha; and
iii) Suriyawewa block of about 5,100 ha.

The Sevanagala sugar cane area is technically managed by the Sevenagala Sugar Industries Ltd. on the basis of individual farm allotments, supplying cane to the factory. Yield has been consistently better under irrigated conditions. The crop is grown on a 4-year cycle of one plant crop and three ratoon crops.

The Kiri-ibbanwewa and the Suriyawewa blocks are managed by the Mahaweli Authority. Paddy is the main crop under irrigation. Other crops are small amounts of cereals, vegetables, grain legumes, chill and onion. Banana is also widely cultivated.

The current land use in the above blocks and in the Extension Area is summarized below, with detailed information in Table 3.5-3.

(Unit: ha, gross)

Land Use	Sevanagala	Kiri-ibban.	Suriyawewa	Ext. Area	Total
Agric. land*1	3,820	3,410	3,430	2,510	13,170
(irrigated)	(1,480)	(2,250)	(2,020)	(0)	(57,500)
Forest	170	100	160	1,460	1,890
Homestead*2	720	1,590	900	940	4,150
Shrub/Grassd.	450	0	280	9,760	10,490
Rock	60	450	250	750	1,510
Others*3	220	410	60	280	970
Total	5,440	5,960	5,080	15,700	32,180

Note: *1 Agricultural land includes irrigated paddy and sugar cane, rainfed paddy and chena areas.
*2 Homestead includes home gardens grown to upland crops.
*3 Others include tanks and roads.

(2) Extension Area

It is difficult to determine the present land use in the Extension Area, except for the three new unit areas of the Suriyawewa block that are managed by the MEA. Extensive shifting cultivation has destroyed almost entirely the natural forest in the area. Areas that are not in shifting cultivation are usually under secondary scrub jungle or grass (presently abandoned lands). Cropping pattern in the area shows that the cultivation in minor irrigation tanks is nearly similar to highland and chena cultivation. Cultivation is only during the maha season and is totally dependent on the rainfall, the difference being that areas under tanks are cropped with paddy while field crops are cultivated on the highlands.

In the Extension Area, there are 17 minor irrigation tanks (Table 3.5-1) with an estimated total command area of 720 ha but there is no assurance of supply for continuous cultivation.

About 90 percent of the farmers in the Extension Area depend on the rainfed cultivation. The usual crops are cereals, grain legumes and vegetables. From a discussion with the farmers it transpired that they are aware of the adverse impacts of shifting cultivation. But it is the main source of income for them. If the rains fail for two or three years, even this cultivation is not possible. Farmers have to be at the mercy of droughts, failed monsoons, weeds, insect pests, wild animals and even domesticated animals. The returns are therefore, never assured. What little is harvested is with much toil. If irrigation water is available and if they are provided land, they are willing to abandon chena cultivation.

In the traditional system, a community would utilize nearby land in between long fallows basing themselves permanently at a suitable residential site with drinking water. Some of the farmers in Hambantota and Suriyawawa AGA divisions live permanently outside the divisions where they have a homegarden, but during the cultivation season they practise rainfed cultivation in an encroachment.

In the present situation most of the farmers permanently reside in these areas, having very poor facilities; even drinking water being brought long distances by bicycle. There are also many farmers who are not totally dependent on chena, but who also cultivate irrigated paddy on a

small plot. Accurate data on shifting cultivation is not available because almost all land is illegally encroached Crown land.

Although, there is not much pasture land in the Uda Walawe project, a considerable amount of livestock farming has developed. Inspite of the many efforts, has been unimpressive. A coordinated attempt to develop livestock production was initiated in 1990 with the formal takeover of all livestock activities in the project area by the Draught Animal and Dairy Development Project of the Mahaweli Authority. Neat cattle, buffalo, goat, poultry and pig are the common livestock types.

Draught animals are, used to some extent by the settlers in cane fields and ploughing and puddling operations in paddy fields. Buffaloes have been also traditionally used in the land preparation for paddy cultivation, particularly in puddling while neat cattle is preferred for ploughing operations. Nevertheless the use of draught animals for land preparation remains low when compared to the two-wheel tractor.

A large majority of the animals are indigenous types characterized by low dolby weights and poor milk yields. The milk collecting centers controlled by the milk producers cooperatives have contributed only marginally; the majority of the supplies coming from independent producers. Transport from collecting centers to the chilling facility is not always reliable resulting in wastage.

Some farmers in the project area maintain large herds of cattle often exceeding 300 head. The Extension Area is used freely as a grazing land by nomadic herdsmen. These herdsmen, locally known as "gambara" are from towns bordering the Extension Area and are usually on the move in search of better pastures. The large number of small tanks scattered over the Extension Area serves as watering holes and the lush growth of grass, particularly in the drying tank beds, provide the much needed food. Their constant movement into and out of the area, makes estimation of the cattle population a difficult task, more so as the period of survey was exceedingly dry.

Based on discussions with four cattle owners, the cattle population using the Extension Area for grazing is estimated to be around 8000 herds. Nearly 50 cattle owners with individual herd sizes ranging between 50 to 350, use the Extension Area and the largely undeveloped lands northeast of the Extension Area for grazing. They preferred areas north of Wediwewa and Gonnoruwa (outside Extension Area) on account of the abundance of small village tanks and better pasture lands. The southern part of the Extension Area is mostly used by herdsmen from Ridiyagama and Hambantota areas.

The importance of livestock development in the project area can be viewed in terms of the benefits such as supply of draught power, provision of nutritional requirements, and generation of additional income.

The use of animal draught power in land preparation for paddy cultivation has declined rapidly from 46 percent in 1985 to 10 percent in 1991 (Table 3.5.4). For haulage purposes, use of animal draught is for the most part, localized in the left bank Old Area, where the other modes of transport are not well established. This is apparent from the use of bullock drawn carts to transport produce to the fair.

The benefits of livestock development need to be evaluated against the existing large herd of cattle in the Extension Area and the fact that livestock in a variety of forms that eventually will find its way to the development area along with the settlers.

3.5.3 Settlement

In the Extension Area, patterns of settlement are diverse. Encroachers have settled in a haphazard manner. However, the settlers/settlements can be categorized as follows:

a. Regularized settlers;

b. Regularized settlers under minor tanks and rainfed irrigation projects;

c. Regularized second generation settlers from the Ridiyagama systems along the western boundary;

d. Settlers who have encroached;

e. Settlements under the Janasaviya programme;

f. Settlements under the MEA;

g. Long standing permanent settlement under minor irrigation tanks awaiting regularization;

h. New settlements along the western boundary of the Extension Area;

i. Recent encroachments;

j. Lands allocated to organizations; and

k. Seasonal migrants;

The non-regularized farmers (encroacher) constitute approximately 59 percent of the total families in and around the Extension Area. Below is a summary:

AGA Division	No. of Families	Area (ha)
Hambantota		
Regularized	1,520	681.27
Non-regularized	1,624	657.15
Sub-total	3,144	13,38.42
Suriyawewa		
Regularized	281	208.77
Non-regularized	853	637.51
Sub-total	1,134	846.28
Ambalantota		
Regularized	698	382.42
Non-regularized	1,052	586.73
Sub-total	1,741	969.15
Sub-total Regularized	2,499	1,272.46
Sub-total Non-regularized	3,529	1,881.39
Total	6,028	3,153.85

Source: Udawalawe Left Bank Extension Project Census

Settlement in the Extension Area is largely concentrated around small tanks and along the western boundary of the project area as a result of natural expansion of the villages established under the Ridiyagama scheme. In fact, many settlers under the more recently established tank

systems were second and third generation members of original settler families in the Ridiyagama scheme. Some of the farm families leave the project area during the dry season for their home towns and again return for the maha cultivation. This has been practised for several years.

3.5.4 Income

The seasonal tanks in the Extension Area generally do not get enough water for successful cultivation. Only when heavy rains are experienced during a maha season, is cultivation possible. Hence paddy cultivation under these tank irrigation schemes is not a stable income source for most of the farmers.

The paddy lands under seasonal tanks in the Extension Area is mostly owned by the people living outside. They migrate during the maha season and reside temporarily.

Other income sources of farmers living in the Extension Area are by the collection and sale of the items indicated below:

a. firewood to surrounding areas
b. Wood Apple
c. Margosa seed
d. Tamarind fruit
e. Game and skins

Farm income is contributed in neighboring areas, eg: Suriyawewa and Ridiyagama. Furthermore, one of the most important income sources is the Janasaviya Programme, which is a grant aid program for poor people. Janasaviya beneficiaries receive Rs 1,458 every month for two years. They can spend Rs 1,000 per month on food and deposit Rs 458 per month in the Bank. The deposits can be used to buy agro-equipment after two years. The Food Stamp Scheme provided by the Department of Social Services is also an important income source for low income people. Foodstuffs and kerosene are supplied to beneficiaries through co-operatives.

The number of Janasaviya beneficiaries and Food Stamp beneficiaries in and around the Extension Area are as follows:

AGA Division	Janasaviya Holders	Foodstamp Holders
Hambantota		
Nos.	1,473	434
Percentage	46.9	13.8
Suriyawewa		
Nos.	506	115
Percentage	44.0	10.2
Ambalantota		
Nos.	165	1,082
Percentage	9.4	61.8
Total		
Nos.	2,144	1,631
Percentage	35.6	27.1

Source: Uda Walawe Left Bank Extension Project Census

The typical farm budget of Janasaviya beneficiaries, Foodstamp beneficiaries and other farmers is summarized below:

(Unit: Rs/year)

Item	Janasaviya Holder	Foodstamp Holder	Other Farmers	Sugar Cane Farmer
Agro-products	8,700	4,580	18,090	42,210
Livestock	750	230	6,220	240
Tree crops	30	160	0	0
Labor fee	3,390	3,380	3,230	2,620
Janasaviya	12,520	0	0	0
Foodstamp	0	2,870	0	0
Subsidy/Loan	1,870	1,450	4,530	5,700
Others	910	600	1,110	3,500
Total	28,170	13,270	33,180	54,270

Source: Farm Economic Survey, JICA Study

The above data shows that 44 percent of the total annual income of Janasaviya beneficiaries is derived from the assistance they receive under the programme. On conclusion of the programme after two years, a general sustainable upliftment in the socio-economic conditions of the farmers through the efforts of the beneficiary is expected. The Janasaviya beneficiaries are not entitled to receive foodstamps in the future.

The living standard of Foodstamp beneficiaries is much lower than Janasaviya beneficiaries. This appears to be the minimum level for subsistence. Most of them are included in the list prepared to select new Janasaviya beneficiaries. Comparison was made between right and left banks on the farm budget as follows:

(Unit: Rs.)

Item	Right Bank*1 3 Blocks	Right Bank*2 2 Blocks	Left Bank*3 2 Blocks
Farm Income	45,570	23,220	34,720
Off-farm Income	8,980	4,310	12,130
Total	54,550	27,530	46,850
Production Cost	30,010	19,990	21,920
Net Income	24,540	7,540	24,930

Source : Socio economic Survey done in Stage 1.
*1 Embilipitiya, Chandrikawewa and Binkama
*2 Murawasihena and Angunukolapelessa
*3 Kiri-ibbanwewa and Suriyawewa (irrigated)

In the right bank, Murawashihena and Angunakolapelessa Blocks experience water shortages. The five blocks in the right bank are therefore divided into two categories. Major farm income for farmers in the Old Area is obtained from the agricultural products under irrigated agriculture. In case of farmers in the right bank under better irrigation conditions, the annual income from agricultural production is approximately Rs 45,500 or 7 times that of Janasaviya and Foodstamp farmers in the Extension Area. Implementation of an irrigation project will go a long way towards improving the well-being of families in the Extension Area.

It was difficult to measure the economic status of farmers in the project area. Often farmers had access to highland plots, partial ownership of land or encroached land elsewhere, but the terms and conditions of ownership were loosely defined. In the Extension Area farmers don't have any part-time jobs which gave them some income. The lack of off-farm employment is

another difficulty. However, most of the farmers are disappointed by the lack of water, lack of potential employment around the project area, lack of facilities and poor health conditions.

3.5.5 Rural infrastructure

Some parts of the project area, viz. Sevanagala sugar area, Kiri-ibbanwewa and Suriyawewa blocks, in the Old Area are already settled and therefore basic rural infrastructure such as settlement plots, roads, schools, postal and medical facilities have been improved by the MEA (Table 3.5.5). However the scenario is very different in the Extension Area. A few organizations have moved into this area to provide very limited facilities. Hambantota Integrated Rural Development Project (IRDP) and Unesco are such organizations. Apart from that under the Government Agent's allocation certain limited facilities in the Extension Area have been improved.

The most difficult problems settlers face are lack of domestic water supply and transport services. Several farmers indicated that domestic water supply was a major problem they faced. Domestic water is supplied by bowsers once in two days. Public transport facilities are not available. Farmers have to use tractors or bicycles. Other problems faced by farmers include lack of medical facilities, schools and housing. Owning rice land and not just irrigated land was their primary motive in staying in the project.

(1) Housing

Clusters of houses are aggregated into hamlets, usually on highland areas. A hamlet is the smallest unit. In the Extension Area, there is some attempt at organized settlement under minor irrigation schemes and along its western boundary. Encroachers have built semi-permanent houses to stake legal claim to the land. Most of the housing units are of a temporary or semi-permanent nature (Table 3.5-6).

(2) Roads

The Old Area is well served by a range of roads. There is one "A" class road,numbered A 18 running on the right bank, while there are 40 "C" class roads and 27 "D" class roads, in addition to farm roads. Road A 18 links the A 2 southern highway with the A 4 from Colombo to Hambantota and further down.

The Extension Area on the other hand is poorly linked. One main gravel road -"100 foot road" - connects Suriyawewa and Mirijjawila in the south. There are no "C" and "D" class roads.

The road network in the Uda Walawe Special Area is illustrated in Fig.3.5-1 and is summarized below:

Class	Total Length (km)	Percentage of Total
A	56	7.2
C	129	16.6
D	193	24.9
Market I	75	9.7
Market II	23	41.6
Total	776	100.0

(3) Transportation

The bus or coach is the main means of transportation in the Old Area. Privately-owned cars are few. Many farmers use 2-wheel tractor and trailer, while others use motor cycles and bicycles, to move from place to place. People living in the Extension Area cannot stake claim to such modes of transportation let alone ownership, of cars and motor cycles.

(4) Communications

A central post office is located at Embilipitiya and divisional post offices are at Suriyawewa and Kiri-ibbanwewa. Telephone facilities are available at Embilipitiya only but there is no direct dialling to other parts of the country. The nearest such facility is at Hambantota. The Extension area lacks such facilities.

(5) Electricity

The existing electricity supply network is shown in Fig.3.5-2. Power from the Uda Walawe reservoir is supplied to the towns of Suriyawewa and Kiri-ibbanwewa, and to the sugar factory village. Power is also distributed to Hambantota and Tangalle. The Extension Area has no access to electricity. Some effort has been made to introduce biogas but without continued success.

(6) Sanitation

While the facilities in the Old Area are somewhat acceptable, those in the Extension Area are rather primitive. The summarized information below reveals the position in the Old Area.

Area	Percent		Latriness Temporary		Semi-permanent	
	Nu	%	Nu	%	Nu	%
Kiriibbanwewa	549	35	2,558	65		
Suriyawewa		20		60		20

(7) Water supply

In the study area, tube wells, open wells and streams are the predominant sources of water. Due to high salinity levels most of the tube wells are not suitable for drinking purposes. Most farmers have open wells which are about 10 m deep with a water depth 0.3 to 3.0 m. Many of them dry out in the dry season. The sugar factory village and Suriyawewa town have water supply schemes and beneficiaries number 364 and 250 respectively.

At present, domestic piped water supply is available in the urban areas of Ambalantota and Hambantota. Two intakes at the Walawe River are used to obtain water for Ambalantota and Hambantota.

In Ambalantota 125,000 persons benefit from piped water while in Hambantota, 150,000 persons receive potable water. The average consumption is 30 liters/person/day.

Abandoned ancient village tanks are a common feature in the project area. Most of them dry up fully or partially during the dry season. These tanks are normally found in topographic depressions. Therefore an accumulation of salts take place which is subsequently fed into the

groundwater system with the next rains. Pollution by man is insignificant in this area. Apart from high EC levels, the ground water in the coastal belt shows a high content of fluoride. This problem mainly exists in deep aquifers in the eastern part of Hambantota AGA division. High fluoride consumption has long term effects such as decaying of teeth and bone structure of humans.

High concentration of iron in the ground water is another problem. Though this is not a health hazard, it gives an undesirable taste and also stains clothes and vessels. It is a serious problem in the western part of the Hambantota district and has contributed to deterioration of the interior parts of tube well hand pumps. Aeration and water filtering in iron removal plants can reduce the high iron content, but the filter media should be cleaned frequently.

Some of the depression springs in the Hambantota district are being used for water supply schemes. Middeniya spring is one of the examples. Depression springs are formed when they occur in a structurally weak area. There is no direct relationship between source of springs and geological structure. In the Vijayan series of the geological formation project area, springs are not found, except the hot springs at Mahapelessa. The presence of high Cl- in the spring water is a feature. The Cl^- content remains constant without changing significantly with time. According to Cooray (1967) the chloride content was 2,574 ppm and it was 2,630 ppm when the spring water was analyzed by Fonseka et al in 1969. The analysis done by the Water Resources Board indicates a chloride content is 2,575 ppm.

(8) Health care

Investigations have revealed that malaria, dysentery, amoebiasis and skin diseases are most common in the project area. Three vector-borne diseases have been reported. The most common is malaria while Japanese Encephalitis and dengue also occur. The incidence of filariasis has also been reported. The Anti-Malaria Campaign is operative in the project area.

Although amoebiasis and dysentery are most common water-borne diseases, many of the settlers build up resistance or at least tolerance, and rarely seek medical treatment. It is clear, that there is a high incidence stemming from two human behavioral characteristics. One is that very few proper latrines are in use. The other is that very few people in the project area boil water before drinking it. Farmers frequently drink from irrigation channels when they are working in the field.

There is no centralised supply of domestic water. The supply of domestic water is limited and it is not adequate. Several settlers complained about the water supply by bowsers and the quality of water. A very limited water supply has been given to the townships of Suriyawewa and Kiri-ibbanwewa.

The reduction of water-borne diseases through improvement in sanitation and drinking water supply in the rural areas in the some parts of Extension Area has been an objective of many initiatives by the Department of Health, Hambantota IRDP (HIRDP) and Unesco for many years. HIRDP has funded several programmes in community and environmental health. A major project has provided improved latrines on a self-help basis, whereby household labor is used to dig pits and build the walls and roof and HIRDP provides a concrete squatting slab, a siphon and the materials for the roof and walls. Between 1983 and 1990, HIRDP has provided assistance for 25,000 latrines. These programmes are implemented under "AGA/GA Development Projects" and "Local-level planning" by line agencies and by private voluntary organisations such as Sarvodaya.

Malnutrition is very common among the settlers due to poverty. Every Saturday (the day of the fair) at Suriyawewa, the Government Dispensary provides treatment to approximately 150 people. Surveys in 1975/76, 1980/82 and 1987/88 showed malnutrition among young

children, and anaemia among the whole population, to be quite widespread in the Extension Area. Acute malnutrition was found in 6.3 percent and chronic malnutrition in 29.7 percent of pre-school children and pregnant women. Vitamin A deficiency is also fairly prevalent.

A breakdown of treatment given by the medical officer at the Suriyawewa Government Dispensary on 25th July 1992 is as follows:

Complaint/Location	No. of People Teeated
Malaria from Extension Area	01
Amoebiasis from Extension Area	03
Skin disease from Old and Extension Areas	08
Fever (type not known) from Old and Extension Areas	23
Asthma from Old and Extension Area	42
Vitamin deficiency from Extension Area	12
Teeth decay from Extension Area	06
Various complaints due to malnutrition from both areas	18
Total	113

The existing health facilities are as follows:

Sevanagala area - Government Dispensary with one ward and 15beds
Dispensary maintained by the sugar factory
Midwives 2
PHI 1

Kiri-ibbanwewa - Ayurvedic Dispensary with one ward, but not yet opened
Midwife 1

Suriyawewa - Government Dispensary 1
Midwives 3
PHI 1

Several health education programmes are being conducted in the Suriyawewa block since 1990. Some of the programmes are as listed below:

- Family Planning
- Nutrition
- Health Awareness
- School Health Education
- Immunization

(i) Other environmental health hazards

Poisoning is a major cause of death in the Hambantota AGA division. In the country as a whole it is the second highest cause of death in hospitals. Two types of poisoning have been reported: (i) misuse of chemicals and (ii) suicide. At least three cases of attempted suicide are being reported per week in the project, area. Snake bite is another major environmental health hazard among the Sri Lankan farmers, especially those clearing jungle land. The main threat is from the viper. More than 250 patients per year are brought to hospital in the Hambantota district, with the largest proportion coming from the Uda Walawe and Kirindi Oya schemes. Ayurvedic treatment is often administered,

reportedly with high success rates, but such treatment does not get recorded, as are the fatal cases that occur outside hospitals.

3.6 Urban Development

The project area is essentially rural in character and is one of the least developed areas in the country. The development of urban areas takes place only slowly. The towns in the project area are Suriyawewa and Kiri-ibbanwewa. On the right bank is Embilipitya, which can boast of many modern amenities. Outside the project area on the southern coast are Ambalantota and Hambantota. The latter is a district administrative centre. Improvements can be brought about to make them more attractive; for example, better waste disposal and aesthetics.

3.7 Industrial Development

Industrial development in the Walawe basin has not been one of the priorities. Large industries are confined to the sugar mill, the distillery and the paper mill. Besides, there are rice mills and saw mills scattered within the developed area.

3.7.1 Sugar mill

The Sevanagala sugar mill was commissioned in 1986 with a rated capacity of 1,430 tones cane per day. The season lasts for 200 days, at 150 operating hours a week. It is proposed to expand the capacity to 5,000 tones cane per day in the next few years. In 1991, cane production was 121,557 tones, on about 4,000 ha of land. The sugar recovery was 8.63 percent. Annually about 10,000 tones of sugar are produced.

By-products include molasses, bagasse, trash and filter mud. Other possible by products are methane, bio-fuel and single-cell protein. Only the molasses, bagasse and filter mud find applications. Molasses, a rich source of sugars, is used mainly for the production of potable alcohol, the local demand for which cannot be met by the production in four mills operating in the country presently. Filter mud is rich in organic matter and phosphates and is used to manure degraded cane fields. Bagasse is used to fire the factory. Trash can be used as cattle feed when treated with sodium hydroxide, molasses and yeast. No environmental pollution results from the sugar mill.

3.7.2 Distillery

The distillery is small and has a capacity of 250 hl of absolute alcohol per day but produces 150 hl other than the molasses from the sugar factory, it uses a further quantity obtained from elsewhere. The primary products are rectified spirits from which, after redistillation, the required silent spirits are obtained for blending with various essences and concentrates. Other possible products can be power alcohol, fine alcohol and quality potable alcohol. The factory needs to find solutions to effluent disposal.

