AN ENVIRONMENTAL PROFILE OF THE POLONNARUWA DISTRICT

AN ENVIRONMENTAL PROFILE OF THE POLONNARUWA DISTRICT

CENTRAL ENVIRONMENTAL AUTHORITY
MINISTRY OF ENVIRONMENT & PARLIAMENTARY AFFAIRS

AN ENVIRONMENTAL PROFILE OF THE POLONNARUWA DISTRICT

A Report written by Dr.Rohana Ulluwishewa for a study sponsored by the Central Environmental Authority with NORAD collaboration

PREPARED IN 1990

Formatted & printed by the Central Environmental Authority
Maligawatte New Town , Colombo 10 , Sri Lanka.

FOREWORD

Sri Lanka's national energies and efforts during the last few decades have increasingly been towards the achievement of economic and social goals of development. However unplanned development , without due regard to the protection and management of the environment could lead to the reduction of the country ,s natural resource base and the degradation of the environment. The fruitful incorporation and integration of environmental considerations into the development strategies are fundamental to sustainable development. Unfortunately environmental concerns have not been incorporated into the planning process of some development projects and programmes. This has been mainly due to the lack of information on available human and natural resources , their utilization and development.

The Central Environmental Authority launched a programme to prepare District Environmental Profiles for each of the districts within the Island to identify and review the human and natural resources , their utilization , and significant environmental problems , associated with each district. I am grateful to the Norwegian Embassy for Development Co-operation (NORAD) for providing the necessary financial assistance to carry out this project.

The profiles have been prepared for the CEA by various competent and authoritative personnel and their ready cooperation in the successful completion of this exercise is duly acknowledged.The project has been managed by the Natural Resources Management Division of the CEA.

I trust this Environmental Profile would serve as a tool in the future development planning process for effective protection and management of the environment.

G K Amaratunga
CHAIRMAN
CENTRAL ENVIRONMENTAL AUTHORITY

August 1993

Co-ordinated by :

Mrs S E Yasaratne Director / Natural Resources Management
Mr W A D D Wijesooriya Senior Environmental Scientist
Mr Anura Jayatilake Asst Director / Natural Resources Management
Mr C Senevirathne Environmental Assistant

Natural Resources Management Division
Central Environmental Authority
1 st Floor , New Secretariat Building ,
Maligawatte New Town , Colombo 10.

CONTENTS

PREFACE

This study has been sponsored by the Central Environmental Authority in collaboration with NORAD. It provides an environmental profile for the Polonnaruwa district. It identifies major environmental problems and examines the shortcomings of the existing methods of environmental management with a view to providing guidelines for an environmental action plan.

I am grateful to the Central Environmental Authority for commissioning this study.

I gratefully appreciate the assistance of the Government Agent, Polonnaruwa district, Mr U G Jayasinghe who kindly provided whatever information required for this study. Special thanks also should be given to Mr L Wijerathne, Secretary of the District Environmental Agency, Polonnaruwa district who made practical arrangements for the field survey.

This study would not have been possible without the support of all Assistant Government Agents and frontline officials of other line departments in the district who provided information for this study. Special mention must be made of the assistance given for this study by Mr Dayananda Jayawardena, Deputy Director of Planning & Mr S W Dissanayake, Environmental Officer, Mahaweli Economic Agency.

I am indeed thankful to Mr Tilak Hewawasam, Director (Planning), Central Environmental Authority who helped me right through the study with the necessary literature. The field survey was undertaken by a team of field investigations comprising Messers H A Gamini, U Anura Kumara and H A Tilak. My special thanks go to Mr G F De Alwis who prepared maps and diagrams.

Rohana Ulluwishewa

Department of Geography
University of Sri Jayawardenapura
Nugegoda

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Rapid development is an urgent need to deal with the current pressing problems such as unemployment, poverty and inequality in Sri Lanka. All development efforts so far been made were aimed at a rapid development. In such efforts, environmental issues have been overlooked, and also environmental impacts of the development activities have been ignored. Recent experience in developing as well as in developed countries demonstrate that the development without due regard to the environment results in resource depletion and environmental degradation which in turn impedes the development itself. Development not only exploits the available resources but also alters the environment where the development takes place. Therefore specific measures have to be taken to minimize the negative effects of development. Otherwise development would not be sustainable.