3.7.3 Paper mill

At Embilipitiya, on the right bank, a paper mill was estabilished in 1978, designed for the use of large quantities of rice straw. Although not in the project area, the factory effluents can impact on ecosystems unless treatment is satisfactorily done to discharge under permissible levels.

3.8 Disasters

The area has been relatively free of natural disasters. No recent floods have occurred. However,a severe drought occurred during the late 1980s and continued into the early 1990s. In fact,in 1992 drought conditions have been critical in most parts of the project area. Rainfall has been much less than in previous years.

Due to the low flow of water into the Uda Walawe reservoir, at the beginning of this season, MEA had to limit the extent of cropping.

In the yala season (June 1992) the cultivated area was 4,050 ha which is 35 percent of the average cropped area in both left and right banks. In June and July 1992, irrigation water was supplied for only two days a week. Paddy cultivation decreased while banana and other field crops increased. Serious shortage of drinking water also occurred in the Extension Area. Wells dried up and water quality also deteriorated.

3.9 Institutional Support Services

The Walawe basin was declared as a "special area" under the Mahaweli Act of 1979. It is administered and managed by the Mahaweli Authority of Sri Lanka (MASL). The MEA a component of MASL, bears responsibility for settling farm families and promoting socio-economic development.

The MEA introduced a new concept in settlement project management, where three geographical units - project, block and unit, are the responsibility of a Resident Project Manager, Block Manager and Unit Manager respectively, for integrated development and management. Settler families number 10,000 to 15,000; 2,000, and 400, for the project, block and unit areas respectively. The project organisation is shown in Fig. 3.9.1.

A number of government institutions are engaged in providing services required by the farmers and settlers. While some of the services are provided by government line departments, yet others are made available by the MEA, particularly in the agricultural and animal husbandry fields.

(1) Sugar cane

A Sugar Cane Research Institute is functioning at Uda Walawe and extension work with the cane farmers is provided by the Sevanagala Sugar Industries. Training is also an important component.

(2) Agricultural extension

In the MEA-managed area, agricultural extension is the responsibility of a Deputy Resident Project Manager, who is assisted by three Subject Matter Officers. Down the line are a Block Manager, an Agricultural officer, an Unit Manager and a Field Assistant. Farmer training takes an important place in the Training and Visit (TV) system of technology transfer. Other techniques utilized are demonstrations, field trials, field days, varietal adaptability trials, fertilizer demonstrations and integrated pest management.

Training of officers takes place within and outside the project area, and a monthly research-extension dialogue is held at the Agunakolapelessa Agricultural Research Station.

(3) Livestock

Assistance to improving livestock production is provided by the Draught Animal and Dairy Development Project of the MEA. It is mainly aimed at upgrading the low-performing indigenous stock. Stud centres and track breeding centres have been established. With the assistance of the Department of Animal Production and Health, routine vaccination has been conducted.

(4) Agricultural research

An Agricultural research centre is located at Angunukolapelessa. Current research priorities are in banana, groundnut and sesame, under rainfed conditions.

(5) Extension area

In the Extension Area, the Department of Agrarian Services has provided services in a limited way. Poor accessibility, seasonal nature of farming, and widely scattered farmers, have militated against a more organised service.

(6) Agricultural inputs

The Department of Agriculture Supplies improved seed through the MEA. Farmers also use their own seed from the previous season. Seed cane is supplied by the Sugar Industries.

Fertilizer is mostly made available by the Ceylon Fertilizer Corporation through the MEA. Each block office has a warehouse from where issues to farmers are made. The agrochemical trade is handled by the private sector.

(7) Agricultural credit

Institutional credit is provided mainly by the two state banks on similar terms. Banks have functioned on an area basis in order to avoid competition and duplication. Some products such as planting material and fertilizer are issued to farmers and payment is made to the suppliers by the banks. Recovery of credit for paddy has ranged from 66 percent to 88 percent between Maha 1988/89 and Maha 1989/90.

3.10 Religious and Cultural Resources

In ancient times too, this area had been the home of farming communities. In the then day to day lifestyles of the people, religion and culture were intimately linked. The culture of the stupa (*dagaba*) tank (*wewa*) and village (*gama*) is also evident when gleaning through early literature. Leonard Woolf in his work, "Village in the Jungle" described the area as "the country of breached and ruined tanks". The Uru-Sita Wewa is monumental to our ancient-hydraulic engineering skills. The scanty population of the area during the early part of the twentieth century is attributed by Woolf to the devastation caused by the spread of malaria. Entire villages had been wiped out.

Among the present day settlers, there is awareness of the great achievements of their ancestor in religious, cultural and technical spheres. The people are anxious to cooperate in preserving existing artefact, archaeological sites or monuments, including those that may be unearthed in the future.

Many temples built in recent times have developed as places of worship. They also cater to the spiritual needs of present day settlers in the Old and Extension Areas, The main temples of historical interest are those at Madunagala and Karambalagla. Both are believed to have been the abodes of the clergy, some of whom achieved a very advanced spritual state.(*arahats*). They are both forest hermitages where monks devote much of their time to meditation, in search of supreme bliss *(nirvana)*(Refer to Fig. 3.4-1).

3.10.1 Madunagala

The Madunagala forest hermitage or monastery is surrounded by the only, virgin forest of any significance in the entire project area. It is situated southeast of Suriyawewa and is about 13 km from Ambalantota, through Ridiyagama. It dates back to the second or third centuries B.C,when this region of the country was part of the kingdom of Ruhuna.

Madunagala has been a much sought after place of worship in olden times, attracting pilgrims from near and far. It continues to be so presently. Concealed in thick forest, a truly serene atmosphere pervades the entire locality.

The hermitage complex provides for the needs of the clergy in their quest for spiritual reawakening. Alms are provided by the people, coming also from outside the area. About 30 caves (*kutti*) provide seclusion to meditating monks. Each of the caves has its own toilet and a *sakmam maluwa* beneath the cool of the trees. The caves exhibit drip ledges (channels on the rock above the entrance to drain away rain water).

There are brahmi inscriptions on the walls of some of the caves. Inscriptions are also found on a rock outcrop where there is aiso a figure of a cobra head carved out in rock. In one of the caves there are statues of bears. Legend has it that bears came near the hermitage to listen to the chanting of religious stanzas (*pirith*).

From the inner terrace of the hermitage, a spiral staircase, carved in rock, leads to the summit of the Madunagala rock, where a stupa (*dagaba*) stands. The forest around, is home to a variety of animals. Of the mammals, the elephant is the largest. Deer, sambhur and monkeys are also found in large numbers. Leopard has been sighted.

3.10.2 Kurambagala

The Karambagala forest hermitage is not far away from the Madunagala hermitage. The name is derived from the presence of large creepers called *karamba (Carissa spinarum)* and large boulders (*gala).* Karambagala is higher than Madunagala. There are only about 10 caves and these too exhibit drip ledges. Ancient brahmi inscriptions are also found, as are tiny fragments of paintings on the ceilings of caves. A stupa perches atop the rock. Amidst the rocks are rock pools that never seem to run dry even during very dry periods.

3.10.3 Hot springs of Mahapelessa

The hot springs lie close to the forest hermitages described earlier. It is widely believed that *arahats* living in the nearby forest hermitages used these hot springs. It is also believed that wild animals particularly, the old, sick and wounded, were attracted to the thermal springs, perhaps due to some therapeutic value in the water. The presence of carcasses and bones of elephants has led to the belief that elephants come to this spot to spend their last days, seeking the peace and solitude that Mahapelessa provides, and perhaps, even benefit from the unknown curative properties of the hot springs.

3.10.4 Ancient stone sluice

The ancient sluice of the Mahagama Tank is unique in that it typifies the engineering marvels of the ancient Sinhalese. Present day engineers, surveying for construction using sophisticated instruments, came to determine the identical spot for the sluice as was constructed by the ancients. The ancient structure is now preserved and the new sluice has been moved to another location. The ancient structure is referred to as the *bisokotuwa*. It is a squarish stone structure paved with firmly quarried stone, and is meant to regulate the flow of water while at the same time preventing silting. It is comparable to the valve tower and valve pit of modern irrigation works. The ancient Sinhalese engineers are credited as the inventors of the surge chamber and the valve tower, and also having incorporated these two principles in the same structure, the *bisokuttwa*. Placed over the ancient sluice is a seven-headed cobra carved of a monolith. The whole structure is artistically done.

4. ENVIRONMENTAL IMPACTS

The implementation of any project leads to at least some modification of the state and quality of the environment. Many of the factors involved are inter-related. As this project proposes the upgrading of the existing Old Area and development of an area already degraded, the proposal is not likely to produce significant adverse impacts. It is not likely to bring about serious changes in hydrology, climate and topography. On the contrary,there is much economic benefit from development through rational land use, rehabilitation of non- productive land and provision of irrigation water to lands that are now unproductive and are in various stages of degradation.

The proposed project is not developed as a "one-off" reservoir development concept. It has been identified as an important aspect of a small tank cascade system.

The Extension Area is categorized as non-forested land in the natural vegetation classification. Secondary forest and scrub jungle will be cleared for paddy cultivation and other infrastructure. Environmental impacts of the project are discussed under existing impacts, predictable impacts of an adverse nature, and beneficial impacts, that will accrue as a result of the project being implemented. Fig.4.1-1 illustrates possible impacts, evaluated in three categories, viz.high impact (H), moderate impact (M), and negligible impact (N). Where inadequate data precludes prediction and assessment, it is categorised as an unknown impact (U) and merits further study.

Beneficial impacts are not assessed. Existing industrial activity, although outside the project area, as far as the main polluter is concerned, is nevertheless taken into reckoning for future work.

4.1 Existing Environmental Impacts

4.1.1 Industrial pollution

(1) Paper mill

The paper mill has two types of effluents, - the normal effluents- resulting from washing of straw, and the black liquor resulting from cooking of straw in caustic soda. The former is relatively harmless and may amount to 18,000 m^3 per day. Table 3.3-2 indicates the quality of Walawe River water, sampled at four points in 1983. The main component is organic matter as revealed by high Chemical Oxygen demand (COD) and Biological Oxygen Demand after 3 days (BOD^3) values. It contains about 2.2g of sodium hydroxide per litre and has a pH of around 10. Daily, about 10,000m^3 of effluent has been discharged earlier. A major fear is the

contamination of the drinking water pumped to Ambalantota and Hambantota. River water is also used by the people along its way. Impacts on aquatic life in the river and in the estuary is another area of concern.

The black liquor effluent containing caustic soda and lignin, presently constitutes a major problem. The chemical recovery plant is not functioning as it has not been capable of dealing with the heavy lime content in the rice straw. The effluent is now stored in an open pond and discharged at intervals via a pipe to the Walawe River. The problem of black liquor discharge needs to be studied further. While this is by no means the perfect solution, it would be necessary to pursue research and development towards a rational solution, so that large quantities of paddy straw available in the Walawe basin, can be readily utilized, and those dependent on the water resource will not be deprived of a legitimate right.

(2) Distillery

The by-products of the distillery are carbon dioxide, slop or stillage, and fusel oil. By improvements to the distillery process greater efficiency can be obtained.

The slop or stillage production amounts to about 136382 litres per day. It is rich in calcium salts and yeast, and has appreciable amounts of nitrogen, and potassium. There is neither recovery of yeast nor is it used as a source of plant nutrients. With the introduction of certain process changes, the resulting slop can be used to irrigate agricultural fields. It is presently ponded in a lagoon where natural mechanization of organic matter takes place. Strong odours are generated. The effluent is discharged into the Walawe about the same time as the effluent discharge from the paper mill.

Fusel oil production can also be reduced with process changes. It is used as an industrial solvent and as a wood preservative. Likewise the amount of yeast produced will also be low.

(3) Other sources

There are a number of rice mills and saw mills in the development area whose by-products of husks, and saw dust and wood shavings, are found in large quantities. There has been no survey of these although possibilities of use as energy sources are likely.

4.1.2 Agricultural pollution

The Old Area of the left bank is primarily geared to the production of paddy,sugar cane and a variety of field crops. The newer varieties of paddy are highly fertilizer responsive and naturally inorganic fertilizers are used to a great extent to obtain satisfactory yields. Likewise a variety of pesticides are also used.

It is quite likely that departmental recommendations are not strictly adhered to. While some farmers use little or no fertilizer and agrochemicals, others use amounts in excess. The Department of Agriculture has recommendations on fertilizer application for different crops, specifying dosage and time of application.

Sugar cane is grown on approximately 4,000 ha of land managed by the Sevanagala Sugar Industries. Irrigated paddies occupy about 600 ha in the sugar cane area. In the MEA-managed blocks of Kiri-ibbanwewa and Suriyawewa the potential for cropping is as follows: irrigated area - about 4,300 ha; irrigable area where water is not readily available - about 7,000 ha; and homesteads - about 3,800 ha.

In paddy cultivation, inorganic basal mixtures, urea and top- dressing mixtures are used. Organic manures are rarely used. Even if desired, unavailability of organic in large quantities, precludes such use. Of the weedicides, MCPA, 3-4 DPA, Macheet and Saturn are widely used. Besides, pesticides are used in the control of pests such as brown plant hopper, stem borer and diseases like blast and sheath blight. Organophosphates and carbamate are mostly used groups of pesticides.

Sugar cane is fertilized with inorganic basal mixtures and top- dressings. Grammoxone and Diuron are the commonly used weedicides. In the cultivation of grain legumes and vegetables too, fertilizers and pesticides are often used.

Not all the nutrients are absorbed by the crops. Depending on soil and weather conditions, part of the nutrients are lost by run-off into surface waters and by leaching into ground water.

In the Extension Area, small amounts of fertilizer and agrochemicals are used in the minor schemes that have been established by the restoration of old tanks. The upland shifting cultivators do not use such inputs.

Nitrogenous fertilizer will eventually be converted into the nitrate form and move into surface and sub-surface waters. Excessive amounts, along with high phosphates, promote the growth of algae, aquatic plants and causes eutrophication. Aquatic plants can choke tanks and canals and hinder water flow and promote water loss. Other potential uses of these water bodies will be impaired. Oxygen in the water is depleted. In such a situation aerobic organisms will die and decomposition of the dead organisms under prevailing anaerobic conditions will give rise to acids and other toxic compounds. With high levels of nitrogenous fertilizers, accumulation of nitrogen compounds within the plants will increase and make them more susceptible to pests and diseases. In infants, nitrates on conversion to nitrites, can interfere with the ability of the blood to transport oxygen. This condition is called methaemoglobinemia.

The Extension Area will provide opportunities for systematic farming practices with greater productivity and increased use of inputs. Traditional methods of pest control have been tried in the past and may be worth evaluating in order to minimize chemical use. Integrated pest management techniques are also being carried out.

Information is not available on the residual levels of fertilizer and agrochemicals in the receiving waters and in the soil. Therefore, as a matter of priority, a programme for analysing residues is imperative, in order to take precautions if levels are excessive or to allay undue fears if amounts are within permissible levels.

4.1.3 Salinity and salt water intrusion

The Walawe river enters the sea at Ambalantota, while some distance from the river mouth, the water flow branches off eastward into a lagoon at Godawaya. This water does not enter the sea because of a sand dune. Sea water enters the lagoon by seepage through the dune and affect the surrounding land. Between the river mouth and the lagoon about 1,214 ha of paddy land are affected.

Sea water can enter the river during times of low flow unless the mouth is closed by sand dunes. Generally the mouth closes in August. With the onset of the northeast monsoon and with increase in river flow, the sand dune gets cleared. The intake for the Ambalantota and Hambantota water schemes is located about 5.0 km upstream from the estuary in order to prevent pumping of saline water. Analysis of the river water a little upstream of the river mouth, in November 1991, indicated an electrical conductivity of 236 us/cm (Table 3.3-2). Ground water samples taken from six wells in the project area, show high levels in terms of electrical conductivity, and dissolved chloride and fluoride ions, making such water unfit for

irrigation and drinking purposes. Unless drainage is effective salinization of irrigated fields can take place over time. Therefore it is important that drainage be given adequate recognition in project planning.

4.1.4 Land and water use

(1) Old area

In the Old Area, land has been more or less fully developed although not always on a rational basis. An example is the growing of paddy on the reddish-brown earths not in keeping with suitability of such soils for paddy. A fundamental mistake has been made and large quantities of water are wasted due to permeability of these soils. Excessive use of water will cause considerable leaching of nutrients. Problems associated with nutrient-rich surface waters are discussed in section 4.1.2. In spite of the excess water released from the reservoir, there are shortages in the lower reaches because the distribution network is not functioning efficiently. Some of the problems are erosion of canal banks, inappropriate side slopes, high flow velocity in the earth canals, lack of bank protection and damaged mechanical structures.

(2) Extension area

The Extension Area has been subjected to shifting cultivation for a long period to the extent that the natural vegetation of Dry Mixed Evergreen Forest has been reduced to a degraded scrub jungle. The small tanks scattered in the area, often do not hold enough water even to supplement a poor maha rainfall, let alone permit a yala cultivation. The total command area of these small tanks is estimated to be only 300 ha. The type of farming as carried out presently, is not in anyway conducive to sustainable resource use. Much of the top soil is eroded. Nutrients lost due to run off and leaching are not replenished either naturally or artificially. Due to haphazard timing of operations considerable build up of pest populations can occur leading to a further reduction of the low yield that is usual. Depredations of wild animals, particularly the elephant, and to a lesser extent of birds, often leave the farmers in desperate situations.

(3) Flooding

The Walawe River does not have an extensive flood plain. No major floods have occurred within the basin. It appears that sediment transport in the river is not high, as it traverses forested mountain stretches before dropping onto the plain. However, flooding along the coastal plain in proximity to the river mouth has occurred, not so much due to the river overflowing but due to heavy rain. Flooding of the area around Karagan lewaya causes problems to about 300 settlers in the Alokapura housing scheme.

Hambantota had gone under water in 1957,1969, and 1990. It appears, that a major flood occurs in this area every 10 years. Ninety-six houses were affected of which 31 were temporary and 65 permanent.

4.1.5 Socio-economic environment

People are also part of the environment and just as much as their actions impact on the environment, their plight vis-a-vis their environment also needs careful consideration. Section 3.5 describes the conditions under which people live, particularly in the Extension Area. Suffice it to say that, emancipation of these peoples from abject poverty, should be the concern of all right-thinking institutions and people, not to mention it as responsibility of government.

4.2 Prediction and Assessment of Environmental Impacts

The greater part of the project area does not contain natural vegetation of a primary nature because the Old Area has already been converted to farmland and the Extension Area has experienced long years of shifting cultivation. Although adverse environmental impacts are not as severe as would occur with clearing of primary forest, some degree of impacts will have to be countered.

4.2.1 Biotic environment

The clearing of the existing vegetation of the Extension Area and its replacement with a vegetation of domesticated crops, some of which will be as monocultures will be the major change that will occur. Aside from the loss of the natural plant cover, there will be an overall impact on the soil, micro-climate and animal populations. Some of these will be of a temporary nature, for example, the likely loss of soil due to wind and water during canal construction and initial field preparation. This can however, be compensated by subsequent sound agronomic practices. Micro -climatic changes will be compensated for when the water begins to flow. Water will be provided to an area, hitherto subjected to seasonal moisture stress. New niches and ecological associations will be established when perennial water supply is instituted.

Those impacts of a long lasting nature will be the conflicts that are very likely to arise between man and elephant, unless the necessary precautions are taken. Yet others will be encountered in the post-project establishment period and these will be management related.

(1) Terrestrial flora

The single largest impact will be the elimination of a large area of the existing scrub vegetation that also serves as wildlife habitat. Wildlife habitats will be eliminated. The existing vegetation being a provider of fuelwood, a void will be created in this regard.

Due to the continued availability of water, a more luxuriant vegetation will be seen in the undeveloped areas adjacent to watercourses due to a beneficial water table.

(2) Aquatic flora

Other than what naturally grows on canal banks and on the edges of other water bodies, there can be a proliferation of water weeds, when the tank and canal network expands. Floating weeds such as *Salvinia, Eichhornia* and *Pistia* can choke water bodies, interfere at penstocks,provide habitats for disease vectors, increase evapotranspiration losses, reduce fish and other organisms and interfere with human use of waterbodies.

When waters are enriched with nutrients, phytoplankton will increase and later can result in eutrophication of closed water bodies.

(3) Terrestrial fauna

(i) Elephant

The elephant is listed as an endangered species in the IUCN Red Data List. The proposed development in the Extension Area will reduce by nearly 50 percent, the existing range of the pocketed herds, numbering 150 to 160. The animals will continuously be confined to the area surrounded by Gonnoruwa -

Badagiriya, Gonnoruwa - Mattala and by the Kirindi Oya Irrigation and Settlement Project (KOISP) right bank canal running from Wirawila to Badagiriya. The carrying capacity of this area after project implementation will not support the continued survival of 150 elephants. Elephant movement to Ridiyagama will not be possible as happens now (Fig. 4.2-1).

Hence, as their only alternative, they will sneak into village tanks for water, and forage in cultivations and home gardens. More often than not, they will be pushed to finding refuge in the Bundala Sanctuary and raid farmers in the KOISP right bank. Project farmland along its eastern border will not be without elephant degradation. They also can take refuge in the uncleared jungle pockets around Ridiyagama, Karambagala and Madunagala, and also in the Forest Department's eucalyptus plantation in the southeastern edge of the project area.

As sugar cane cultivation is a high priority in the proposed basket of crops, keeping elephants away from such juicy meals will be difficult, if not impossible. The economic losses, although not quantified in this report, can be tremendous. To ignore the implications of the presence of a 150-strong herd(s) in and around the project area, will not be in the long-term project interest. On the other hand, the elephant, considered a national treasure, will be the victim of a losing battle with man, in an environment that would gradually become more and more inhospitable to both parties. The conflict with the elephant will be the major environmental issue needing resolution at a very early stage. To undertake the implementation of the project, without paying heed to the elephant will be somewhat foolhardy.

(ii) Other wildlife

With the elimination of large areas of scrub jungle, the remaining species such as the flying squirrel, rock squirrel, purple-faced langur and the Ceylon Gray Langur will be pushed into the remaining pockets particularly the Madunagala - Karambagala forest and the nearby Bundala Sanctuary, and these will offer compensation to some extent. Species such as the wild pig, rat, and tilapia, have the ability to adapt remarkably well to habitat change. The terrestrial species can breed fast and assume pest proportions damaging crops such as sugar cane and paddy. The wild pig, predated by the leopard, will have a free range to multiply rapidly in the absence of the leopard. The tilapia is a rapid breeder and can eliminate smaller species in its aquatic habitat.

(iii) Birds

The removal of the existing vegetation will impact to some degree on the bird population, both resident and migratory. While some of the affected resident species will move to new grounds, others such as the parakeet and the munia will adapt to the new habitat remarkably well, even by changing the usual feeding habits. For example, parakeets will switch from being fruit eaters to grain eaters.

Migratory birds in the category of forest dwellers will find a considerable reduction in the usual habitat. On the other hand inhabitants of aquatic habitats will have enhanced places as a result of project implementation. The project area happens to be located at the southern-most point in the migratory route along the Indo - Asian Flyway, far beyond to the south, is the vast Indian Ocean (Fig. 4.2-2).

(4) Aquatic fauna

The impacts on the aquatic fauna mostly relate to the presence of agrochemicals, fertilizers and sewage in detrimental quantities. It is likely that use of chemicals-both pesticides and fertilizers will increase with more land being brought under cultivation. With more people settling, human and livestock pollution is also likely.

There is inadeqnate information on the presence or absence of chemical residues in the receiving waters.

If it is the case that surface waters do get polluted from the sources mentioned, then the invertebrate populations and fish will be affected initially. Then begins a chain reaction up the food webs leading to bio-accumulation in the higher living forms, manifested in various ways leading finally to depleted populations of fish, birds, reptiles, amphibians and mammals.

4.2.2 Physico-chemical environment

(1) Soil

During the construction stage, when the natural vegetation is removed, the soil will be exposed to the elements. The hot temperature will soon burn up what little soil organic matter there is and there will also be a breakdown of soil structure under the impact of heavy machinery. The impact of which will be higher if the work takes place during wet weather. The likelihood of soil loss due to rain in the monsoon months of October, November, December and January, and loss due to wind erosion during the dry months, is a possibility. The soil will also be worked seasonally when new crops are planted. Continued working will deplete the physical properties of soil unless adequate precautions are taken.

During this early stage, when initial land clearing and preparation for holdings, is carried out, soil compaction, surface run off, flash floods, sediment transport, sediment deposition and alternation to natural drainage systems are likely to occur.

(2) Water quality

(i) Surface water

The Walawe River is a major source of domestic water for the inhabitants. Surface water in the project area can be affected by one or all of three ways. These are by fertilizers and agrochemicals, industrial effluents and faecal pollution. Impacts on water quality due to agricultural pollution have been addressed in section 4.1.2. In the absence of analytical data on pollution by agrochemicals, fertilizers and human waste, no firm conclusions can be made.

Surface water pollution from industrial effluents is not very significant except during the period of effluent discharge into the Walawe river. The main component of the effluent is organic matter evaluated by high COD (Chemical Oxygen Demand) and BOD3 (Biological Oxygen Demand after 3 days). While it is beyond the scope of this report to address such issues, nevertheless cognizance should be taken of the presence of such potential impacts that can be of a significant nature in the quest for a pollution-free river basin. However, the responsibility lies outside MASL boundaries.

(ii) Ground water

There is no evidence to suggest large-scale impacts on groundwater quality and quantity due to the project. The main source of ground water recharge is rainfall.

However, small-scale impacts can occur due to excessive conveyance losses in deep percolation zones and side seepage,higher operational losses in the irrigation system and substantial field application losses. In the Walawe area percolation rate is extremely high. According to the field survey, about 80-100 percent of percolated water reappears in the immediate downstream drains. Unlined channels may allow the recharge of groundwater.

(iii) Salt water intrusion

The river mouth is closed during the dry season due to the formation of a sand bar. During the wet season, the sand bar is breached by the higher river flow. Hence salt water intrusion up the river is not foreseen.

4.2.3 Socio-economic environment

(1) Demographic changes

The population of the project area will gradually increase. Firstly, there will be the influx of skilled and semi-skilled workmen when construction work commences. The unskilled workmen can be drawn from the area although certain aspects of work will attract this category of worker from outside the area. The services will be provided in part by the project management and by the private trade. This increase in people is of a temporary nature, and will not impact on the environment in a significant way.

Settlement will bring in the next influx of people; this time of a permanent nature. Of those settled, farming families alone will amount to 5,000 to 6,000, some of whom have been living in the area more or less on a permanent basis.

New opportunities will attract traders, craftsmen, small time service industrialists, and administrators. Under these categories, permanent residency will mostly be evident, although for the present and next one or two generations, 'home' is also where they originally came from. That 'home' will beckon them seasonally due to strong family ties.

A factor to be taken into consideration at project planning is the natural increase of population among the permanent settlers and the need to provide economic opportunities to the generations that follow, through means other than farming, where saturation point will be reached soon. To relieve the pressure on farm land, government policy interventions are necessary.

A large scale dislocation of people is not anticipated. There can be some resettlement to be considered when the final plans are made on the Timbolketiya weir construction and canal link to the right bank main canal. These are presently under consideration.

(2) Fuelwood supply

Fuelwood is a widely used source of energy in the project area and will continue to have future demand as well. But the availability of fuelwood will decrease, as more land is being cleared for agriculture. With the growth of the population, demand for fuelwood increases. In the Walawe project area, the fuelwood is not presently a fundamental problem. The annual

fuelwood consumption has been estimated by the ADB at 91,400 m^3 in 1992, and in 1994, is expected to be 98,000 m^3, based on an annual fuelwood consumption by a family at 3.5 m^3. However, this does not take into account, the settlement envisaged in this report.

At present, many families obtain their fuelwood from the secondary forest, which is transported mostly on bicycle by the men. Women do not venture out over long distances but gather fuelwood more within reasonable walking distances of their homes. There is little evidence of settlers purchasing fuelwood for ordinary day to day needs, although for special occasions, it is possible that some may do so.

The problem, though not acute now, can reach serious proportions when the people are settled as much of the present supply area has to make way for agriculture. The project plans provision of fuelwood coops on a hamlet basis.

(3) Domestic water supply

Domestic water supply is a fundamental problem now and will be so in the future. When the water for irrigation increases it will effect the supply for domestic use. Analysis of well water has indicated its unsutiability for human consumption due to high electrical conductivity and dissolved ions of fluorine and chlorine. Hence, with increased numbers settling down, the supply of domestic water can be a serious problem. The project seeks to rectify this problem.

(4) Diseases

Environmental changes associated with the development of irrigated agriculture and human settlements are known to have a great impact on vector and water-borne diseases. The network of irrigation canals, will create good breeding grounds for mosquitoes. Gem mining that now takes place in some places, eg. Ridiyagama, can leave uncovered pits that collect water.

These effects arise from project-related changes such as increased volume of open water; the creation of new areas of standing water; changes of the annual water level in the small tanks and changes in the ratio of domestic animals to the human population.

Malaria can be problematical unless the necessary precautionary measures are taken. Other health hazards likely to be encountered are snake bite, poisoning, agricultural accidents and water-borne diseases associated with sanitation.

4.3 Impacts Due to Other Proposals

4.3.1 Railway to Kataragama

A proposal to extend the southern line of the railway from Matara, where it now terminates, to Kataragama has been accepted by government. However, no firm decision has been made on the alignment of the track, although three alternative routes have been proposed. Route 1 is inland of Dickwella, Ranna and Nonagama towns. Route 2 runs through the towns of Kekanadura, Dickwella, Tangalle, Ranna, Nonagama, Ambalantota, Hambantota, Wirawila and Tissamaharama. Route 3 is most interior and runs through Dandeniya, Beliatta and Angunakolapelessa.

An initial environmental examination has been conducted on the route most favoured from economic and engineering viewpoints. The report indicates that the trace (route 2) is "not aligned through officially designated ecologically-sensitive areas". The trace is said to traverse mostly cultivated and residential areas, and impacts in these areas are said to be light.

The impacts of railway extension have not been thoroughly considered in the report. They will have to be considered in depth at a later stage before decisions are arrived at.

4.3.2 Timbolketiya weir

It is proposed that water from the Timbolketiya River be transferred to the right bank main canal by constructing an intake weir on the river, and a link canal. This proposal will entail the re-settlement of about 300 families. Two alternatives are under consideration and impacts will be considered subsequently.

4.3.3 Karagan Lewaya

The Karagan Lewaya has a small catchment where there are 14 working tanks. The lewaya has an outlet to the sea through the Bombuwatiya drainage canal. In 1991 there was a major flood in the area which had affected a large number of houses. Proposals are underway by the Irrigation Department to prevent the water level rising during periods of intense rainfall. Further studies are necessary to ascertain the impacts of the project on the lewaya, in view of proposals by other institutions.

4.4 Beneficial Environmental Impacts

The project is designed to bring about the rehabilitation and development of an under-developed left bank area, of approximately 30,800 ha. It will benefit some 6,000 farmer families who now line in the Extension Area and will improve the irrigation potential in the developed Old Area by upgrading the irrigation infrastructure.

Given that much of the area is degraded and will continue in like manner, if measures are not taken to arrest such, the project is expected to outweigh undesirable impacts.

4.4.1 Overall economic benefits

The overall economic benefits of implementing the project proposal accrue from:

- the upgrading of the irrigation infrastructure in the Old Area and bringing about rational land use;
- more efficient use of available irrigation water through better distribution and management;
- provision of irrigation water to hitherto unproductive areas by extending the left bank canal (27.6 km) into the Extension Area;
- bringing under cultivation increased extent of land (5,950) under a diversified, market-oriented basket of crops;
- increasing the national production of paddy, sugar, grain legumes, vegetables, fruits, and livestock products;
- reducing the foreign exchange expenditure on food imports and paving the way to the export of selected food items;

- rehabilitating 17 small tanks in the Extension Area and using them in a cascade system to recapture returns flows and make optimum use of the water;

- transfer of technology to the impoverished Extension Area and improving the living conditions of the poor;

- providing settled patterns of agriculture as an alternative to land-degrading shifting cultivation;

- making available opportunities for a range of agro-based industries;

- creating a variety of employment opportunities through services that support agriculture in the main, and industry to a lesser degree;

- creating an environmentally-sound, sustainable, agro-ecosystem,ensuring compatibility of the integral components through integrated management;

- creating opportunities of providing a more suitable homeland for some 150 elephants, now more or less trapped in the Extension Area, thereby eliminating losses on both sides, viz. agricultural products, property and life on the development side, and a national asset (the elephant) on the conservation side.

4.4.2 Biotic environment

With an altered water regime in the Extension Area, assuring soil moisture supply in the usual dry period, the project will create certain beneficial impacts on humans, on plants and on animals. The micro-climate along the canals and water bodies will also change and those animals such as burrowing reptiles and amphibians requiring moist soils will find favourable conditions throughout the year.

The existing vegetation along the water bodies will change. Apart from the usual species growing luxuriantly, even characteristic wet zone species may thrive. The increased number of water bodies will benefit aquatic invertebrates, birds, fish, amphibians and reptiles.

Taking advantage of this favourable moisture condition, it would be desirable to enrich the riverine vegetation that is now in a degraded condition, so as to profit from the ecological benefits associated with such vegetation types. Benefits include controlling bank erosion and providing stability to the banks, providing habitats to birds and the smaller animals, and altering favourablly certain conditions for crop growth, eg. acting as windbreaks.

4.4.3 Physical environment

(1) In the Old Area, project benefits will mainly consist of an improved irrigation infrastructure. The water will be carried further because of an improved canal network and the availability of water during the dry months over a large part of the project area will bring about desirable micro-climatic benefits and enhance the biotic environment to some degree.

(2) Likewise, in the Extension Area, the network of canals (Fig. 4.2-3) will enhance most aspects of human life and certain aspects of the biotic environment.

4.4.4 Socio-economic environment

(1) Settlement plan

Some 33,000 people are to be settled on about 27,000 ha in the project area. There will be 22 villages. Of the three types of settlement, the lowest in the hierarchy will be the hamlet, made up of 250 farm households. Every three to four hamlets will have one village centre. These will have basic amenities, while an area centre will be provided with social and technical services of a wider range. The village alignment plan is shown in Fig. 4.2-4.

(2) Housing

Some 7,000 housing units will be constructed. Each settler family will be provided with a nucleus house of one room, which will be gradually expanded.

(3) Employment

Besides agriculture, numerous ancillary employment opportunities will be generated, attracting permanent settlers, as well as seasonal migratory populations. These include provision of agricultural inputs, livestock production, marketing of agricultural produce, servicing of agricultural machinery, transportation, trade, health care, education, communications and public services.

(4) Fuelwood and pasture land

Provision of fuelwood in a new settlement is of crucial importance. An average of 30 ha per village has been allocated for fuelwood production. Pasture land will also be allocated near villages.

(5) Health

A primary treatment unit (Gramodaya Health Centre) will serve every two hamlets. A sub-divisional health centre will be provided at the area centre.

(6) Education

While each hamlet will have a primary school, a secondry school will serve each area centre.

(7) Potable water

Potable water will be supplied to each area centre and community stand pipes will provide for domestic needs.

(8) Electricity and telecommiuncations

These will be supplied to the area centres.

(9) Road network

Villages will be inter-linked by hamlet and market roads. While the former will be of compacted gravel, the latter and the main roads will be metaled.

(10) Other services

An area centre will have a block office, post office, bank and a *pola*. A unit service centre will be set up in each hamlet and village centre.

5. MITIGATING MEASURES

The mitigating measures listed in this chapter relate to the biotic, physico-chemical and socio-economic environments in the proposed project area. At the end of the chapter the proposed mitigating measures are prioritised.

5.1 Biotic Environment

5.1.1 Terrestrial environment

(1) Flora

As a compensatory measure for the loss of plant cover, tree planting should take place along river banks, canal banks and in the tank watersheds. It should also be done along roads. School compounds should be used to provide refuge to some of the plant species that are fast disappearing. These mini arboreta can serve educational needs as well. Settlers should be provided with saplings of their choice to be planted in home gardens. The marshy habitat at Udaberagama may be conserved for educational purposes. The saplings can be provided from FD or MASL nurseries. The estimated cost is Rs.350,000.

(2) Fauna/protected areas

(i) Elephant

With the possibility of a long-drawn out struggle between man and elephant, the ideal appears to be a separation of the two, by having the elephants moved to safe locations where conflict is minimized, if not prevented. To reap maximum benefits of the stated project objectives, this is a vital necessity. Moreover, in view of the historical and cultural importance, the plight of the elephant merits close attention.

It appears from emerging trends in natural resource use, that man and elephant can co-exist without serious conflict, only in low densities. The elephant issue in the Hambantota district can be resolved by creating conditions and the means for their judicious dispersal to more suitable areas, thereby eliminating/reducing the almost year-round pressure on cultivations and settlements.

The mitigating strategies are based on three major proposals: (a) to set up jungle corridors to facilitate movement to the national parks from the Extension Area and the Bundala sanctuary, (b) to set up electric fencing along the eastern border of the Extension Area, and (c) evacuation of elephants.

(a) Two jungle corridors are proposed. The first extends from Badagiriya tank to the right bank of Malala Oya and then, northwards to meet the southern boundary of the proposed Uda Walawe-Lunugamvehera corridor.

The second corridor begins at the 152nd km post on the Hambantota-Wellawaya road (which is also the northern boundary of the Bundala sanctuary), and extends through Mettigatwewa and Buruthakanda to meet the Badagiriya - Uda Walawe corridor. The corridors can be 1 to 2 km in width. The details are provided in Annexes I and II. Fig. 4.2-1 shows the two corridors on the map.

(b) A main power/solar power fence along the eastern border of the Extension Area from Suriyawewa in the north to Sippikulama near Karagan Lewaya is the second major proposal (Fig. 4.2-1). The details are in Annex III.

(c) The Department of Wildlife Conservation (DWC) should evacuate all elephant herds from in and around the project area to the Badagiriya - Uda Mattala forest pocket, east of the Hambantota-Gonnoruwa-Meegahajandura road and Malala Oya. Timing of erection of the fence and driving the herds east are important so as to prevent back-tracking.

(d) DWC should capture by immobilization and remove all loners found remaining after the herds have been driven eastward. Only five or six loners will remain. The captured loners should not be released near the project area.

(e) DWC staff should be posted to the project area on a permanent basis to undertake the following tasks.

- monitor movement of evacuated elephants to prevent them backtracking;
- monitor efficiency of the electric fence;
- induce elephant movement northward along the corridor to the Uda Walawe National Park; and
- induce elephant movement northeastward through Devranvehera (Ranawaranawewa) to the proposed Lunugamvehera National Park.

The estimated cost is as follows:

	Rs.
- Establishment of two jungle corridors	50,000
- Vegetation/biomass resource survey in the areas surrounded by Gonnoruwa-Uda Mattala, Bundala and Badagiriya, Yala blocks ii, iii and iv, Lunugamvehera proposed National Park and Uda Walawe National Park	150,000
- Construction of main/solar power fence (length 35.2 km) cost, Rs. 4,993,200	
* scrub jungle clearing along trace to a width of 4.5 m	211,200
* installation of fence posts	385,000
* construction of power fence	3,377,000
* installation of solar components	200,000
* provision of four watch units	320,000
* provision of quarters	175,000
* provision of warning signboards	275,000
* contingencies	50,000
- Evacuating of herds - a grant to DWC to meet wages of casual labourers for three months and purchase of thunderflashes	500,000
- Capture of 6 loners - a grant of Rs.25,000 for each animal captured and removed successfully	150,000
- Monitoring for a period of two years - a grant of Rs.250,000, including maintenance	350,000
Total Cost	6,293,200

(ii) Nearby protected areas

(a) DWC should enhance the carrying capacity of the nearby wildlife habitats that are now legally protected, so that certain species that get displaced can find alternatives sources of food, water and shelter. Deepening and compaction of water holes constitutes the main enrichment measure. The nearby protected areas include the national park of Uda Walawe and the sanctuaries of Bundala, Kalametiya and Katagamuwa. The Madunagala-Karambagala forest including the Mahapelessa hot springs should receive protection in the status of a sanctuary.

(b) DWC should declare without delay the Lunugamvehera National Park and the Uda Walawe-Lunugamvehera Jungle Corridor.

5.1.2 Aquatic environment

(1) Aquatic vegetation

Aquatic weeds have a widespread coverage in the Old Area and the potential for spreading in the Extension Area is high when irrigation commences. Practical solutions have to be found to keep the canals and water bodies free of weeds. While some herbicides such as 2.4-D and Diquat have minimum harmful effects on other organism, there is the need to physically remove the dead growth. In practise it is cheaper to remove the growth without recourse to spraying.

Biological control of Salvinia has reportedly been successful under field conditions elsewhere in Sri Lanka and may also be tried in the project area. Biological control of aquatic weeds especially "Hydrilla" in canals, tanks and reservoirs by introduction of fishes such as grasscarp shall be studied by referring to the studies and experiences in Systems B and C. The use of water weeds in biogas digestors, as manures and mulches, in composing, and as animal feed are some of the other possibilities. Studies on possible applications of water weeds should continue. Minimum fertilizer use is recommended to arrest eutrophication due to nutrient-loaded runoff and return flows.

Responsibilities lie with the MASL, Departments of Agriculture and Agrarian Services, District Secretariats and Farmer's Organisations. The estimated cost is Rs.400,000.

(2) Aquatic fauna

The undesirable impacts on aquatic fauna will arise from the excessive use of fertilizers and agrochemicals. The discharge of industrial effluents into the main river, is a seasonal problem. As no baseline data is available on the amounts present in the aquatic environment, it is proposed that water samples from selected points in the basin be analysed to ascertain the current status. The promotion of techniques of integrated pest management, along with education of farmers on the environmental implications of excessive fertilizer and agrochemical use, are short-term measures. In the long-term, breeding varieties resistant to some of the major pests and diseases and the use of more organic manures will be steps in the right direction in minimising use of these inputs.

5.2 Physico-chemical Environment

5.2.1 Soil conservation

Erosion control and soil conservation should be a primary consideration from the outset, ie. from land clearing and construction stages. These activities should be carried out during the dry season as impacts will be less than during the wet season. The use of heavy machinery should be minimised and the following measures are recommended:

- forming windrows of brush along the contours;
- moving layers of top soil be avoided;
- minimising ripping
- using disk harrows for clearing light growth; and
- conducting all operations in upland areas on the contour.

Other possible techniques are a alley cropping, agroforestry, mulching terracing, crop rotations, mixed cropping and inter-cropping. After land preparation, with the first showers of rain in maha, the land should be sown to a quick-growing legume eg. *Pueraria, Crotalaria* or pasture, grain legume or a cereal such as *kurakkan*, in order to minimize surface runoff during the rainy season. This intermediate crop is essentially a cover crop and can be ploughed in at the beginning of the next Yala, to improve the organic matter status of the soil.

If the farmers are not settled by the first maha rains after land preparation, the project management should undertake this activity. Reservations of rivers, canals and tanks should be grown to food, fuelwood, fodder or medicinal trees to serve the needs of the people as well as to act as windbreaks. Windbreaks will benefit agricultural crops. These activities can be carried out by Farmer's Organisations.

Institutional responsibility will be with MASL, Departments of Agriculture and Agrarian Services, Divisional Secretariats, HIRDP and private voluntary organisations. The

responsibility that lies with the MASL, may sometimes be executed through a contractor who will need to be adequately briefed. The estimated cost for tree planting is Rs.250,000.

5.2.2 Surface water quality

Analysis of surface waters should be carried out at least twice yearly, during wet and dry seasons to determine the nature and levels of contamination by organic, inorganic and bacterial pollutants. The main parameters should include pH, dissolved oxygen, temperature, suspended solids, major anions and cations, conductivity, nutrient salts, heavy metals, pesticides and coliform bacteria. The possibility of agricultural pollution is discussed in section 5.1.2.

Based on the nature of pollution, remedial measures should be taken. Further information is required and solutions have to be sought. One particular area is the discharge of industrial effluents into the river. As a number of public and private institutions have responsibilities and interests in the region, each institution should develop its own mechanisms for carrying out the analytical and remedial measures and these should be coordinated by MASL. The institutions are Department of Agriculture, Department of health, Divisional Secretariats, National Water Supply and Drainage Board, HIRDP, National Paper corporation, Sevenagala Sugar Industries and interested private voluntary organisations. The estimated cost is Rs.500,000.

5.2.3 Soil salinity

As a routine measure, it will be desirable to monitor salinity in the agricultural areas, especially those near the coast, in irrigation waters, at the mouth of the Walawe, and in ground water. Studies are recommended on salinity problems in irrigated farming and impacts of agricultural run-off into Karagan Lewaya. Responsibility lies with the MASL, Department of Agriculture, and NWSDB. The estimated cost is Rs.400,000.

5.3 Socio-economic Environment

5.3.1 Fuelwood supply

With the elimination of a large part of the vegetation in the Extension Area, fuelwood will be a basic settler need. Fuelwood coops should be established very early - after village sites have been determined. Fast-growing fuelwood species such as eucalyptus and ipil-ipil, and casuarina nearer the coastal belt, can also be grown on homestead boundaries, canal banks and road reservations and other vacant non-irrigable areas. As the urban centres outside the project area grow, there will be an increasing demand for fuelwood from these as well.

Another key area is the introduction of improved stoves among the settlers so as to economise on fuelwood consumption. Responsibility lies with the MASL, Forest Department, farmer organisations and District Secretariats.

5.3.2 Domestic water supply

The poor quality of ground water as indicated by analysis of well water samples is due to natural causes. In vies of this, and the fact that using irrigation water for drinking can be problematical the provision of potable water is considered imperative. Responsibility lies with the MASL, NWSDB and private voluntary organisations.

5.3.3 Irrigation infrastructure

Given the constraints of government responsibility down to the field-level, it is recommended that farmer's organisations be established and responsibility delegated, after initial training, which later should be carried out at regular intervals. Responsibility lies with MASL.