Environmental problems have accumulative effects. If corrective measures are not taken timely heavy expenses would be required to mitigate the problem. Therefore, it is advisable to take early action to mitigate the environmental problems, and also previous experience demonstrates that prevention of such problems is cheaper than cure. Hence, investment in environmental management will save future expenditure. Today, developed countries spend considerable amount of capital to mitigate the adverse effects of environmental problems which had resulted from their past mistakes. Their experiences demonstrate the significance of taking early action for effective environmental management.

Environmental management is proper resource use and resource management, and it acts as a regulatory force on human wantonness in resource exploitation and resource wanting. The central theme of environmental management is the reduction or minimization of the impact of human activities on the environment. It is also an endeavor to avoid the overuse, misuse and abuse of the resources in the environment. On the other hand, environmental management is the mechanism which maintain the balance between the resource conservation.

Environmental management is not a new concept. In the past, the rulers enforced various laws to protect and conserve the forest, wildlife and water resources. On the other hand, the people, the resource-users inadvertently or intentionally practiced a wide range of cultural practices which had conservative effects on soil and water resources. However, during the colonial era, the rulers focused only on the exploitation of natural resources. they totally ignored the environmental aspects of resource exploitation. Even after the independence, most of the development efforts which have so far been made did not pay due attention to the environmental protection and management, and it resulted in reduction of natural resources and environmental degradation. Therefore, it is an urgent matter to incorporate and integrate the environmental component into the development planning. It is an imperative for sustainable development.

The Central Environmental Authority (CEA) has, therefore, launched a programme to incorporate the environmental dimension into the development planning through strengthening the district institutional framework for the environmental protection and management. for this purpose, the CEA has decided to prepare district level action plans. As an initial step towards this, it was necessary to prepare environmental profiles for the

districts selected for the programme in order to provide basic information and guidelines for the proposed action plans. This report entitled the "Polonnaruwa District : An Environmental Profile" has been prepared to provide the basis for the development of an environmental action plan for the Polonnaruwa District.

OBJECTIVES

The objectives of the present study are as follows :

(1) To identify the natural resources of the district with a view to understanding its potential resource base.

(2) To identify and review the more significant environmental problems.

(3) To examine the existing methods of environmental management and planning with a view to identifying their shortcomings and limitations.

(4) To make recommendations and guidelines for environmental planning.

METHODOLOGY

This study is mainly based on field investigations which were conducted during the period from October 1989 to May 1990. The field investigations were conducted in three phases as follows;

Phase 1 : The phase 1 of the study involved collection of information from the AGAA in the district. For this purpose; a questionnaire was administered to all the AGAA. The questionnaire was designed to collect information on major environmental problems, the government agencies which are responsible to deal with those problems, constraints which reduce the administrative capability of those agencies and possible solution.

Phase 2 : In the second phase, the district level officers of the line departments which are responsible to deal with the identified environmental problems, and the members of the District Environmental Agency (DEA) were interviewed with a view to collecting information on the administrative capability of each department/institution.

Phase 3 : The third phase involved field visits to a number of selected problem-areas. The areas which were seriously affected by specific environmental problems have been selected in consultation with the Agar and the local level officers of the concerned departments. The primary objective for such field visits was to collect first hand information on the identified problems. The field visits involved observation and discussions with key information in the affected area.

LIMITATIONS

The field investigations were seriously disturbed by the unsettled conditions that prevailed in the country in general, and particularly in the district. Due to the unsettled conditions, the workshop which was organized for the officers in the field of environment in the district in order to collect primary data, had to be postponed three times. Therefore, it was decided to meet all those officers concerned individually. However, it was extremely difficult to meet some officers who were stationed outside Polonnaruwa because they were absent from their working places due to security reasons. Limited availability of official records and reports was also a serious constraint throughout the study. The field visits for in-depth studies had to be restricted only to some selected areas as the district covers a very wide area.