5.3.4 Health care

Past records document the increasing difficulties faced by settlers in their early months. Hence there should be the minimum health care facilities available when the settlers arrive. Diarrhoea, dysentery, snake bite, malaria, poisoning and agricultural accidents are commonly encountered. A survey of illicit gem mining is recommended. An acceptable level of sanitation is very important. It is recommended to flush irrigation canals every seven days as a vector-control measure. Responsibility lies with MASL, Department of Health and private voluntary organisations.

5.4 Archaeological Sites

Archaeological sites and artefacts found during the construction phase or subsequently, will have to be reported immediately to the Department of Archaeology. Such sites will have to be isolated from the rest of project activities. Artefacts unearthed are the legal property of the Department.

5.5 Prioritisation of Mitigating Measures

5.5.1 Requiring very early attention before construction begins

(1) Elephant conservation

- Declaring Lunugamvehera National Park
- Declaring jungle corridors
- Constructing electric fence
- Evacuating elephants and other animals
- Enhancing carrying capacity in nearby protected areas
- Posting DWC staff

5.5.2 Requiring attention during construction phase

(1) Fuelwood
- Establishing fuelwood crops on a hamlet basis

(2) Soil conservation
- Providing contour bunds and windrows during jungle clearing/land preparation

(3) Gathering baseline data on pesticide and fertilizer residues in receiving waters

(4) Gathering baseline data on factory effluents after a normal discharge into the river and before

(5) Studying salinity levels at the river mouth

(6) Monitoring elephant movements

5.5.3 Requiring attention during the settlement phase

(i) Providing potable water
(ii) Advising on soil conservation and providing agricultural extension
(iii) Providing tree saplings and other agri-inputs
(iv) Providing basic health care
(v) Following up on data collecting in section 5.5.2 above
(vi) Monitoring elephant movements

5.5.4 Requiring subsequent attention: during second year after settlement

(i) Monitoring of domestic water quality; river, canal tank and ground water and river mouth water quality
(ii) Tree planting along river and canal banks, roads, tank catchment and home gardens
(iii) Testing methods of aquatic weed control
(iv) Monitoring health care facilities
(v) Monitoring elephant movements
(vi) Following-up on water quality monitoring

6. COORDINATION, MONITORING AND EVALUATION

Environmental planning and environmental management, cut across institutional boundaries. These disciplines cannot meaningfully operate in watertight compartments. Environmental issues cannot be addressed without dialogue among resource users, some of whom will be competing with one another for a given resource. Use-conflicts are inevitable when projects are implemented, and mitigation of such, leads to a wholesome end-product--an environment that is sustainable.

Both environmental planning and management are relatively new disciplines to the Sri Lankan planning, administration and management institutions in the public and private sectors. Hence, there are presently many areas of uncertainty in coming to terms with what should be an appropriate path towards sustainable use of natural resources. This drawback is felt mostly in the peripheral planning and management situations that do not usually profit from the resources at the centre, eg. there is an inadequacy as far as the district's trained personnel are concerned. Political expediency often contributes to ad-hoc decisions that are arguably not the most rational in terms of either economics, or of sustainable development.

Nevertheless, new perceptions in natural resource management are gaining acceptance. To provide for a livable environment, also economically viable, and to ensure that resources are wisely used without degradation, environmental impact assessment is one of the tools, and is the basis for this report. The principles of EIA must now seep down to those charged with the responsibility of project implementation so that their decisions will be arrived at from a broad spectrum look at environmental implications. To this end, training at project/district level should be considered.

A large number of government institutions have responsibility for resource use and management in the area, each having its own narrow domain, interests and obligations; some of them jealously guarded. But often there are trade-offs to be made, and the need to respond to the wants of the majority or the under-privileged. Inadequate dialogue among institutions, ad-hoc decisions on resource use, and lack of vision and foresight, are major constraints that impede the attainment of sustainable development goals.

6.1 Environmental Coordination

Since many resources, and may be an equal number of institutions, are involved in this project, coordination should begin even before the first operations begin.

6.1.1 Environmental coordination unit

It is proposed that this aspect be the responsibility of an inter-agency committee, called the Environmental Coordinating Committee, operating at the project site. It will be a field-level committee, chaired by a senior MASL decision-maker, and be constituted by representatives from line agencies, the private sector, district secretariats and Private Voluntary Organizations (PVO) having active interests in the area. A MASL Environmental Officer stationed in the project area, should function as the committee secretary and be the driving force in attaining committee objectives. Fig. 6.1-1 illustrates the links of the committee and its functions.

(1) Composition

It is proposed that participation in the committee be initially made up of senior representatives from MEA, MECA, DWC, Department of Agriculture (DA), Forest Department (FD), Health Department's Anti-Malaria Campaign (AMC), District Secretariats (DS), HIRDP, and relevant PVOs. There should be provision to co-opt other institutions as work progresses and/or the need arises. Likely candidates are Coast Conservation Department, Fisheries Department, Irrigation Department, Agricultural Insurance Board, KOISP, Southern Provincial Council and Sri Lanka Railways.

(2) Other coordinating bodies

There are a number of inter-agency committees that function at district level at Hambantota. As the larger part of the Extension Area lies in the Hambantota district, establishing a dialogue between the project and these committees will not be in vain. These committees are District Agricultural Committee (DAC), District Land Use Committee (DLUC), District Environmental Agency (DEA) and the HIRDP District Coordinating Committee.

The Environmental Coordinating Committee should meet once a month and report to MASL after each meeting, or as the need arises. The MASL should in turn review progress and offer back-up services as necessary.

6.2 Monitoring

Monitoring at regular intervals to determine the status of the project impacts, calls for the mobilization of the resources of a number of public and private sector institutions. It is exceedingly useful in identifying water and soil health problems in order to prevent potentially serious adverse impacts. For the effective evaluation of results during monitoring phases, it is necessary to establish baseline data before the project commences. While baseline data has been obtained in some areas, it is lacking in certain other areas. For example, available water quality data do not indicate the status of pesticide and nutrient concentrations, and salt water movement in the river or seepage into coastal lands through the dunes.

6.2.1 Baseline data

The following baseline information should be obtained:

(1) Pesticide residues in receiving waters and in ground water;
(2) Fertilizer residues, mainly nitrogen and phosphorus in receiving waters;
(3) Salt water intrusion in the Walawe estuary and upstream at selected locations;
(4) Salinity in inland agricultural fields and in coastal lands;
(5) Coliform bacterial counts in river, tank and well water;
(6) Heavy metals in receiving waters.

6.2.2 Water quality

Water quality should be monitored subsequently every six months, during the wet and dry seasons. The following parameters are recommended: pH, suspended solids, dissolved oxygen, electrical conductivity, nutrient salts, pesticides, major cations and anions, heavy metals, coliform bacteria, COD and BOD. Samples should be taken at selected points of canals and return flows. These will vary somewhat, depending on the purpose for which the water is used. The frequency may also vary, eg. every two months for salinity measurements and every three months for faecal coliforms in potable water and domestic supplies.

6.2.3 Soils

Soil monitoring will essentially be for salinity, although nutrient deficiency can also be a factor in the recommendation of judicious fertilizer applications. The breakdown of pesticides in soils can also be studied in areas where heavy pesticide application is made.

6.2.4 Health care

It can be assumed that malaria will be a major issue. A comprehensive programme to identify potential breeding places of the vector and surveillance on the part of the Anti-Malaria Campaign, are necessary components. The availability of drugs in the dispensaries, including anti-venom for snake-bite is important.

6.2.5 Estimated cost

MASL should bear overall responsibility for monitoring all aspects of project implementation. Below is an indication of major monitoring areas, institutions responsible and approximate annual costs.

Area	Institutional Responsibility	Budget (Rs)
Potable water quality in settlements	MASL, NWSDB	300,000
River water quality in lower reaches	NWSDB, MASL	200,000
River water quality upstream	NPC, SSI, SRI, CISIR	200,000
Irrigation water quality including return flows	MASL, DA	400,000
Soils	MASL, DA	300,000
Health care	MASL, AMC, HD	200,000

6.2.6 Public participation

The participation of the public, if adequate, can have a very salutory impact on project implementation, or on the day to day life of a community. Public participation is facilitated by groupings representing a common interest(s). In this regard farmer associations have been conceived as useful instruments to achieving project goals. They are, when operational, expected to take over certain aspects of project management, eg. irrigation operation and maintenance below the block level.

Likewise in agricultural/livestock production or environmental management, if the people's interest can be cultivated, awareness created, and their views canvassed in decision-making, then development-conservation issues can be viewed from a more wholesome angle. Therefore grassroots participation should be encouraged and consistently nurtured through a multi-faceted approach. Other organizations for specific interest areas should also be encouraged.

The school club is a wonderful place to breed ideas, transfer ideas for assimilation, and to seek support for implementation, whether in nature conservation or waste disposal or any other facet of community life. On the contention, that a young mind is easier to bend than an adult mind, maximum inroads should be made to seek the participation of the youth, by giving them adequate recognition in decision-making, that finally affects them.

7. CONCLUSIONS AND FURTHER STUDIES

7.1 Conclusions

It is concluded that the proposed project will generate several major socio-economic benefits and has a high degree of acceptability. The beneficial impacts far outweigh the adverse impacts.

In summary, the beneficial impacts of the project accrue on the basis that:

- the Old Area is to benefit from a rehabilitated irrigation infrastructure resulting in better water flow and reduction of on-farm losses;
- there is no loss of habitat in the Old Area and there are no impacts on wild plants and animals;
- more rational cropping is to be practised in the Old Area, with allocation of RBEs only to field crops and not to paddy;
- more land will be brought under cultivation as there will be better water distribution;
- farmer income will increase;
- the Extension Area will receive irrigation water for the first time which will permit the people to undertake systematic farming on the rich soils;
- the small tanks will be used in a cascade system, thereby economising water use through capture of return flows;
- already about 6,000 families live in the Extension Area under very difficult conditions;

- the faunal diversity, not in anyway unique to the region is low consequent to habitat loss and poaching;

- the vegetation is degraded to scrub jungle except in Madunagala-Karambagala;

- only rainfed farming is possible -- carried out by settlers under small tank schemes, and shifting cultivation by many migrants;

- even the small tanks depend on rainfall and there is no assurance of a good monsoon each year;

- even when land has been cultivated during a satisfactory monsoon, large scale crop damage takes place due to depradations by wild animals, particularly the elephant;

- the settlers now have very poor amenities such as education, basic health care, roads, transportation and agro-services; and will be provided with better amenities;

- fuelwood shortage likely at the beginning of settlement, to be offset by village wood lots for fuelwood.

- a large number of settlers live below the poverty line income of Rs 700 per month;

- settlers having to live in this manner is most deplorable at a time when poverty alleviation receives national emphasis and their lot will be improved;

- settlers are also at the mercy of the elephant, (and vice-versa) which is now more or less pocketed; the project will, mainly through availability of financial resources, enable addressing resolution of the man-elephant conflict and find acceptable solutions;

The impacts of a significant nature that can be identified at the beginning of the project and have to be resolved very early are:

- conflicts with the elephant that cause problems to both man and elephant;
- fuelwood shortage due to land clearing;
- availability of drinking water; and
- provision of health care;

The project reports prepared so far, identify the last three as shortcomings in the Extension Area, and have made provision for amelioration.

Those impacts of a less significant nature, where corrective action is possible through good management during project implementation are:

- soil erosion and sedimentation;
- habitat loss;
- spread of aquatic weeds;
- drainage; and
- micro-climatic effects

However, there are a number of potential environmental impacts that require attention in the post-project management stage, for which additional data are required. These relate to the following:

- water quality in the river, canals and wells;
- pesticide magnification in aquatic and terrestrial ecosystems;

- nutrient accumulation in receiving waters;
- industrial effluent issues;
- salinity of agricultural lands; and
- salt water intrusion;

7.2 Required Studies

7.2.1 For conflict resolution

In the light of insufficient data, conflict resolution in certain areas have to be addressed subsequently. Therefore it is recommended that studies be conducted and be continued as a monitoring programme in the following areas:

(1) Water quality

- pesticide concentration
- nutrient accumulation
- ground water analysis
- salinity
- salt water intrusion
- coastal waters

(2) Terrestrial

- pesticide over-use (misuse) and concentration in soil
- salinity on irrigated paddy land

(3) Health care

- malnutrition
- ecology of mosquito vectors
- resistance to currently used insecticides
- snake-bite

(4) Industrial pollution

- paper mill issues
- distillery issues
- process modification

(5) Karagan lewaya

- impacts in relation to the current, and other development proposals, eg. irrigation runoff.

7.2.2 Management studies

The under-mentioned research and development work is recommended in order to maximise resource use and to bring about economies of scale.

- conservation farming systems
- integrated pest management
- integrated crop-livestock systems
- use of manures to reduce high quantities of fertilizers otherwise used
- use of water weeds in biogas digester, composts and mulches
- agroforestry systems
- management of grazing land and livestock damage to crops
- management of fuelwood coops
- applications of social forestry
- irrigation water management issues
- soil erosion and sediment transport in canals
- initial settlers issues including social integration
- use of improved cooking stoves

TABLES

Table A1.3-1 SALIENT FEATURES OF UDA WALAWE DAM AND RESERVOIR

(a)	Reservoir	
	1) Catchment area	1,164.8 km2
	2) Capacity at F.S.EL	268.76 MCM (WL 88.39 m)
	3) Capacity at D.S.EL	26.26 MCM (WL 74.98 m)
	4) F.S.L	WL 88.39 m
	5) H.F.L	WL 90.21 m
(b)	Dam	
	1) Type	Rolled Earthfill
	2) Max. height	36.57 m
	3) Length	4.9 km
	4) Top elevation	90.52 m
(c)	Spillway	
	(1) Radial Gated Structures	
	1) No. and size of gates	5 nos. 18.96 m (W) x 6.60 m (H)
	2) Spill EL of gates	82.18 m
	(2) Natural	
	1) Length	366 m
	2) Crest EL	88.69 m
(d)	Power Unit	
	(1) Right Bank	
	1) Type	Kaplan Vertical
	2) Installed capacity	1.8 MW
	3) Minimum operation EL	79.4 m
	(2) Left Bank	
	1) Type	Kaplan Vertical
	2) Installed capacity	3.6 MW
	3) Minimum operation EL	79.4 m

Table A1.3-2 MAIN FEATURES OF THE SAMANALAWEWA HYDROPOWER PROJECT

(1)	Reservoir	
1)	Maximum Storage	298 MCM (WL 462.55 m)
2)	Minimum Storage	60 MCM (WL 424.05 m)
3)	Fully Supply Water Level (FSL)	WL 460.00 m (278 MCM)
4)	Minimum Water Level	1 unit WL 116.40 m
5)	Tail Water Level	2 units WL 117.20 m
6)	Design Flood Discharge for Spillway	3,600 m3/s
(2)	Power Plant	
1)	Number of Turbine Unit	2 Francis
2)	Number of Powerhouse	1
3)	Maximum Flow for Power Matrix	40.20 m3/s
4)	Maximum Power Supply	120 MW (60 MW x 2)

Table A3.3-1 HYDROLOGICAL DATA GENERATING STATIONS IN THE WALAWE BASIN

Name of the Station	Period of Records	Mean Value (till 1985)	Elevation Above (MSL)	Aspect
Mahawelatenna	1949/upto date	2,126	549	Rainfall
Massena	1949/upto date	4,107	-	Rainfall
Nagarat Estate	1949/upto date	2,606	2,073	Rainfall
Rassagala Estate	1949/1974	3,592	549	Rainfall
West Haputale Estate	1949/1974	2,373	-	Rainfall
Balangoda	1949/upto date	2,737	549	Rainfall
Blackwood Estate	1949/upto date	2,476	1,158	Rainfall
Detanagala	1949/upto date	2,921	1,024	Rainfall
Ginnihiriya	1949/upto date	2,270	2,152	Rainfall
Keenagala Ella	1949/upto date	3,080	-	Rainfall
Lauderdale Group	1949/upto date	3,477	-	Rainfall
Samanalawewa	1949/upto date	2,947	346	Rainfall
Mawigala	1949/upto date	2,137	427	Rainfall
Embilipitiya	1942/upto date	-	-	Runoff
Liyangastota	1948/1957	-	-	Runoff
Samanalawewa	1958/upto date	-	-	Runoff
Udawalawe	1986/1960	-	-	Runoff

Table A3.3-2 WATER QUALITY ANALYSIS

Sample No. / Source		1 Well	2 Well	3 Well	4 Well	5 Well	6 Well	7 Well	8 Well	9 Well	10 Well	11 Well	WHO Standard
T. Air	°C	34.5	35.0	36.5	33.5	33.0	30.0	30.0	34.0	30.0	33.0	33.0	-
T. Water	°C		29.5	30.0	31.0	30.0	29.0	26.0	26.5	26.5	29.0	27.0	32.0
pH		7.4	7.9	8.0	8.3	8.5	8.1	7.1	7.5	7.6	7.3	6.0	6.5-9.2
EC	uS/cm	1,360	1,973	738	1,039	1,045	395	115	178	207	236	589	-
S.S.	mg/l	54.00	99.00	101.00	53.00	139.00	132.00	73.00	138.00	128.00	100.00	190.00	500.00
D.O.	mg/l	56.8	70.9	76.9	70.0	50.2	47.7	107.3	105.4	100.4	101.6	35.5	-
NO3-N	mg/l	0.362	0.196	0.195	1.172	0.375	0.647	0.481	0.332	0.572	0.512	0.812	45.000
HCO3-	mg/l	739	650	484	696	681	264	80	126	135	150	193	-
Cl-	mg/l	115	342	69	46	60	14	7	9	12	15	90	200
F-	mg/l	1.50	1.80	0.85	6.90	3.10	0.29	0.23	0.31	0.34	0.37	0.13	1.50
Ca2+	mg/l	95	116	64	46	44	57	17	27	34	4	32	-
Mg2+	mg/l	16	28	90	47	24	262	330	44	28	60	8	-
Na+	mg/l	153	146	44	150	145	25	4	14	17	19	89	-
Total Hardness		303	405	530	309	209	1,221	1,400	249	200	332	113	500
S.A.R.*		3.79	3.18	0.87	3.69	4.38	0.29	0.05	0.38	0.50	0.44	3.71	-
Classification of Irrigation Water**		C3-S1	C3-S1	C2-S1	C3-S1	C3-S1	C2-S1	C1-S1	C1-S1	C1-S1	C1-S1	C2-S1	-

Note: *: Sodium absorption ratio
**: Classification of irrigation waters defined by the electgric conductivity and the S.A.R.

Table A3.4-1 LIST OF SOME FAUNA SPECIES THAT MAY BE FOUND IN THE PROJECT AREA (1/4)

*: Endemic Form

FISH	
Glossogobius giurus	- Bar-eyed gody
Chela laubuca	- Blue laubuca
Labeo dussumieri	- Common labeo
Puntius amphibius	- Scarlet - banded barb
Puntius chola	- Swamp barb
Puntius dorsalis	- Long-snouted barb
Puntius filamentosus	- Filamented barb
Puntius sarana	- Olive barb
Oreochromis mossambicus	- Tilapia
Amblypharyngodon melettinus	- Silver carplet
Mystus gulio	- Long-whiskered catfish
Wallaqo attu	- Shark catfish
AMPHIBIANS	
Bufo melanostictus	- Common Indian toad
Rana hexadactyla	- Bull frog
Rana breviceps	- Frog
Rana temporalis	- Frog
Polypedates leucomystax	- Chunam tree frog
Kaloula pulchra	- Burrowing frog
REPTILES	
Lissemys punctata	- Softshell terrapin
Testudo elegans	- Star tortoise
Crocodylus palustris	- Stream or swamp crocodile
Calotes versicolor	- Common garden lizard
Calotes calotes	- Green garden lizard
Mabuya carinata	- Ratsnake mabuya (S-Hikanala)
Varanus bengalensis	- Land monitor (S-Thalagoya)
Varanus monitor	- Water monitor (S-Kabaragoya)
*Phthon molurus Pimbura**	- Rock python (S-Pimbura)
Ptyas mucosus	- Rat snake (S-Garandiya)
*Ceraspis carinatus**	- Sri Lankan wolfsnake (S-Dara-Karawala)
Boiba forsteni	- Foresten's cat snake (S-Naga mapila)
Naja naja	- Common cobra (S-Naya)
Vipere russelli	- Russell's viper (S-Tith-polanga)
Typhlina bramina	- Blindsnake (S-Depath-naya, Bumuthu kanaulla)
*Chrysopelea taprobanica**	- Golden treesnake (S-karawala)
Dendralaphis tristis	- Seba's Bronzeback (S-Tura haldanda)
*Oligodon sublineatus**	- Dumeril's kukrisnake (S-Pulli dathkctiya)
Dryophis nasutus	- Green whipsnake (S-ahetulla)
*Bungurus ceylonicus**	- Sri Lankan krait (S-polon karawala)
Cerberus rhynchops	- Dog-faced watersnake (S-Diyabariya)

Table A3.4-1 LIST OF SOME FAUNA SPECIES THAT MAY BE FOUND IN THE PROJECT AREA (2/4)

*: Endemic Form

Pteropus giganteus	- Fruit bat or flying fox
Cynopterus spyinx	- Indian short nosed fruit bat
Myotis adversus	- Brown bat
Suncus murinus murinus	- Common Indian musk shrew
Suncus murinus caerulescens	- Indian grey musk rat
Badicota indica	- Great bandicoot rat
Mus musculus	- Indian house mouse
Mus cerricolor	- Sri Lankan field mouse
Rattus rattus kandianus	- Sri Lankan house rat
Funamblum palmarum	- Southern Sri Lankan plam squirrel
Hystrix indica	- Indian porcupine
Manis crassicaudata	- Indian pangolin
Paradoxurus hermaphroditus	- Common Indian plam cat
Herpestes smithi zeylanicus	- Ruddy mongoose
Herpestes edwardsi	- Grey mongoose
Herpestes vitticollis	- Stripe necked mongoose
Felis viverrina	- Fishing cat
Felis rubignosa	- Rusty spotted cat
Canis aureus lanka	- Sri Lankan jackal

RESIDENT BIRDS

Podiceps ruficollis capensis	- Little grebe
Pellcanus philippensis philippensis	- Grey Pelican
Phalacrocorax carbo sinensis	- Indian cormorant
Phalacrocorax niger	- Pigmy cormorant
Aninga rufa melanogester	- Indian darter
Ardea cinerea rectrostris	- Eastern grey heron
Ardeola grayii grayii	- Pond heron
Egretta alba modesta	- Large egret
Egretta intermedia intermedia	- Median egret
Egretta garzetta garzetta	- Little egret
Ibis leucocephalus	- Painted stork
Anostomus oscitans	- Open bill stork
Ciconia episcopus episcopus	- White necked stork
Platalea leucorodia major	- Spoonbill
Dendrocygna javanica	- Lesser whistling teal
Haliaster indus indus	- Brahminy kite
Elanus caerulus nociferus	- Black wingerd kite
Accipter badius	- Shikra
*Gallus lafayetti**	- Sri Lanka jungle fowl
*Galloperdix bicalcarata**	- Sri lanka spurfowl
Pavo-cristatus	- Common peafowl
Turnix suscicator leggei	- Bustard quail
Amaurornis phoenicurus	- White breasted waterhen
Vanellus indicus lenkae	- Red-wattled lapwing
Venellus malabaricus	- Yellow-mottled lapwing
Charadrinus alexandrinus seebohmi	- Kentish plover
Tringa hypoleucos	- Common sandpiper

Table A3.4-1 LIST OF SOME FAUNA SPECIES THAT MAY BE FOUND IN THE PROJECT AREA (3/4)

*: Endemic Form

RESIDENT BIRDS (CONT'D)

Himantopus himantopus ceylonensis	- Black winged stilt
Esacus magnirostris recurrirostris	- Great stone plover
Sterna albifrons albifrons	- Little tern
Columba livia intermedia	- Rock pigeon
Streptopelia chinensis ceylonensis	- Spotted dove
Psittacula Karameri manillensis	- Rose ringed parakeet
Eudynamys scolapacea	- Indian koel
Rhodophytes viridirostris	- Blue faced malkoha
Centropus sinensis parroti	- Southern coucal
Callocalia fusiphaga unicolor	- Edible nest swift
Hemiprocne longipennis coronata	- Crested tree swift
Ceryle rudis leucomelanura	- Pied Kingfisher
Alcedo atthis taprobana	- Common kingfisher
Halcyon smyrnensis fusca	- White breasted kingfisher
Merops orientalis ceylonicus	- Green bee eater
Merops leschenaulti	- Chestnut headed bee eater
Coracias bengalensis Indica	- Indian Roller
Anthracoceros coronatus	- Malabar pied hornbill
Megalaima zeylanica	- Brown headed barbet
Dinopium benghalense psarodes	- Red backed woodpecker
Hirundo daurica hyperythra	- Sri Lanka swallow
Oriolus xanthornus ceylonensis	- Black headed oriole
Dicrurus caerulescens insularis	- White bellied drongo
*Acridotheres tritis melanosternus**	- Common mynah
Corvus splenders	- House crow
Corvus macrorhynchus	- Black crow
*Phcononotus melanicterus**	- Black capped bulbul
Phcononotus cafer haemorrhosus	- Red vented bulbul
Phcnonotus luteolus	- White browed bulbul
Turdoides affinis	- Common babbler
Rhipidura aureola	- White browed fantail flycatcher
Cisticola juncidis cursitans	- Fantail warbler
Orthotomus sutorius sutorius	- Tailor bird
Copsychus sanlaris ceylonensis	- Southern magpie robin
Saxicoloidles fulicata leucoptera	- Black robin
Dicaeum erythrorhynchos ceylonensis	- Tickells flowerpecker
Nectarinia zeylonica zeylonica	- Purple-rumped sunbird
Nectarinia lotenia lotenia	- Loten's sunbird
Nectarinia asiatica asiatica	- Purple sunburd
Passer domesticus indicus	- House sparrow
Ploceus philippinus philippinus	- Baya weaver
Ploceus manyar flariceps	- Streaked weaver bird
Lonchura malabarica malabarica	- White throated munia
Lonchura punctulata punctulata	- Spotted munia
Lonchura malacca malacca	- Black headed munia
Porphurio porphyrio poliocephalus	- Purple coot
Hydrophasianus chirurgus	- Pheasant tailed jacana

Table A3.4-1 LIST OF SOME FAUNA SPECIES THAT MAY BE FOUND IN THE PROJECT AREA (4/4)

*: Endemic Form

POSSIBLE MIGRANT BIRDS

Plurialus squatarola	- Grey plover
Numenius phaeopus phaeopus	- Whimbrel
Tringa totanus curhinus	- Eastern Red shark
Tringa nebularia	- Green shark
Tringa stagnatilis	- Marsh sandpiper
Celidris minutus	- Little stint
Calidris ferruginea	- Curlew sandpiper
Pitta brachyura	- Indian pitta
Terpsiphone paradisi paradisi	- Indian paradise flycatcher
Motacilla flara thunbergi	- Grey headed yellow wagtail
Motacilla caspica capspica	- Grey wagtail
Haematopus ostralegus	- Oyster catcher
Plurialus dominica fulva	- Golden plover
Numemius arguata arguata	- Common curlew
Limosa limosa limosa	- Black tailed godwit
Tringa terek	- Terek sandpiper
Arcnaria interpres interpres	- Turnstone
Capella sternura	- Pintail snipe
Calidris elbus	- Sanderling
Calidris testaceus	- Curlew sandpiper
Chilodonias hydrida indica	- Indian whiskered tern
Chilodonias leucoptera	- Whitewinged black tern

Table A3.5-1 TOTAL POPULATION IN THE PROJECT AREA

Area	Male	Female	Families	Total Population
Extension Area				
Hambantota AGA Division	7,186	6,985	-	14,171
Ambalantota Division	4,195	3,884	1,989	8,079
Old Area				
Suriyawewa	2,403	459	6,843	2,862
Kiriibanwewa	-	-	3,239	-
Hambantota District	-	-	9,714	44,547

Source: MEA Census, 1992
JICA Interim Report 1991

Table A.3.5-2 PRESENT LAND USE

(Unit: ha)

Land Use	Sugar Area Sevenagala	MEA Area	Extension Area
1. Agricultural Land			
Irrigated paddy	370	2,540	-
Rainfed paddy	-	70	260
Irrigated sugarcane	1,120	-	-
Chena cultivation and others	985	2,180	2,520
Irrigated upland	-	360	-
2. Forest Land			
Dense forest	-	-	-
Open forest	620	260	740
Forest reserve	-	-	960
Forest plantations	-	-	20
3. Rang Land			
Shurb/Srassland	650	605	10,310
Livestock farm	-	25	490
Tank	20	-	-
Barren land/Rock land	60	700	-
4. Homesteads*	1,800	2,490	200
Total	5,625	9,230	15,500

Note: * Homesteads include home yard for upland crops.

Table A3.5-3 PRESENT LAND USE UNDER THE TANK IRRIGATION SYSTEM IN THE EXTENSION AREA

(Unit: acre)

Name of Scheme	Paddy Field under Tank Irrigated System	Upland Field* Around Tanks	Other Upland Field
1. Bolhinda Wewa	20.0	18.0	21
2. Ballagas Wewa	48.0	0.0	44
3. Oruwalanda Wewa	25.0	24.0	400
4. Mahapitapelessa Wewa	50.0	-	50
5. Pitawala Wewa	15.0	7.0	32
6. Wedi Wewa	105.0	-	-
7. Goara Wewa	15.0	30.0	65
8. Goyankolamulla Wewa	27.0	-	-
9. Hondawelpoluna Wewa	48.0	-	-
10. Kattana Wewa	22.5	15.0	70.5
11. Andiyangama Wewa	40.0	-	275
12. Katu Wewa	175.0	126.0	-
13. Arabokka Wewa	50.0	-	10
14. Galwakkada Wewa	19.0	22.8	-
15. Samarakoon Wewa	-	-	-
16. Sodagama Wewa	62.5	25.0	-
17. Andarawewa	ND	ND	ND
Total	722.0	267.8	967.5

Note: * The field cultivated by the farmer under the tank irrigation system.

Table A3.5-4 METHOD OF LAND PREPARATION

Season		Kirribbanwewa Block (ha)				Suriyawewa Block (ha)				Left Bank Total	Percentage			
		2-Wheet Tractor	4-Wheet Tractor	Manual	Buffalo	2-Wheet Tractor	4-Wheet Tractor	Manual	Buffalo		2-Wheet Tractor	4-Wheet Tractor	Manual	Buffalo
1985	Yala	739	0	24	457	1,016	0	19	1,065	3,520	52.86	0.00	1.30	45.84
85/86	Maha	584	1	50	488	1,334	0	172	506	3,135	61.18	0.03	7.08	31.71
1986	Yala	739	5	29	475	1,423	0	25	731	3,427	63.09	0.15	1.58	35.19
86/87	Maha	774	17	19	409	1,482	0	46	642	3,389	66.57	0.50	1.92	31.01
1987	Yala	737	2	25	279	1,520	0	60	585	3,198	70.58	0.06	2.35	27.02
87/88	Maha	739	29	62	305	1,222	8	15	442	2,822	69.49	1.31	2.73	26.47
1988	Yala	470	15	53	546	1,186	6	7	436	2,719	60.90	0.77	2.21	36.12
88/89	Maha	719	18	29	293	1,282	0	8	400	2,749	72.79	0.65	1.35	25.21
1989	Yala	976	188	28	235	1,207	82	11	456	3,183	68.58	8.48	1.23	21.71
89/90	Maha	1,020	0	2	410	2,001	8	86	663	4,190	72.10	0.19	2.10	25.61
1990	Yala	966	12	7	560	2,081	24	70	755	4,475	68.09	0.80	1.72	29.39
90/91	Maha	1,425	0	43	331	2,577	3	63	481	4,923	81.29	0.06	2.15	16.49
1991	Yala	1,052	35	31	136	2,224	35	34	239	3,786	86.53	1.85	1.72	9.90

Table A3.5-5 INFRASTRUCTURE FACILITIES

Facilities	Sevanagala	Kiriibbanwewa	Suriyawewa
Government Dispensary and Maternity Homes	-	1	1
Ayurvedic Dispensary	-	1	-
Family Health Workers Centre	-	4	3
Hospital	-	-	-
Primary School	4	2	2
Junior School	2	4	5
Senior School	3	1	1
Class 'A' Road	-	-	-
Class 'C' Road (Metaled)	Yes	Yes	Yes
Class 'C' Road (Graveled)	-	-	Yes
Class 'D' Road (Metaled)	Yes	-	Yes
Class 'C' Road (Graveled)	-	-	Yes
Bus Depot	-	-	-
Bus Service	Yes	Yes	Poor/Yes
Telephone Exchange	-	-	-
Sub-Post Office	-	-	1
Drinking Water Supply Scheme	-	-	-
Police Station	-	-	1
Community Centre	2	-	1
Divisional Secretariat	-	-	1
Junasakathi Bank	-	-	5
Rural Development Bank	-	-	1

Table A3.5-6 HOUSING CONDITIONS

	Households		Condition of Roof				Condition of Floor				Condition of Walls				Built By	
	Main Family	Sub Family	Tile	Asbestos	Cadi	Other	Cement	Wood	Wattle	Other	Brick	Wattle	Cadians	Other	Owner	Tenant
Hambantota	2,642	502	942	169	1,411	121	11,090	43	1,399	110	1,286	892	356	108	2,376	170
Suriyawewa	1,056	68	67	13	934	42	81	33	910	32	127	758	137	34	769	251
Ambalantota	1,597	153	319	34	1,153	41	371	88	1,108	30	474	901	191	31	1,416	168

FIGURES

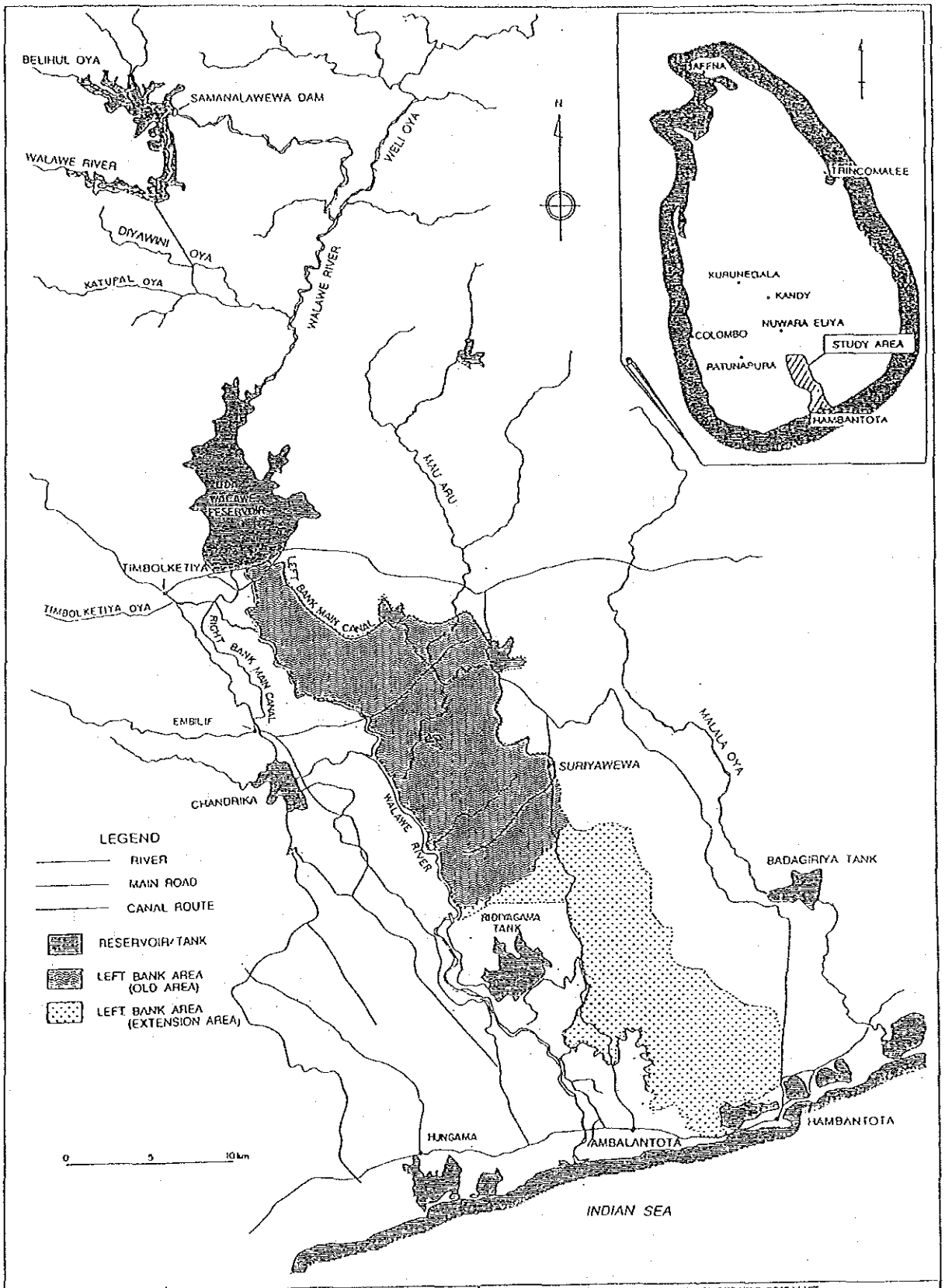
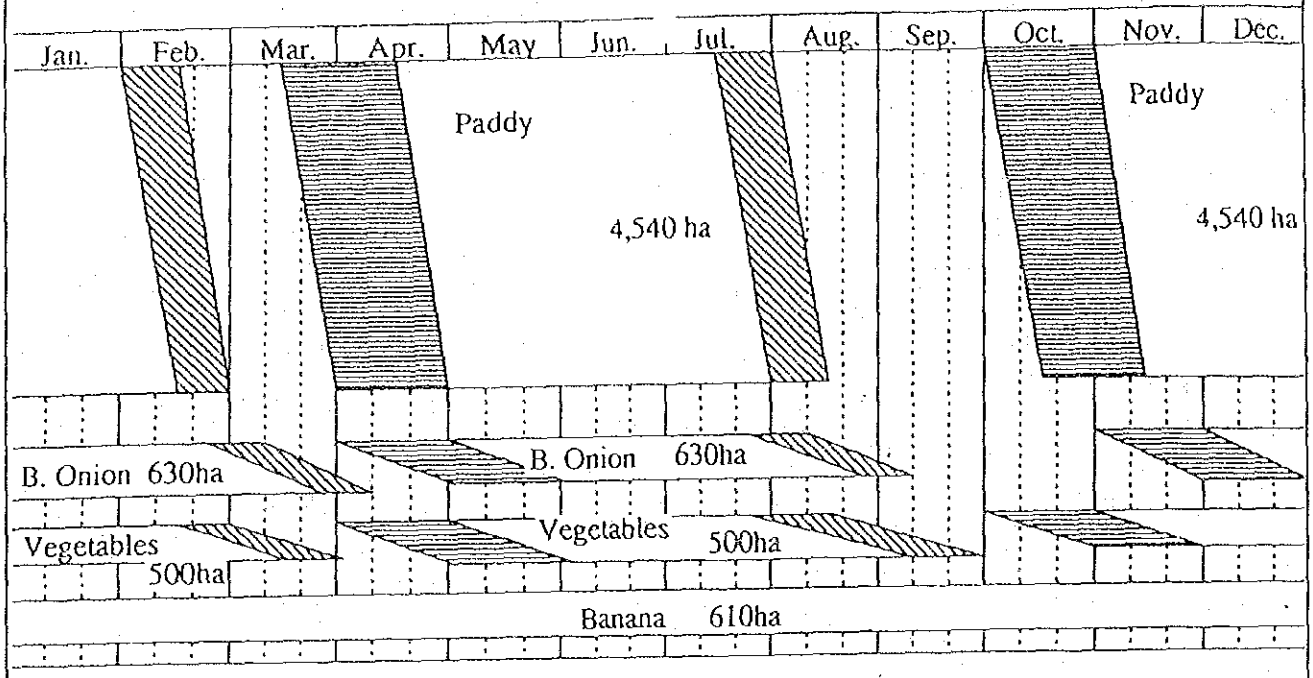


Fig. 2.1 - 1
LOCATION OF THE PROJECT AREA

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



Paddy

The suitability of the Low Humic Gley soils provide for 4,540 ha of paddy, in each of Yala and Maha seasons.

Sugar Cane

Based on an assurance given that the Sevenagala Sugar Industries will accept the cane, 3,000 ha have been set aside for sugar cane.

Banana

As crop diversification in the right bank will provide for an expanded banana cultivation, only 610 ha have been allocated.

Big Onion

In view of the high capital outlay, 630 ha is considered in each of Yala and Maha seasons.

Vegetable

Each season, 500 ha will be under vegetable production. The proposed packhouse and cold chain project are an inducement for greater vegetable production.

Fig. 2.2 - 1
PROPOSED CROPPING PATTERN

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

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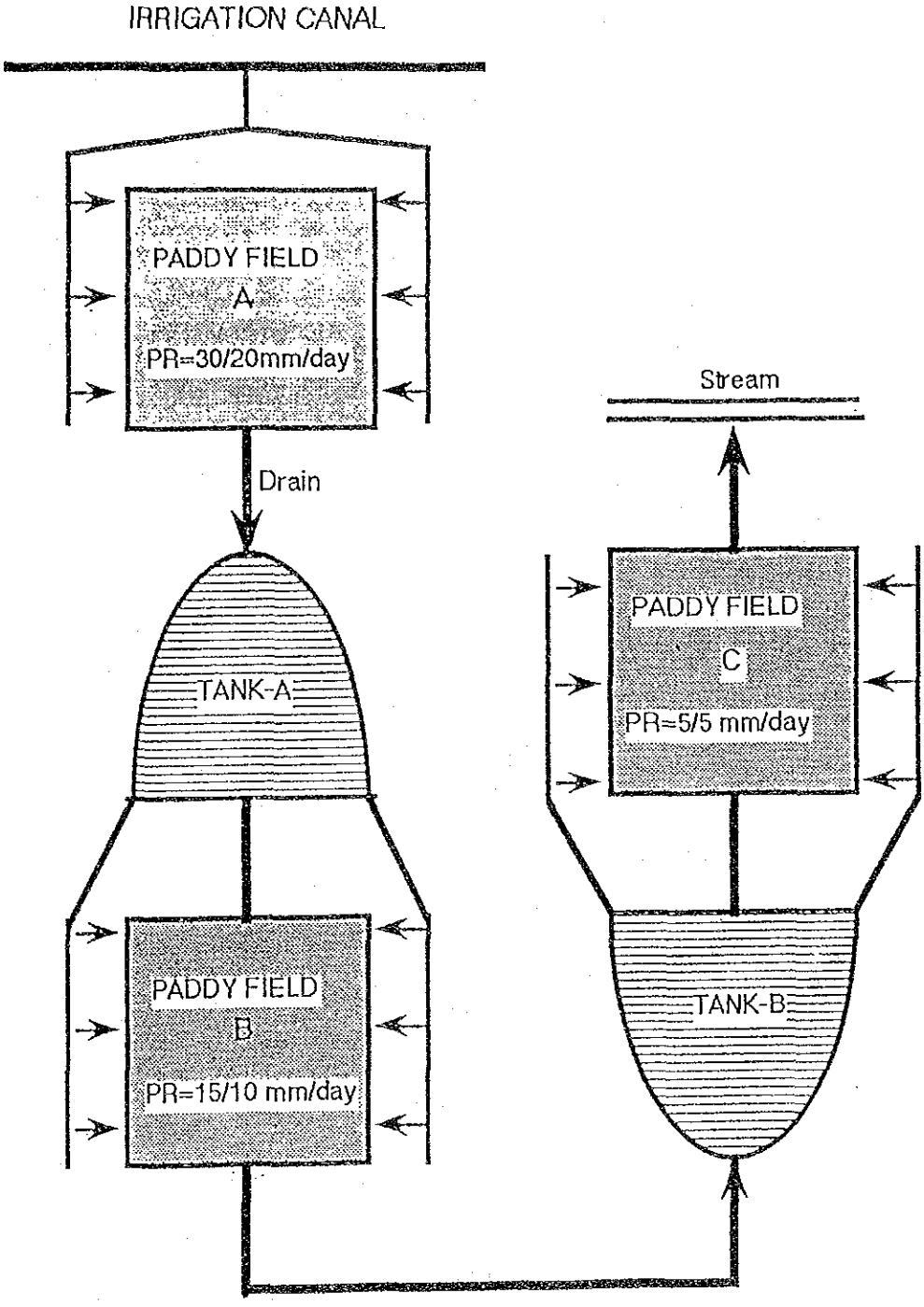

PR : Percolation Rate of Paddy Field

30/20 : PR=30 mm/day during the land preparation period
and PR=20 mm/day during the growing period.