2 PHYSICAL AND HUMAN SETTING

Physical Setting

This section deals with the physical setting of the district with special reference to the natural resource base Polonnaruwa district occupies an eastern location in the North Central Province (Figure 1). It has a land area of 3449.8 sq kilometers. Topographically the landscape of the area is flat or gently undulating with 3-4 percent slope except few isolated hills and outcrops of bare rocks (Figure 2). Though these hills have an elevation ranging from 500 over 1000 feet, the large part of the area lies below 500 feet. The area gently slopes from South-west to North-east. The Mahaweli river, the longest river of the island enters into the district from the South-west, and flows towards the North-east.

Natural Resource Base

The word natural resources is used here to refer to all forms of matter or energy considered useful by human societies. The resource base in any area consists of renewable resources as well as non-renewable resources. While the renewable resources can maintain themselves or be continuously replenished if managed wisely, the non-renewable resources are not regenerated or reformed in nature at rates equivalent to those at which they are used.

(1) Renewable Resources :

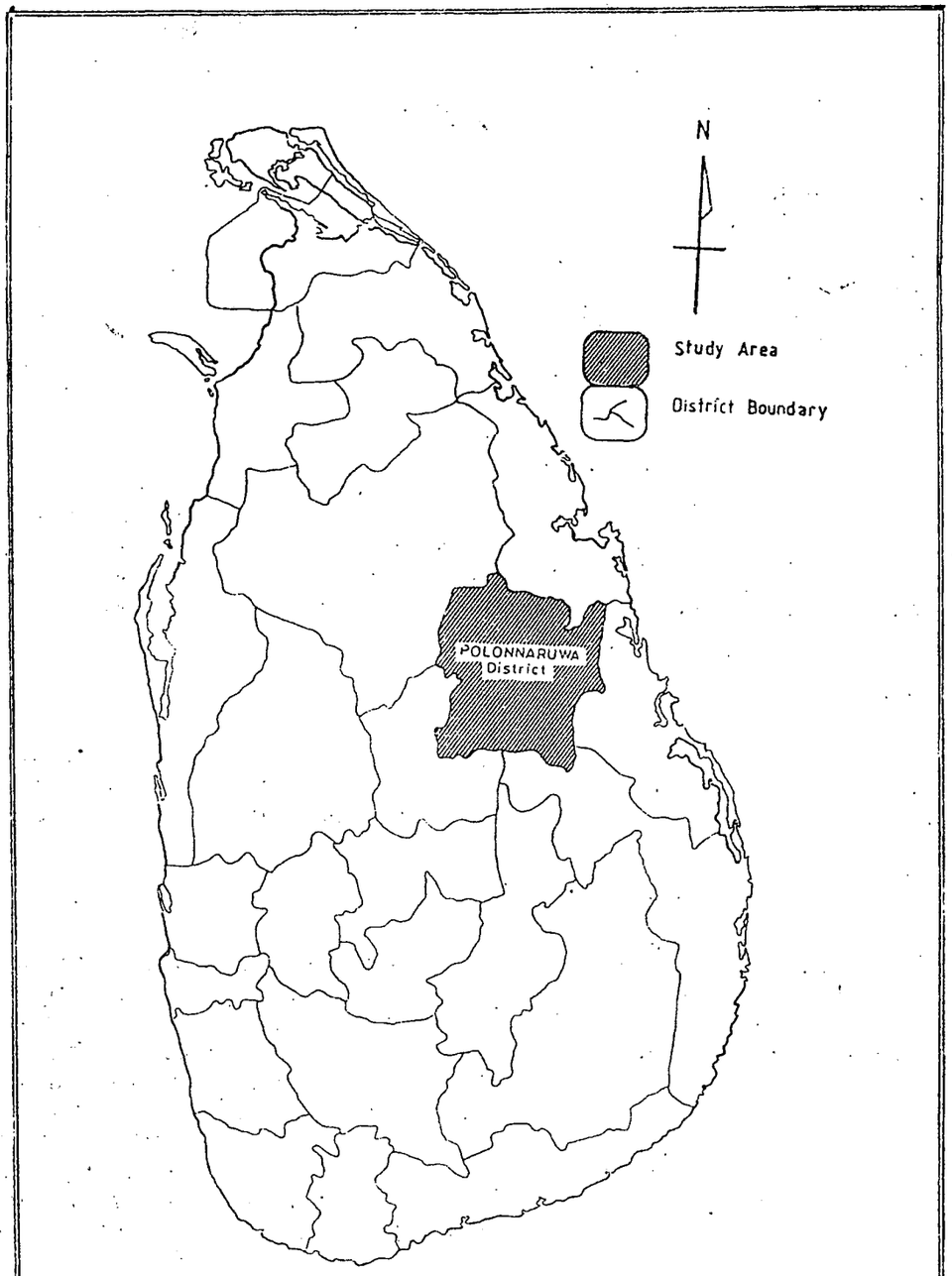
Renewable Resources includes the non-living resources such as soil, water and air, and living resources such as flora and fauna. The biological links or inter-relationships between living and non-living renewable resources form the mechanism through which an ecosystem function.

1.1 Soil :

As in other areas in the Dry Zone, the major soil groups in the district are Reddish Brown Earth and Low Humic Glay soils (Figure 3). While alluvial soils occur in the Mahaweli flood plain area, erosional remnants and rock knob plains occupy the isolated hills in the western part of the district. The Reddish Brown Earth and Low Humic Gley Soils which have greater agricultural potentials, occur in a catenary sequence in the undulating landscape of the area (Figure 4). While well-drained and imperfectly-drained Reddish Brown Earth occur in the convex upland and lower middle slopes respectively, Low Humic Gley soil which is poorly-drained, occur on the concave valleys. The former soil group is suitable for subsidiary food crops with irrigation during the dry season and without or with supplementary irrigation during the wet season. The latter is well suited for paddy cultivation.

1.2 Water :

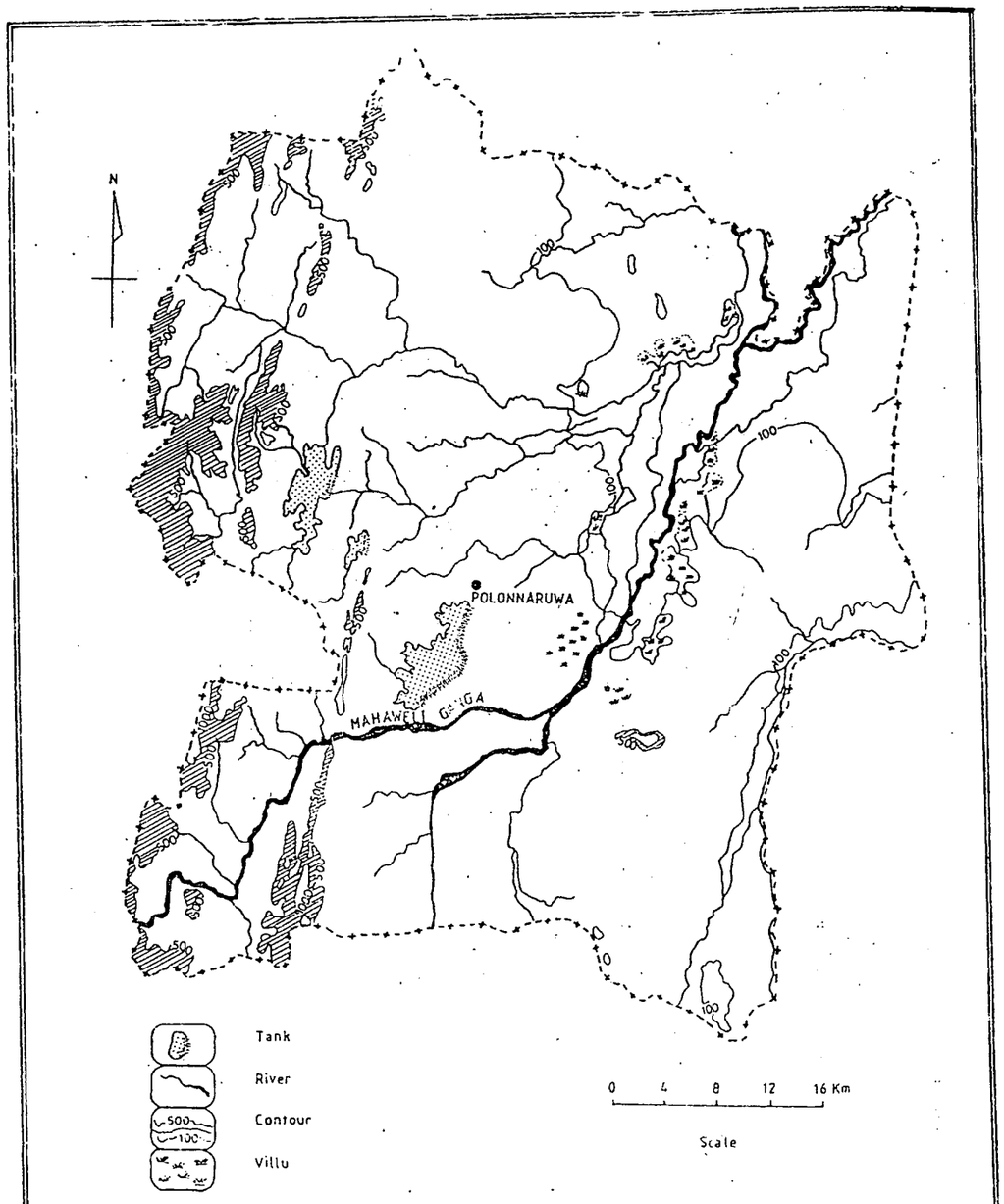
Water which is an essential element required for the survival of all living beings, is a very scarce resource in the district because the rainfall, the major source of water is relatively low and highly seasonal (figure 5). Though the average annual rainfall is 1150 - 1800 mm, it is confined to two short rainy seasons.seasons (Maha, October-January and Yala, March-May) leaving the rest of the year relatively