Fig. 2.2-2
Tank Cascade System

GOVERNMENT OF DEMOCRATIC SOCIALIST
REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON
WALAWE IRRIGATION UPGRADING AND
EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

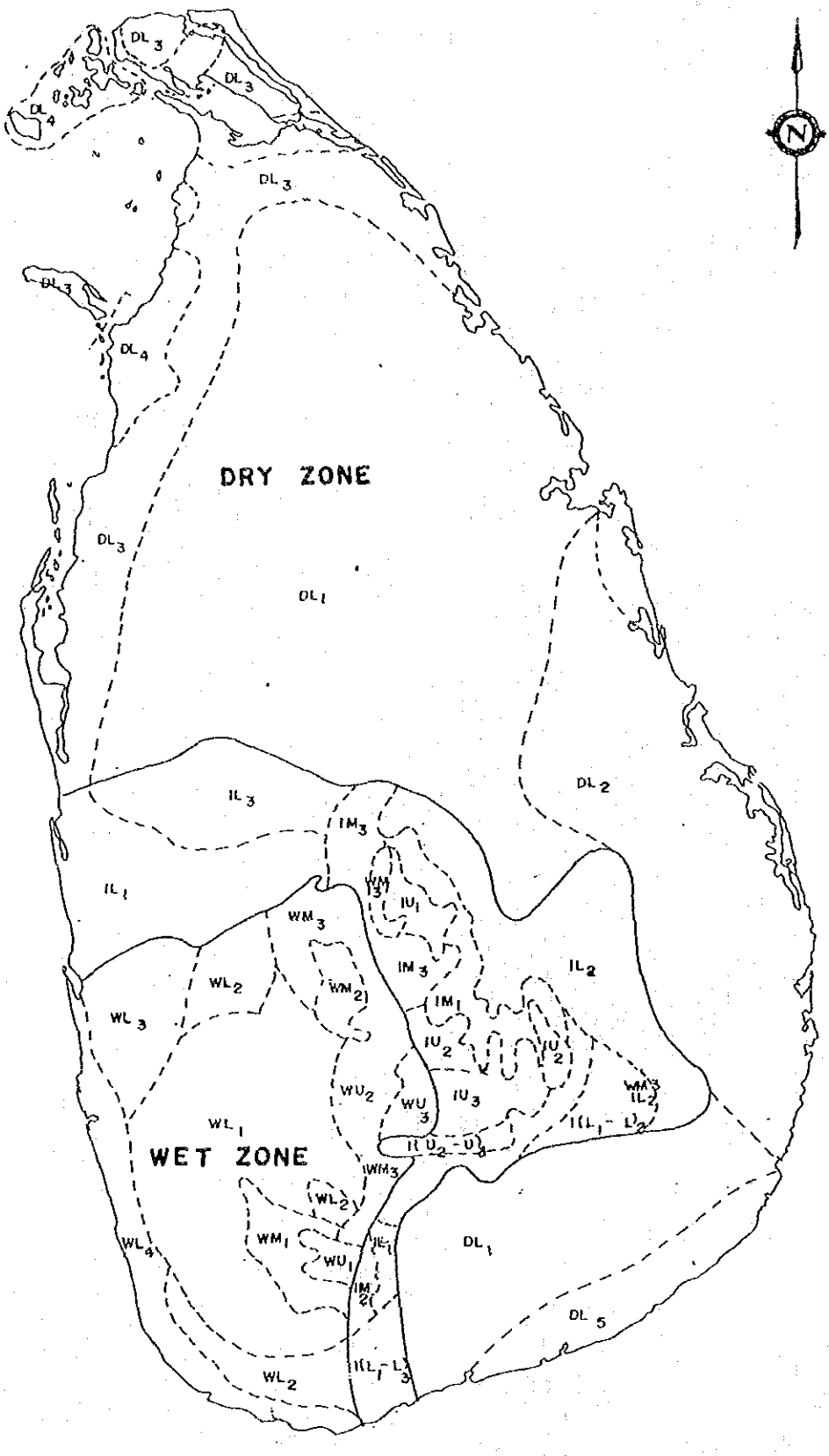

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Fig. 3.2 - 1
AGRO ECOLOGICAL REGIONS
OF SRI LANKA

GOVERNMENT OF DEMOCRATIC SOCIALIST
REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON
WALAWE IRRIGATION UPGRADING AND
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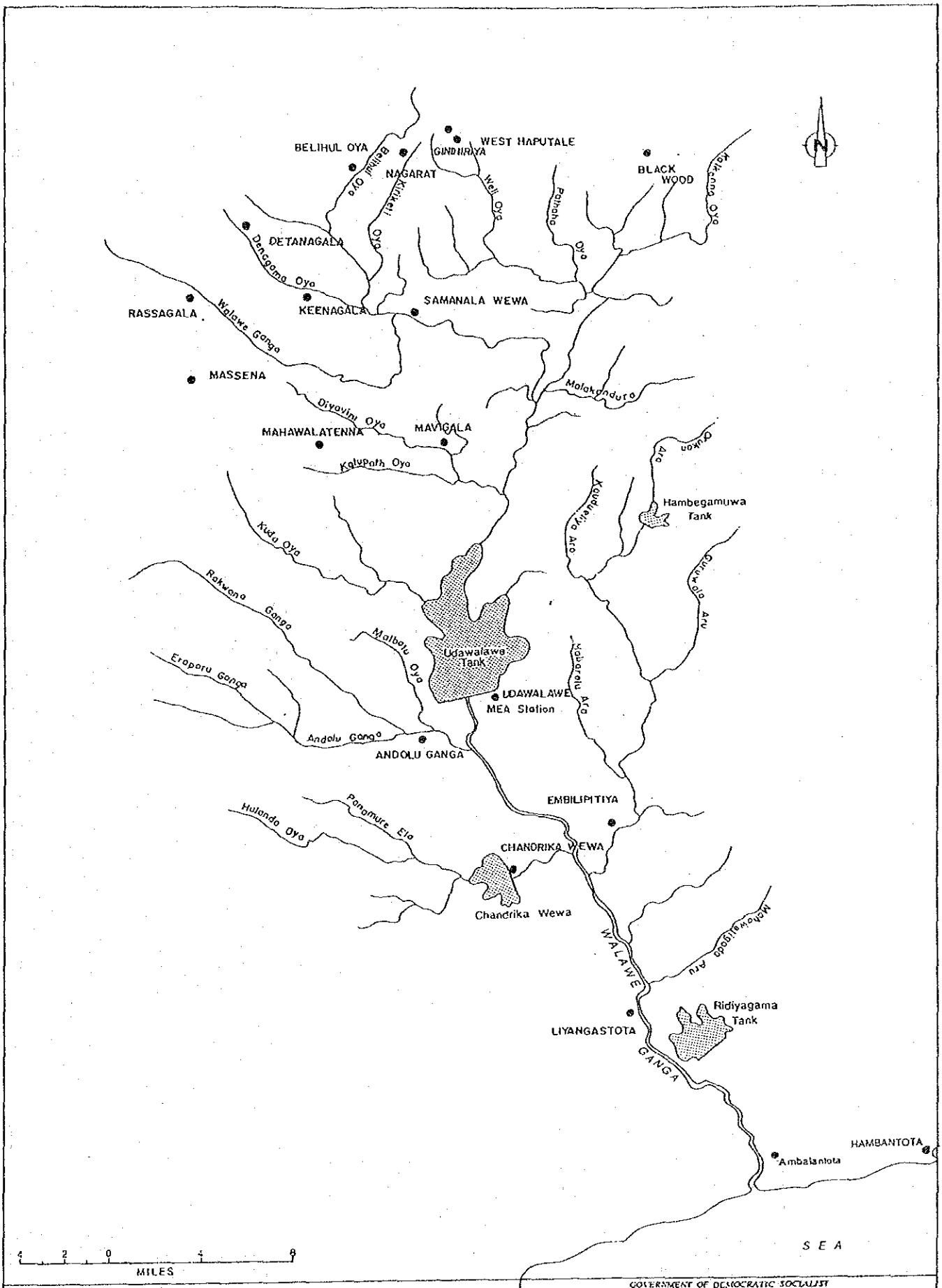

Fig. 3.2 - 2

HYDROLOGICAL DATA GENERATING STATIONS

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

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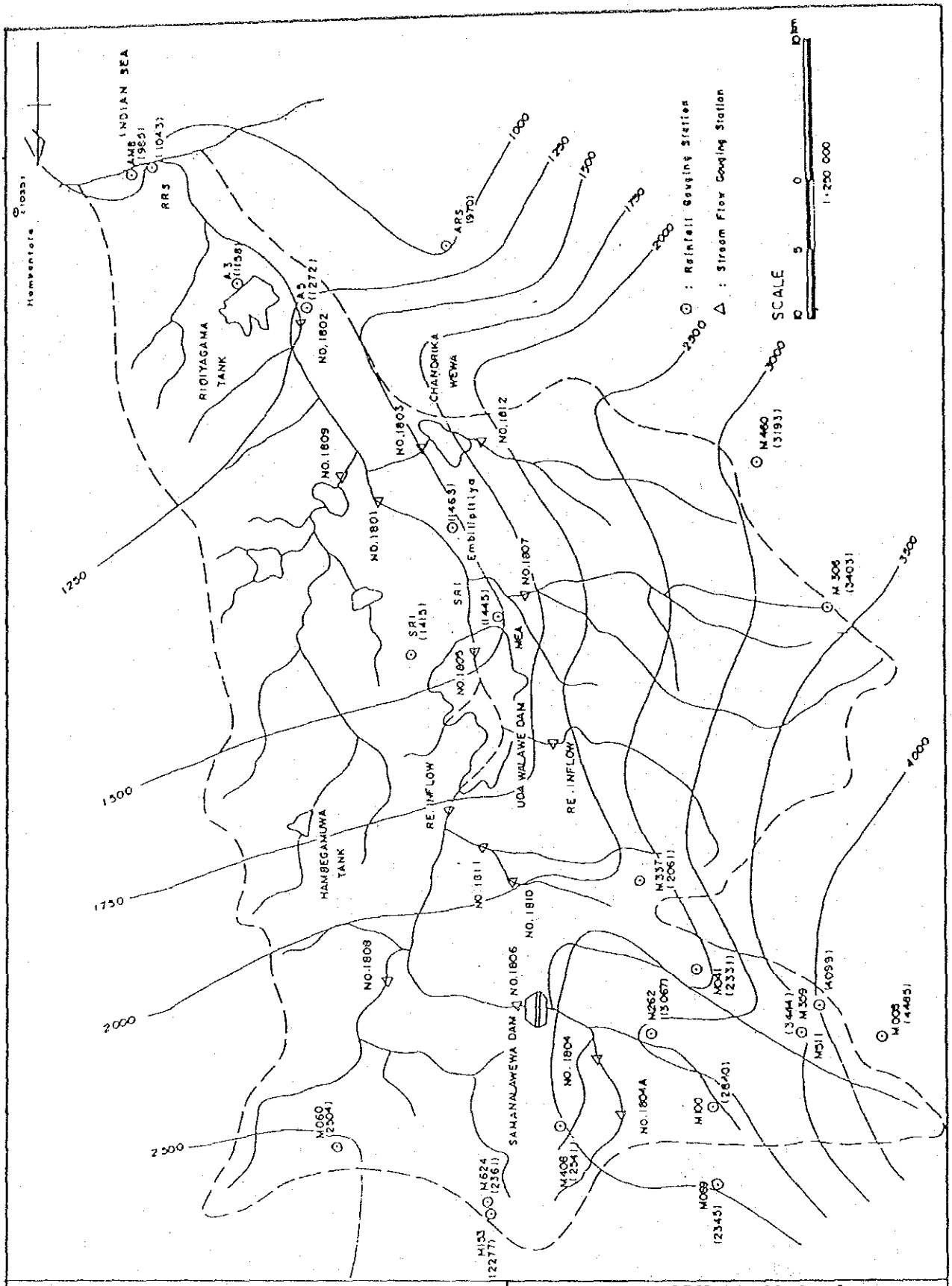
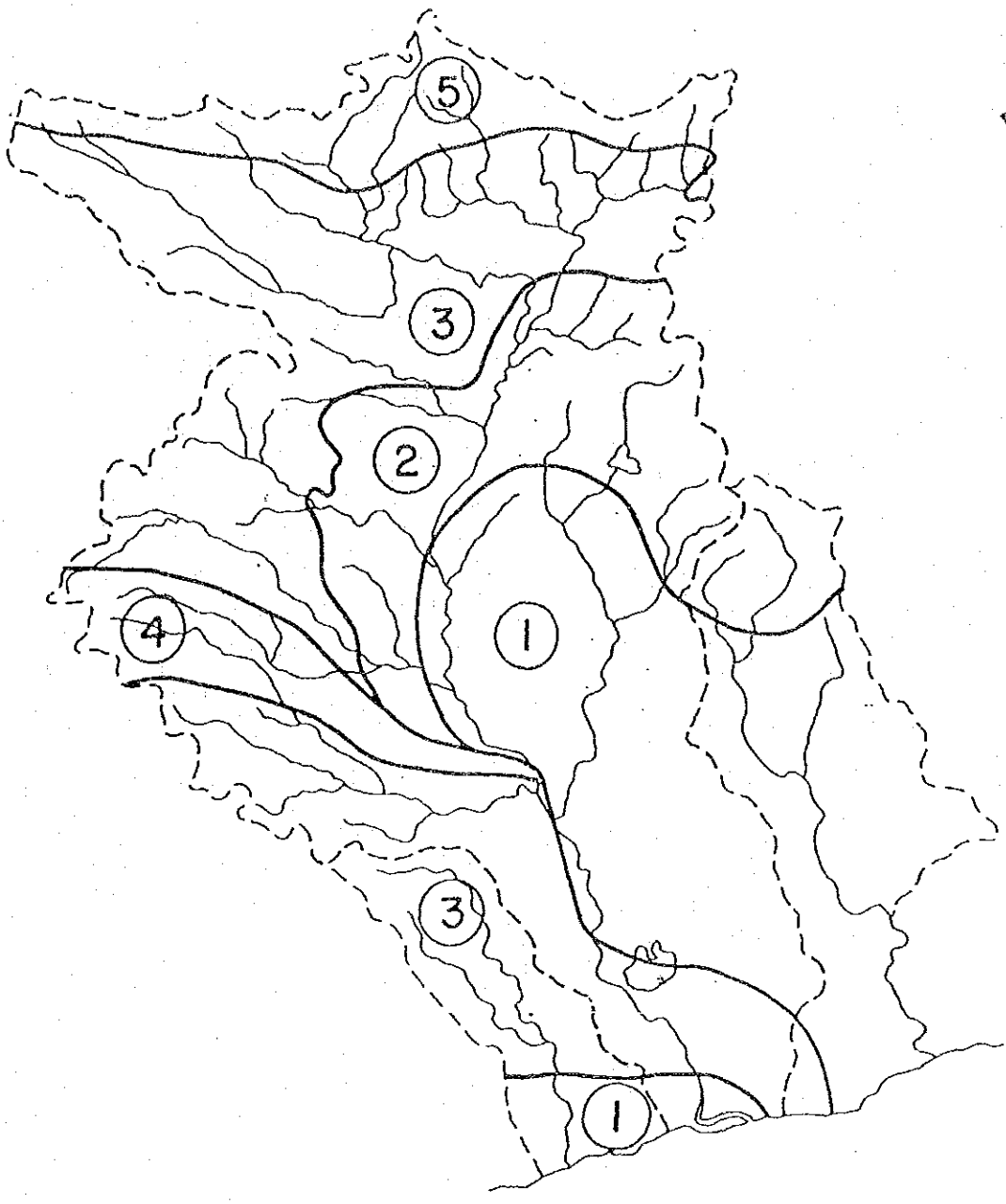


Fig. 3.2 - 3
RAINFALL DISTRIBUTION

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON
WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



① Hornblende and Biotite Gneiss

② Hornblende, Biotite and Charnockitic Gneiss

③ Quartzo-Feldspathic Gneiss and Granulite

④ Predominantly Chornockite

⑤ Chornockite and Quartzite

SCALE

MILES 4 0 8 16 MILES

Fig. 3.2 - 4

MAIN ROCK TYPES

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

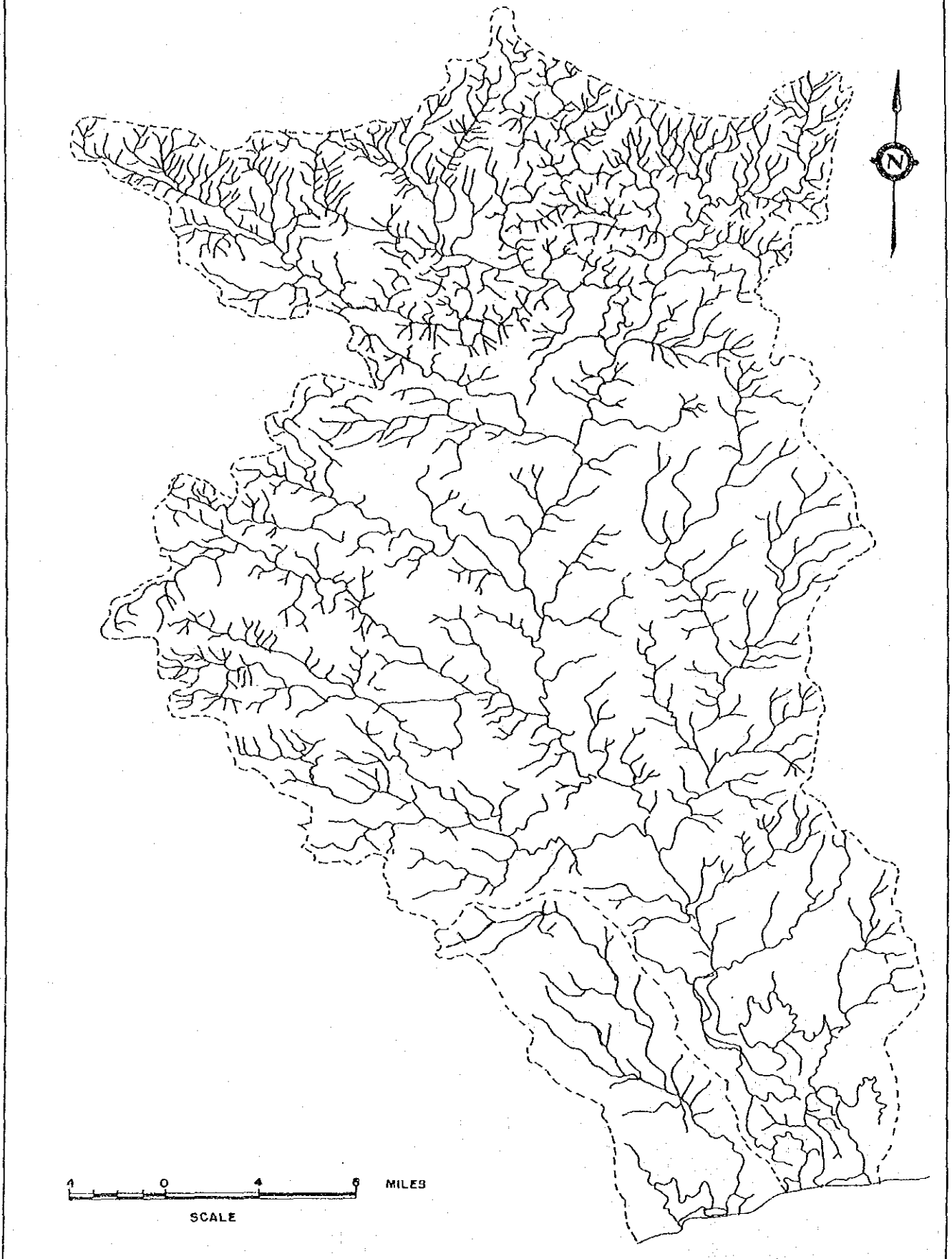


Fig. 3.3 - 1

WALAWE RIVER BASIN

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON
WALAWE IRRIGATION UPGRADING AND
EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