Scale 1 : 2000 000

Orientation - Polonnaruwa district

Fig : 1

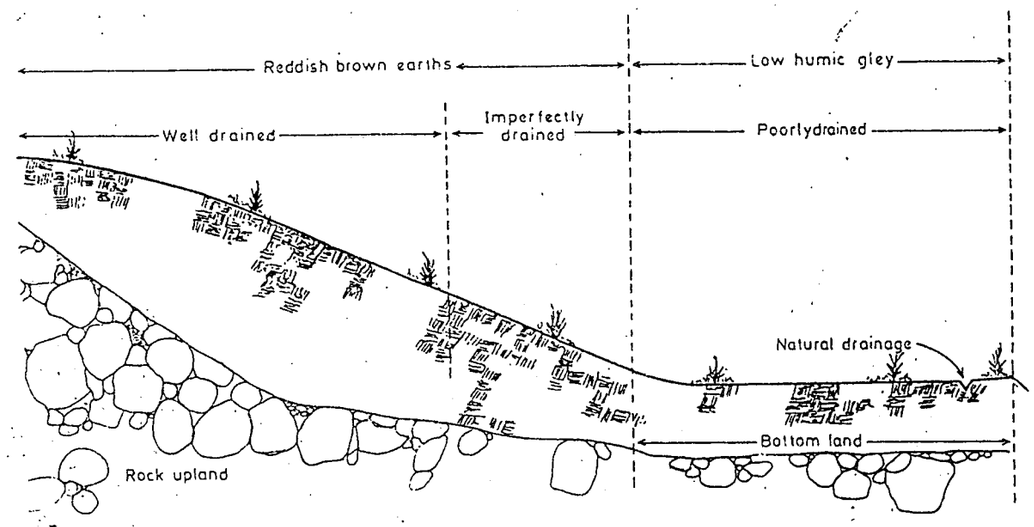


Topography

Fig: 2

Fig : 3

Soil types



Distribution of soils in the Dry Zone landscape

Fig : 4

rainless. The rainfall is also erratic, and yearly fluctuation is very high (Figure 6). Certain years of high rainfall is followed by years of low rainfall. The high temperature throughout the year (30-32 C) increases the evapo-transpiration, further reducing the efficiency of rainfall. Therefore, ancient people had developed means for local storage of rain water by damming streams or building embankments to retain water in natural depressions. These man-made reservoirs plus natural water bodies such as rivers and villus cover approximately 1.31 percent of the area, or 45.3 sq. kilo meters.

Table 1 - Area covered by Inland Water

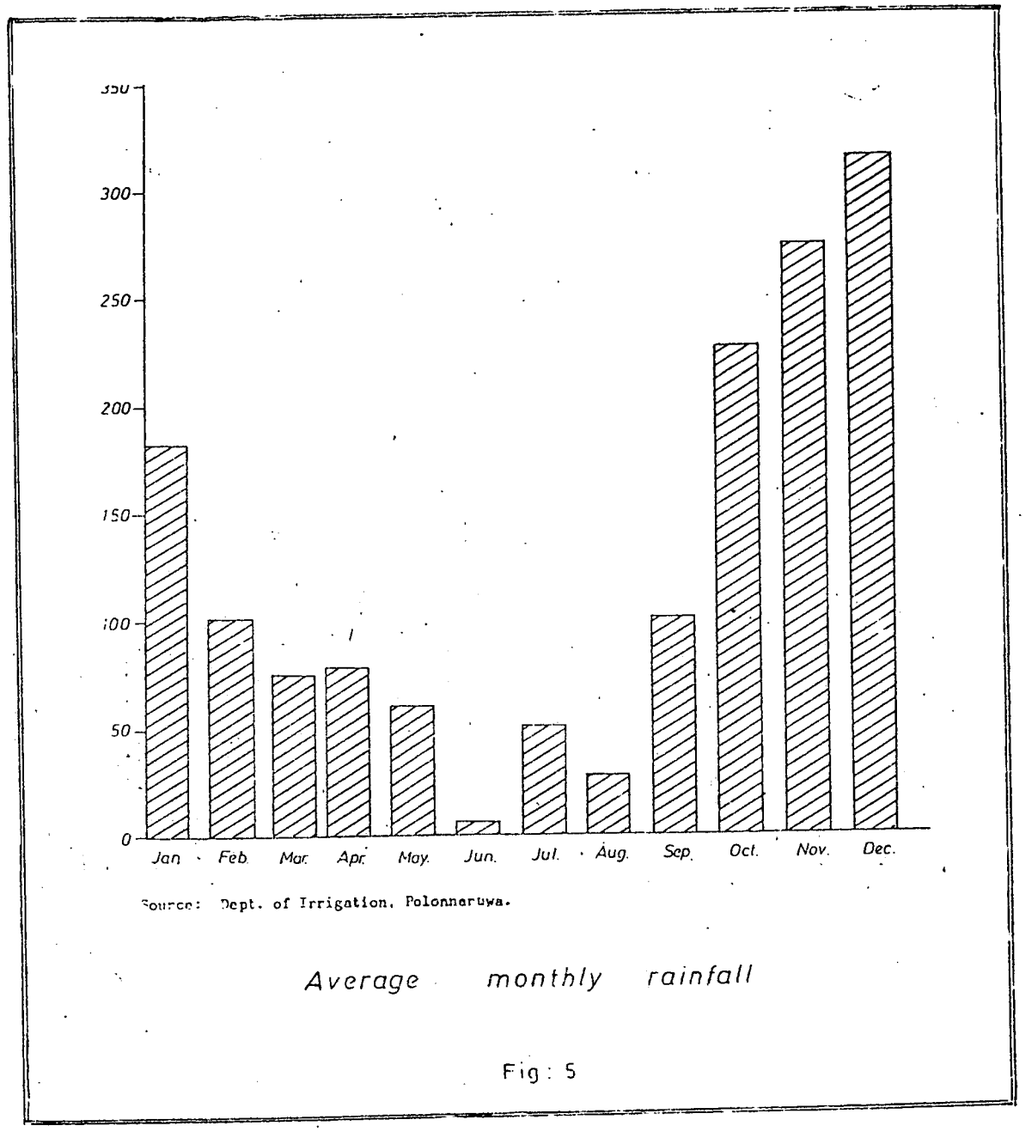
AGA Division	Land Areas	Areas under Water	Percentage
Dimbulagala	1018.1	7.3	0.71
Elahera	372.3	-	-
Hingurakgoda	338.7	14.8	4.36
Lankapura	219.6	-	-
Medirigiriya	942.1	13.1	1.39
Tamankaduwa	558.3	10.1	1.80
Total	**3449.1**	**45.3**	**1.31**