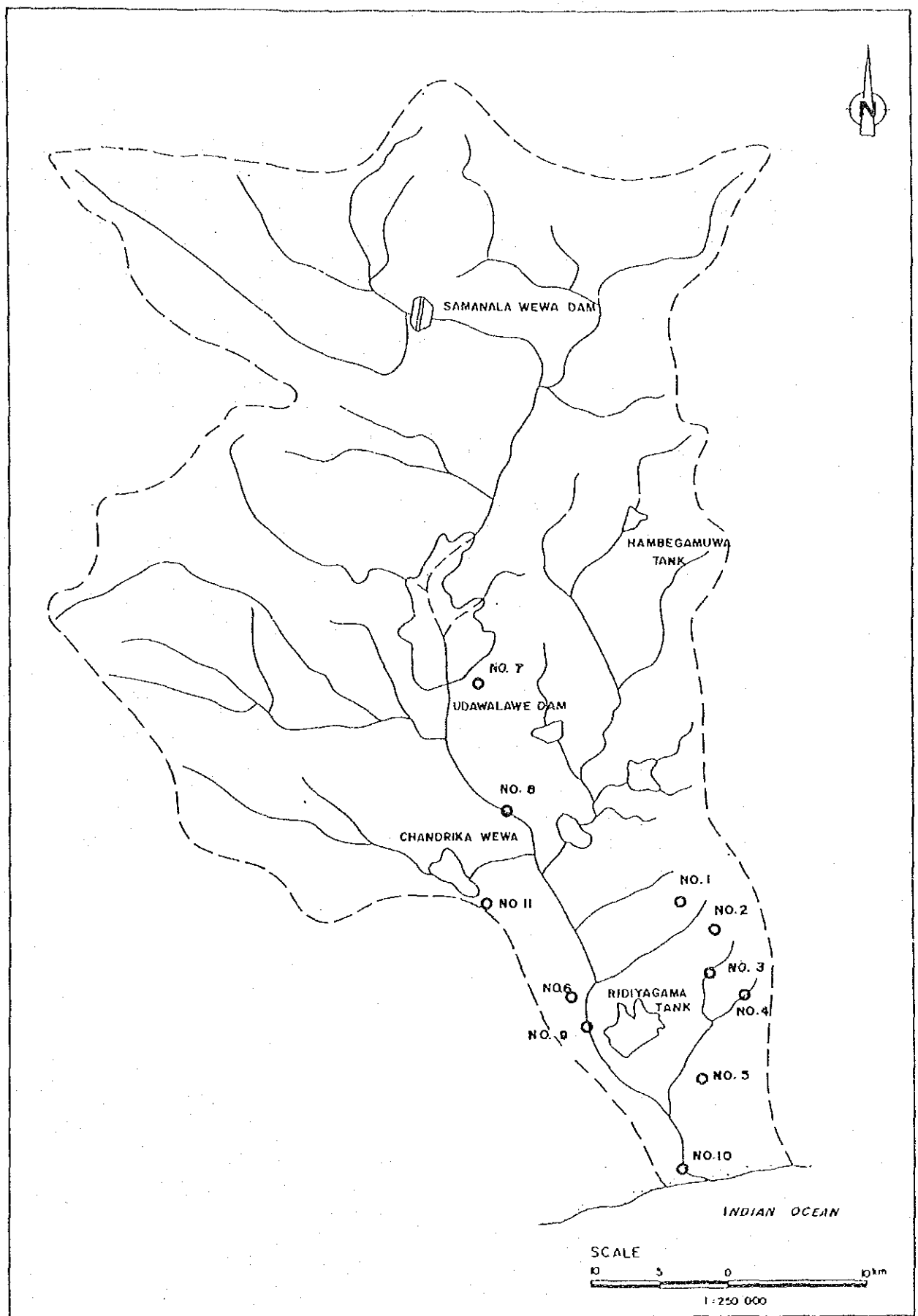


Fig. 3.3 - 2

WATER SAMPLE ANALYSIS

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

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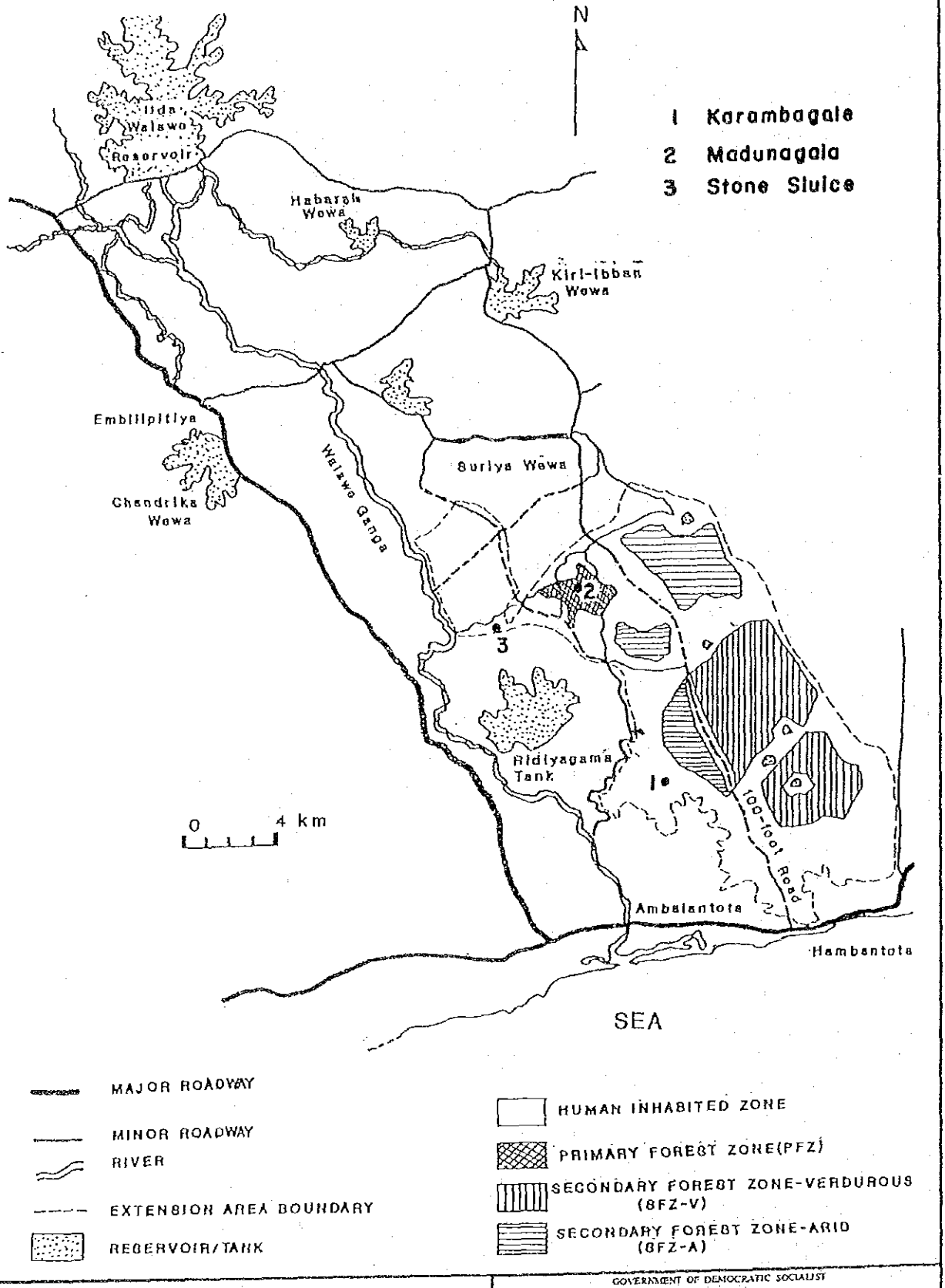

Fig. 3.4-1
Distribution of Faunal/Human Inhabited Zones

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

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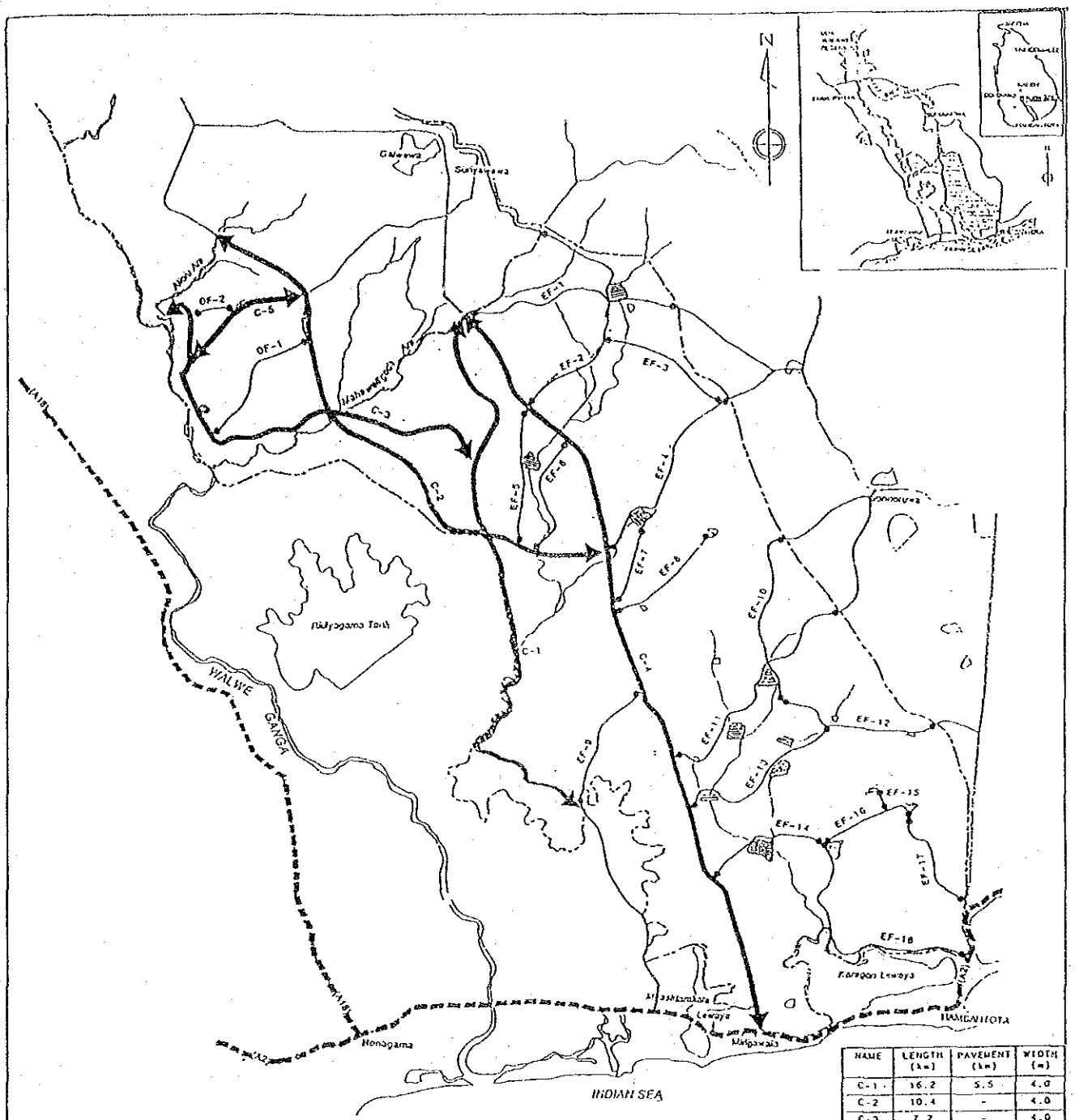


NAME	LENGTH (km)	PAVEMENT (km)	WIDTH (m)
C-1	16.2	5.5	4.0
C-2	10.4	-	4.0
C-3	7.2	-	4.0
C-4	20.3	-	4.0
C-5	3.8	-	3.5
EF-1	3.8	-	3.0
EF-2	6.6	-	3.5
EF-3	3.8	-	2.5
EF-4	5.4	-	3.0
EF-5	3.0	-	2.5
EF-6	3.5	-	2.0
EF-7	2.1	-	3.0
EF-8	2.9	-	3.0
EF-9	3.9	-	3.5
EF-10	4.7	-	2.5
EF-11	6.4	-	3.0
EF-12	4.1	-	2.5
EF-13	4.7	-	2.5
EF-14	3.5	-	3.0
EF-15	0.6	-	2.0
EF-16	2.5	-	2.0
EF-17	3.2	-	3.0
EF-18	6.5	-	3.5
OF-1	3.7	-	3.0
OF-2	1.6	-	3.0

LEGEND
- CLASS "A" ROAD
- MAIN ROAD
- INTERNAL ROAD

GENERAL LEGEND
- BOUNDARY OF STUDY AREA
- BOUNDARY BETWEEN OLD AND EXTENSION AREA
- BOUNDARY OF OLD EXTENSION AREA
- RIVER/STREAM
- MAJOR ROAD
- TANK

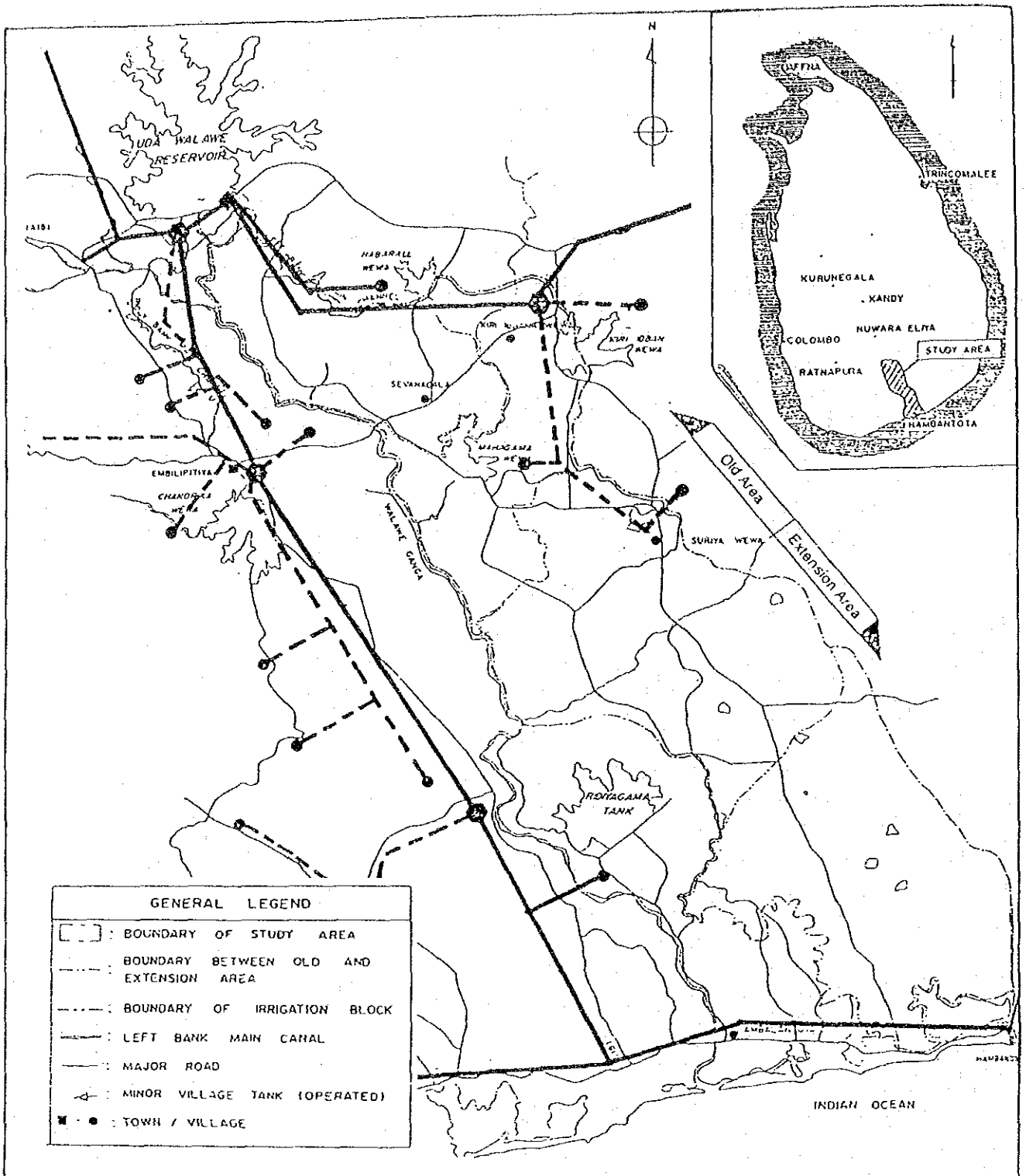
Fig. 3.5-1

Road Network in the Extension Area

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

- 33 kv Transmission Line
- 11 kv Transmission Line
- Primery Station
- Sub Station

SCALE

Fig. 3.5 - 2

EXISTING ELECTRICITY SUPPLY NETWORK

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

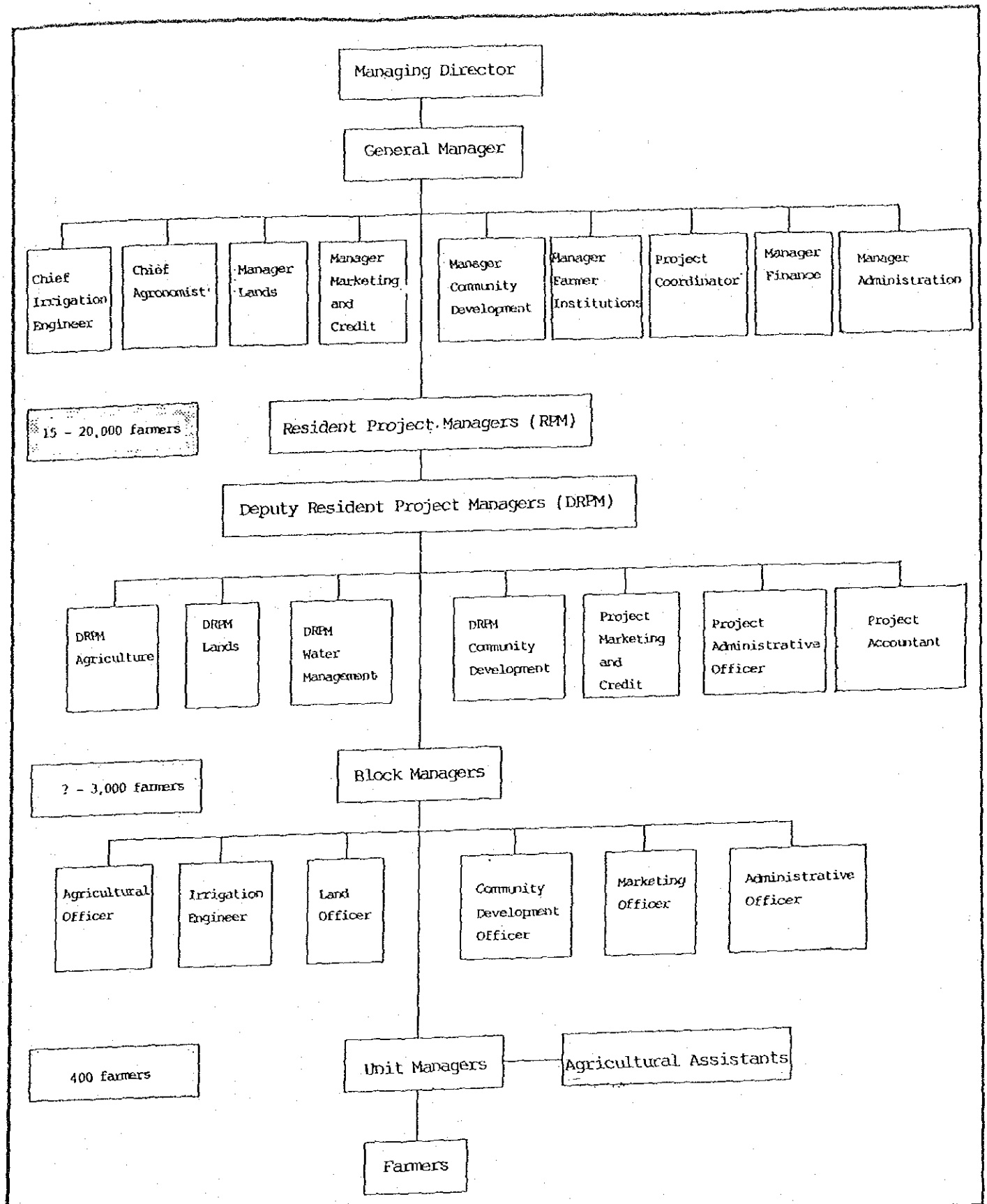


Fig. 3-9-1

Organization Structure

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

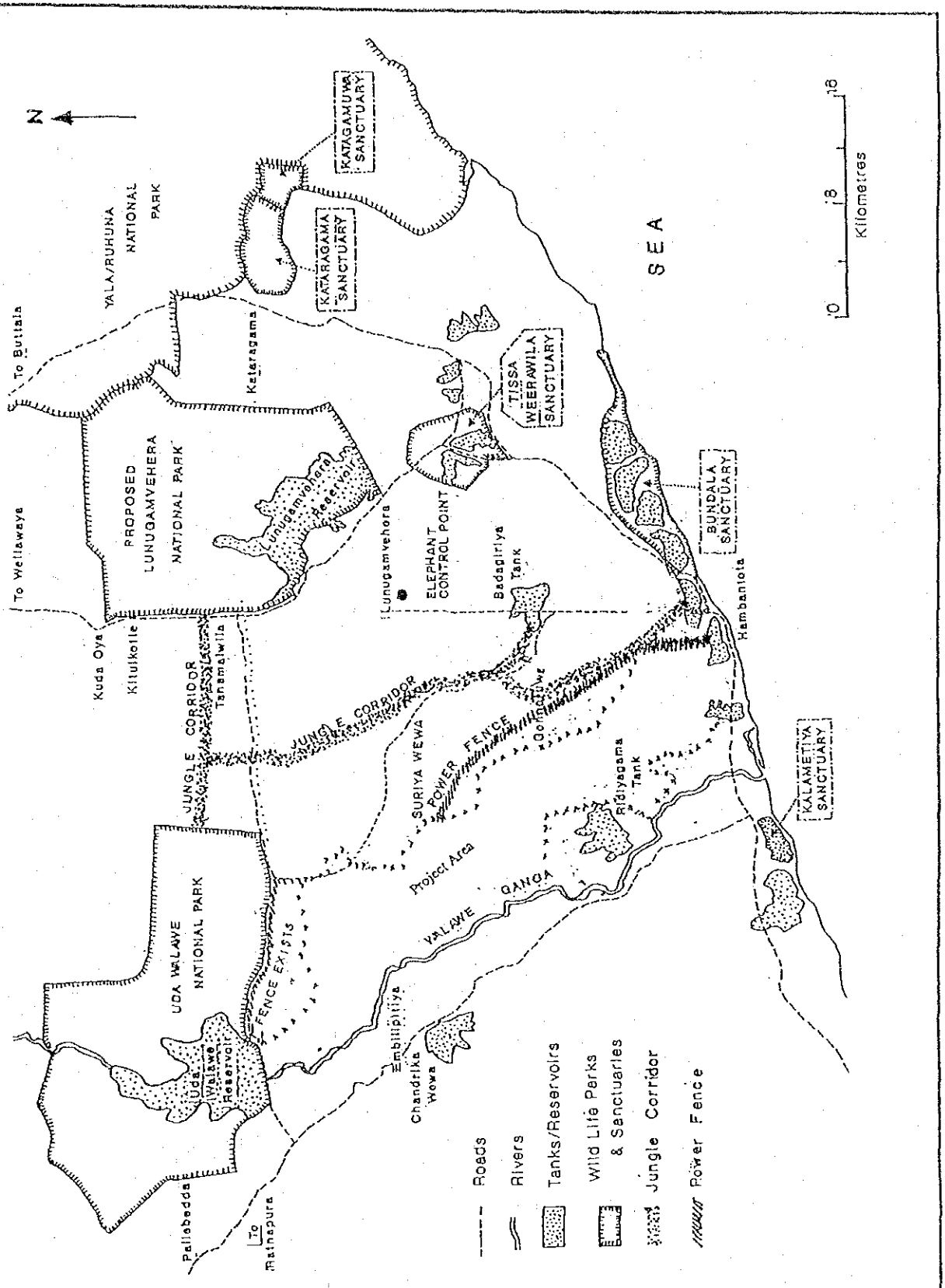
THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.1-1 Evaluation of Environmental Impacts

ENVIRONMENTAL VARIABLES \ PROJECT ACTIVITIES	Land clearing	Canal construction	Canal repair	Land preparation	Houses	Urban centres	Roads	Electricity	Communications	Irrigation upgrading	New irrigation	Crop husbandry	Livestock production	Pesticide use	Fertilizer use	Health care	Education	Potable water	Weir construction	Existing industries
Natural Vegetation																				
Habitat loss	M																		N	
Species loss	N																			
Wildlife																				
Habitat loss	M																			
Species loss	N																			
Aquatic spp.	N																			
Conflict	N																			
Physico - Chemical																				
Micro-climate	M																			
Soil erosion	M	N		M		M	M					M	M							
Sedimentation	M			M		M	M					M	M							
Salinity										U	U									
Waterlogging												N								
Drainage							M													
Water table	M			N																
Surface water quality	N			N									M	U	U					M/U
Ground water														U	U					U
Sea water intrusion										N/U	N/U									
Air pollution	N					N	N													
Socio-economic																				
Resettlement																			M	
Fuelwood	M																			
Culture																				
Archaeological site																				
Off-site																				
Karagan lewaya										N/U	N/U			U	U					
Coastal waters										N/U	N/U			U	U					

Impacts : H = High; M = Moderate; N = Negligible; U = Unknown



GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4-2-1 Wildlife Protected Area