1.3 Flora :

The natural vegetation in the district consists of four major types, viz Dry Mixed Evergreen Forest, Riverain Forest, Lowland Savanna (Damana) and Wet Grasslands (Villus). The Dry Mixed Evergreen Forest is a secondary forest that has been developed after about 1400 Ad which marked the end of a long period of early civilization. The dominant species in this type of forest are wira (Drypetes sepiaria), satin (Chloroxylon swietenia) kaluwara or ebony (Diospyros ebenum), milla (Vitex pinnata) and halmilla (Berrya cordifolia). All these are highly valuable hard wood timber. Riverain forest is grown on river bank of the Mahaweli Ganga and on its flood plain which is subject to seasonal inundation. The riverain forest is characterized by the presence of species such as kumbuk (Terminalia arjuna), helamba (Mitagyna parvifolia), mee (Madhuca longifolia). Villus occur on some lowlands of the Mahaweli Flood Plain which are subjected to seasonal inundation, and therefore, the villus have very little tree growth. The villu consists of specific grass species which are adopted to the local conditions. The trees that grow around the villus are mara (Samanwa saman), eramudu (Erythrina spp.) and nebadda (Vitex leucoxylon). Damana grasslands are found extensively in the northern part of System B of Mahaweli. The major species found are madan (Syzigium cumini), dawn (Anogeissus latifolia) and aralu (Terminalia chebula). The latest statistics show that both open and dense forest cover occupy 39.5 percent of the total area of the district, and grasslands and marshy lands occupy 3.2 and 2.1 percent respectively.

1.4 Fauna :

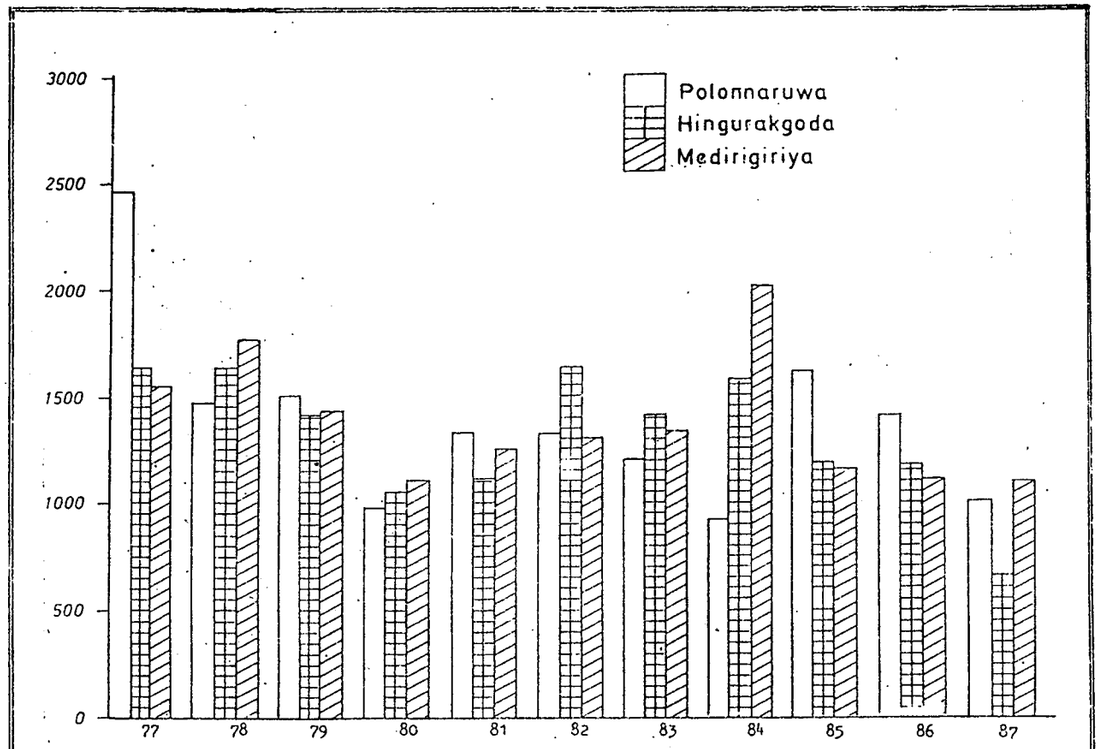
The wildlife habitat in the district includes Dry Mixed Evergreen Forest. Riverain Forest, Damana grasslands and villus. The Dry Mixed Evergreen Forest which accounts for a large share of the wildlife habitat offers food to a wide range of animals including frugivorous birds, deer, monkeys, wild boar and elephants. The riverain Forests which are mainly found along the Mahaweli Ganga is a high quality



Source: Dept. of Irrigation, Polonnaruwa.