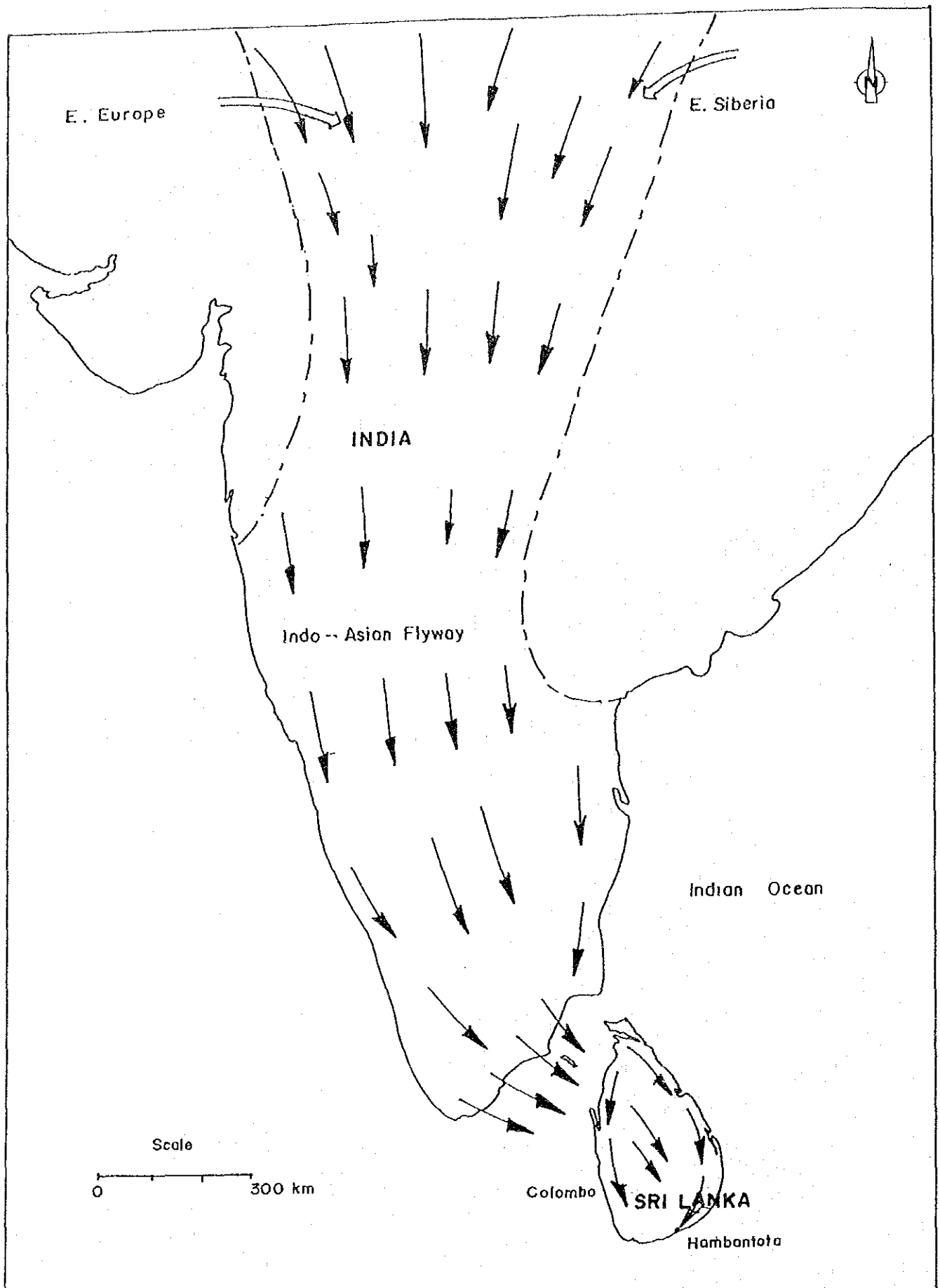


Fig. 4-2-2
BIRD MIGRATION INTO SRI LANKA AND THE PROJECT AREA THROUGH THE INDO-ASIAN FLYWAY

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
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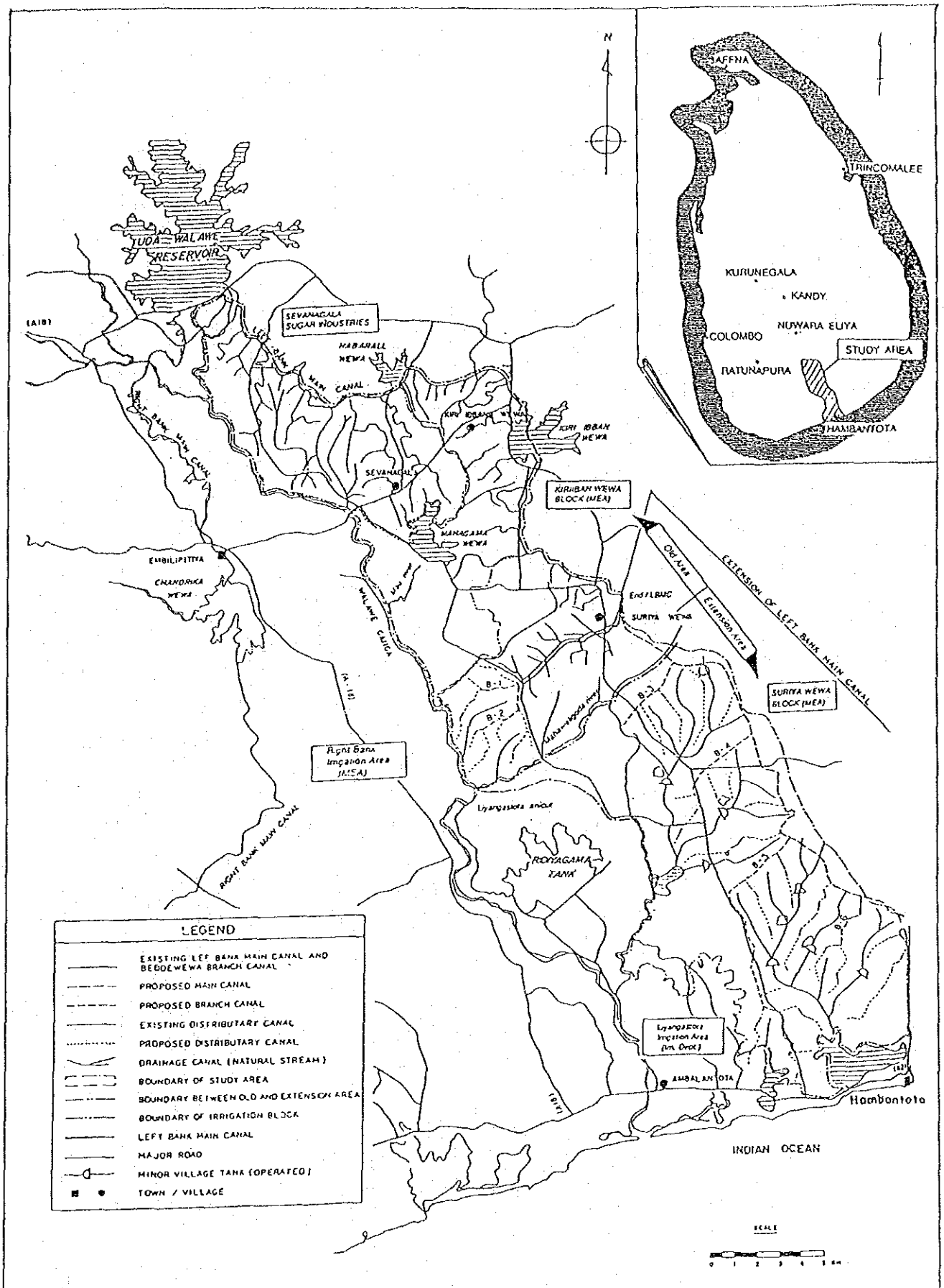

Fig. 4·2 – 3

CANAL NETWORK

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

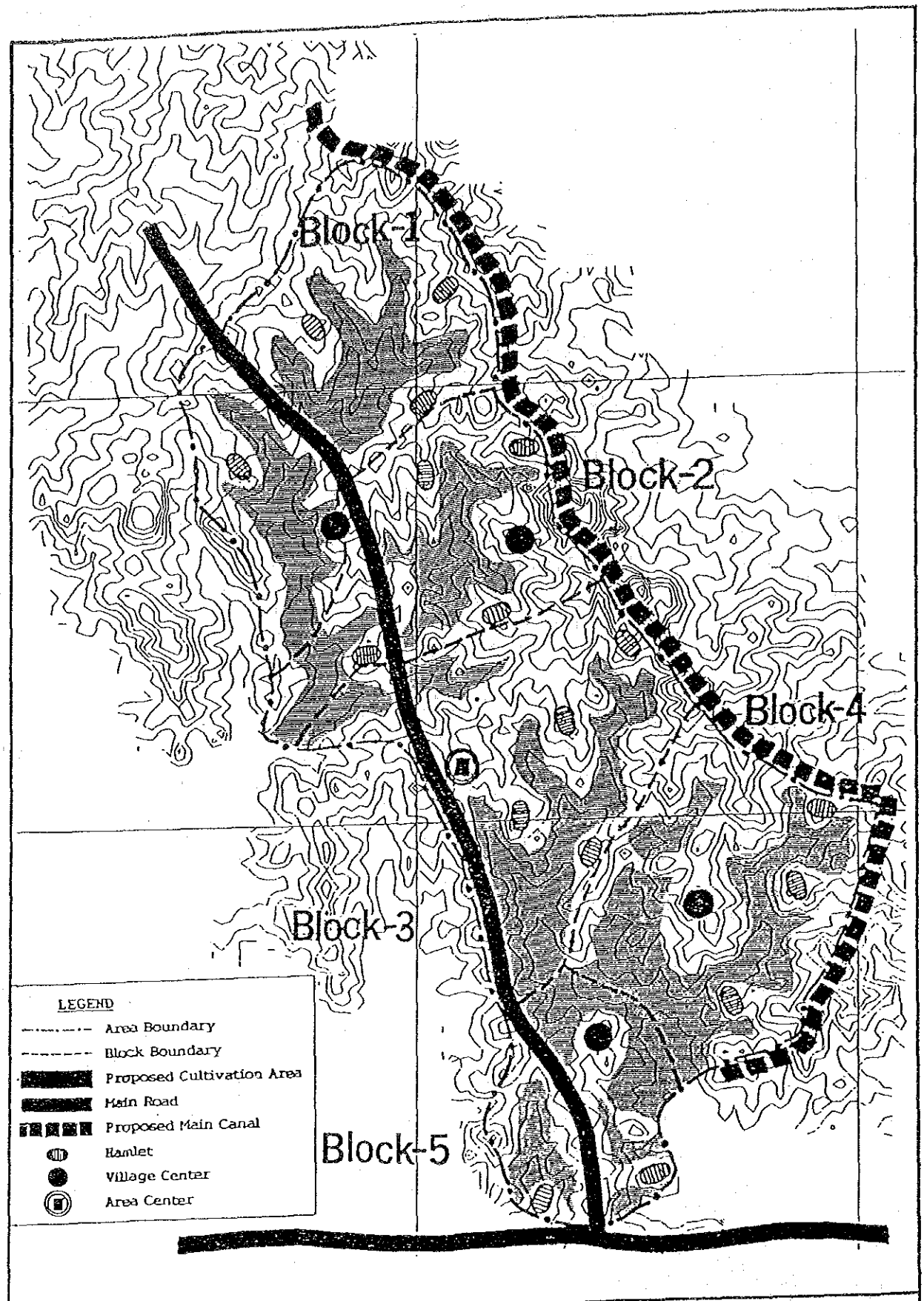

Fig. 4-2-4
VILLAGE ALIGNMENT PLAN

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
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THE FEASIBILITY STUDY ON
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EXTENSION PROJECT

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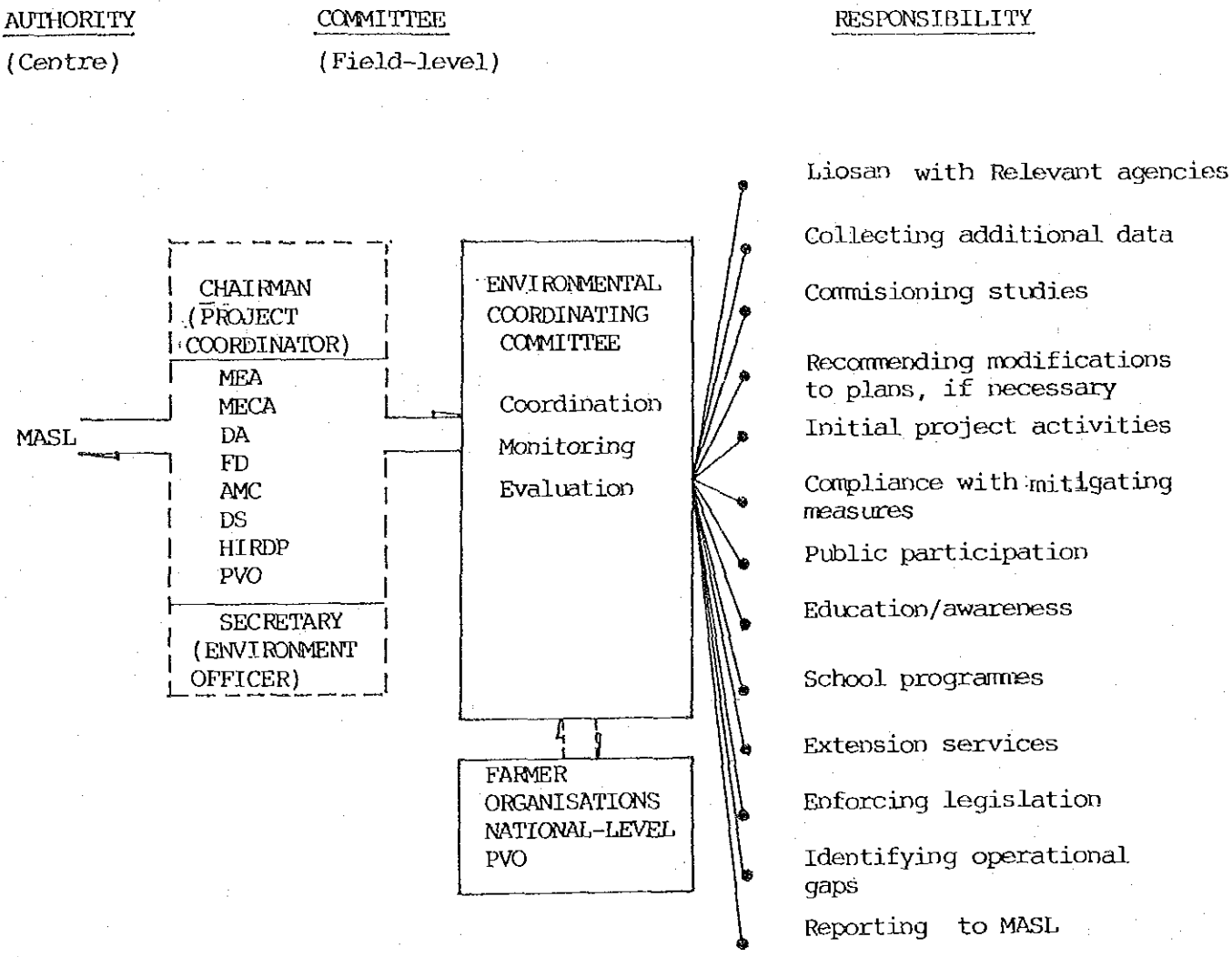

Fig. 6.1 - 1 Environmental Coordinating Unit

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APPENDIXES

Appendix I

Establishment of Jungle Corridor - I

From the northwestern edge of Badagiriya tank, extending northwestwards to meet the left bank of Malala Oya and extending northwestwards and northwards along the left bank of the said Oya to meet Indiwewa-Uda Mattala cart track, and thence northwestwards to a distance of approximately 1.6 km along the left bank of the thence northewestwards along the AGA Division boundary to meet the provincial boundary; thence northwards to meet the left bank of Malala Oya at Kudawewa; thence northwards along Malala Oya to meet the confluence of katagal Ara and Malala Oya; thence generally northwards, northwestwards and northeastwards along Katagal Ara to meet the southern boundary of the proposed Uda Walawe-Lunugamvehera Jungle corridor.

Note: Above described is the western boundary of the proposed jungle corridor. This corridor could easily be plotted on the ground, to a width of 1.5 to 3.0 Km

Appendix II

Establishment of Jungle Corridor - II

Commencing from 152 km post on Hambantota-Wellawaya road (which) is the northern boundary of Bundala Sanctuary) northwards to Mettigatwewa and northwestwards to the southwestern edge of Keligaman tank; thence 4.8 km westwards (3rd mile post) on Hambnatota-Gonnorunwa road; thence westwards and northwestwards to meet Hunikuwagala (Galawew on the South); thence northwestwards Buruthakanda and northwards along the 200 foot contour to meet Buruthakanda-Gonnoruwa cart track; and thence northwards, northeastwards to meet Gonnoruwa-Meegahajandura road at 16.4 km (10 1/4 miles); and thence generally northeastwards to meet the Malala Oya and the western boundary of the proposed Badagiriya-Uda Walawe Jungle Corridor.

Appendix III

Erecting a main/solar-powered electric fence along the eastern boarder of the project area from Suriyawewa to Sippikulama

From Suriyawewa eastwards along the cart tract leading to Uda Mattala, to a distance of approximately 4.8 km to meet unnamed tank (midway between Galwewa and Ualla); thence by a straight line drawn southeastwards to meet the eastern end of Andarawewa (8.8 km); thence from the last mentioned point at Andarawewa by a straight line drawn to Buruthakanda. (10.0 km); and thence from the last mentioned point by a straight line drawn to Hemikuwagala. (3.2 km); thence by the straight line drawn from the last mentioned point to the 4.0 km post (2 1/2 mile post) on Hambantota-Gonnoruwa road (4.8 km); from the last mentioned point southwards parallel to Hambantota-Gonnoruwa road to meet the northern boundary of the Cotton Experimental Station land; thence skirting the said land generally southwestwards to Nelunpatwila (karagan Lewaya) -(7.6 km or 4.7 miles).

Note:
- The total length of the electric fence is 34.4 km (21.5 miles).
- Six gates are required at road crossings.
- Four watch huts are required at Suriyawewa; on Buruthakanda-Gonnoruwa cart track; 3.2 km (2nd mile post) on Hambantota-Gonnoruwa and at Nelunpathwila.

Appendix IV

Sources of Data and Information

A. Interviewed personnel

1.	V. Gunawardhana	- Additional G.A. Hambantota
2.	D.L Ariyadasa	- Mill Manager, Sevenagla Sugar Industries
3.	Dr. Sumith Abesinha	- Health Department, Suriyawewa Government Dispensary
4.	A.A. Chandarasena	- Project Director, IRDP, Hambantota
5.	Dr. S.A.K. Kulantunga	- Private Practitioner, Suriyawewa
6.	Dr. S.Abeyakoon	- DMO, Embilipitiya
7.	A.L.M. Ismail	- Deputy Director, Irrigation Department Hambantota
8.	P.A.G.Paranamana	- Irrigation Engineer, Ambalantota
9.	Hon. T. Kuttiarachi	- State Minister, Parliament and Affairs
10.	S. Manthripala	- Government Agent Moneragala
11.	S. Berugoda	- Director, Land Use Policy Planning
12.	M.W.P. Wijesingha	- Chairman, Water Resources Board
13.	Indu Ranasinha	- Deputy Manager, Planning Coast Conservation Department
14.	S.M. Bandara	- Geologist, Water Supply and Drainage Board, Embilipitiya
15.	P.S.Samaratunga	- Area Manager, Water Resources Board, Embilipitiya
16.	K.S. Dayananda	- Engineer, IRDP, Hambabtota
17.	M.H.S. Dayaratana	- Deputy Director, Ministry of Policy Planning
18.	Wijeratana	- Railway Department
19.	Jayasinha	- Director, Planning Southern Provincial Council

Institutions Contacted

1. Department of Meteorology
2. Department of Wildlife Conservation
3. Land Use Policy Planning Division
4. Water Resources Board
5. Ministry of Policy Planning and plan Implementation
6. Water Supply and Drainage Board
7. Integrated Rural Development Project, Hambantota

Appendix V

Comments Made by the Public and Voluntary Organizations

The consideration has been given to the local remote organizations such as Farmer Organizations, Community Development Societies and other various small village societies in the project area. It is strongly falls that, the impacts of the project will go to settlers in that area and therefore beneficiaries will be the same people who have already settled in the project area.

A Summary to the comments made by the Voluntary Organizations outlined below.

Rural Women Society- Andarawewa

" We have been living here since early 1940s. Now this is our third generation. If water comes to this area, we are very happy because we will have a good life here. Human is the main component of the environment. Without human beings, you can't pursue the environment. I am a genuine farmer leader in this area. But the main problem is water. I am fully aware of the project area and its environment. I don't think, that we will have much negative impacts due to this project. May be very few negatives impacts can be occurred. But, if we think carefully about that we could mitigates such problems"

Farmer Organization - Andarawewa:

" Members in our organizations are very poor. We depend on the farming. When we won't get rainfall, we can't do any thing. Always we have to wait till rainfall comes. If we get water, this is only what we need. Thanks to God, we hope we will get water very soon.

You look at this area. We don't have natural forest. There is nothing to be disturbed. All are secondary forests. Even we disturbed those because of chena. We burn all these, before cultivation. Is there no environmental problem? Human being is most important part of environment. If this project could service us. I think there is no environmental problems in this area. Poor is the most significant environment issues in this area. If this project can help to eliminate that entire issue, it will be a large benefit for us"

Yaya 10- Farmer Organization:

" I am not sure about the environmental hazards in this area. I can see only wild life problem as environmental point of view. If this prepared project can proposed some action to reduce this, we will get most of the benefits proposed by the project. I hope most important part of this environment is people, not the wild life.

Its true that we have to think about animal also. But you shouldn't forget about poorest people in this project area. We are mostly depend on rain. But as you know we are in dry zone and can't trust on the rainfall. We have no other way to survive. We are mostly depend on rain. But, as you know we are in dry zone and cant trust on the rainfall. We have no other way to survive. We are too strong to do cultivation. But natural condition, not allow us to do cultivation. I know, we have fertilized soil also. But without rain how can we do. It will be best opportunity for us, not for us, for our children also."

Janashaakthi Bank Society- Andarawewa:

" We know that we are not knowledgeable to make comments on the environmental issues. But being in the project area long time we can see such problems. I know two such problems we are having now. One is elephant problem, the other one is damages due to livestock.

Cattle damage all our crops, thanks bunds , and pollute our water in the tanks. We have to use same water which they used. If this project can proposed some action against this problem, it will be a very good effort to protect our crops. The problem is there is no place to eat grass for cattle.

During the dry season, elephants use to come to this area form far away. I hope two path ways existing in this project area. One is from Lunugamwehara area and the other one is form Uda Walawe don't have enough food and water in that area, the use to come here to find food and water. If proposed project can proposed some action for these two issues, we can't see any other issues".

Farmer Organization - Samodagama:

" I am not fully aware of this proposed project. But I know what are the main components. Definitely these components will help us to eliminate our poor life and we hope our future will be bright. I want to campaign our life before this project implementation and after the project implementation. Now we are in before project implementation, you can see out life style. We are suffering form various disasters of our lives. No proper food, no clean water, no proper health care, no electricity, etc. I hope , if you come to the project area, after project implementation, you will see the difference, But only thing we are sure is the period of project implementation. I would proposed that human beings should be first and animals should be second. Both sections of the environmental can't keep is first place".

A Farmer- Suriyawewa:

" As you can see now, today we are suffering without water. This is very long drought period. We are getting relief food aids form various organizations. If we are ready for natural disasters such as drought, providing water along LB, then people of this area would not suffer any of these problem. Especially this area, along Suriyawewa, people are very unlucky. But the people of RB are very fortunate. Always we have to depend on rainfall and chena farming. We are aware of environmental issues of chena cultivation. But no other way to live. If you provide any alternatives for chena we are willing to response. Water is most important item in this area, with the water, I hope other facilities we will get us water, without putting too much thinking of other problems."

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