Average monthly rainfall

Fig : 5



Source: Department of Irrigation, Polonnaruwa.

Annual rainfall variations

Fig : 6

habitat. Elephants, water buffaloes, and wild boar are some common species there. The grasslands both Damana and Villu are favored by elephants. They take shelter in the adjoining forest during the day and move into the grasslands in the evening. Villus also provided nesting and feeding grounds for numerous migratory bird species. Fresh water fish is another important living renewable resource in the district. Fish fauna can be found in irrigation tanks, rivers, villus, and in the flooded paddy fields. A wide range of fish species are found in the major river, Mahaweli Ganga. Villus are highly productive fishing grounds, and are excellent spawning and nursery habitats for many fish species. The common species in Villu are Tilapia, Labeo, Freshwater shark and Butter Catfish. Paddy fields also serve as large areas of open water where many fish species breed. A considerable number of small sized fish are found in this habitat.

(2) **Non-Renewable Resources** :

The district is poor in non-renewable natural resources. The only non-renewable resources presently in use are mica, gem, crystalline limestone, granite rocks and clay. Mica is found in Ratmale in the Hingurakgoda AGA division, and Konduruwewa in the Elahera Aga division, and mining is done by the local people in a small scale. Gem mining is done in the Elahera AGA division in the valley of the Amban Ganga. Crystalline limestone is found in Yudaganawa, Relapanawa, and Etambaoya in the Medirigiriya AGA division, Katukeliyawa, Ihakaluwewa and Attanakadawala in the Elahera AGA division, and Moragaswewa in the Hingurakgoda AGA division. Granite rock which is used for building construction road metal and as aggregate in concrete is widely available almost everywhere in the district, and quarrying is done by the local people. In the Mahaweli Flood Plain area and around the irrigated paddy fields clay is widely available. The clay is widely used for brick making in Medirigiriya, Hingurakgoda, Minneriya and Tamankaduwa AGA divisions.

Human Setting

The district is primarily an agricultural area. Its prosperity therefore depends on rational land use and judicious management of its soil and water resources. The total land area of the district is 333,280 hectares of which 34.9 percent is used for agricultural activities such as paddy cultivation, homesteads, and other sparsely used crop lands (Table 2). The built up area is only 0.1 percent.

Agriculture

Paddy cultivation :

Paddy cultivation is the most important crop in the district, and it accounts for more than 56 percent of the area under agricultural holdings (Agricultural census, 1982). This is approximately 5.5 percent of the total paddy extent of the island. While 90.8 percent of the total asweddumized area is under major irrigation projects, 3.8 percent is under minor irrigation tanks. The area under rainfed cultivation accounts for 5.2 percent of the total paddy cultivated area in the district. According to the Kachcheri statistics, during the period 1980-1987 the asweddumized area under major irrigation projects has increased by 24.5 percent whereas the area under minor irrigation tanks and rainfed cultivation has increased by 37 and 17 percent respectively. During this period, the total asweddumized area in the district has increased by 16.9 percent. The reason for the increase in paddy

extent is the development of new lands under the Mahaweli System B and G.

During the Maha season over 96 percent of the asweddumized area is cultivated but it is only 75 percent during the Yala season. Since recently a rapid increase in paddy yield is evident. During the period 1980-1987 the average yield in Maha season has increased from 58.29 bushels/acre to 65.20 bushels/acre. In both seasons, the average yield is higher than the national average by 33.5 and 11.5 percent respectively. The district contributes 11 percent of the national paddy production.

Table 2 - Land Use-Polonnaruwa District AGA Divisions

	(M)	(S)	(L)	(E)	(T)	Total	%
Built-up Land	-	150	-	10	80	240	0.1
Ass.Non.Agr.Land	-	-	0	-	70	70	0
Homestead	5,740	4,870	4,110	3,340	5,220	23,280	7
Mix Trees & Other	-	30	-	10	-	50	0
Paddy	10,880	9,060	7,660	4,270	8.940	40,820	12.3
Sparsely used Lands	14,100	5,950	2,120	5,530	23,420	51,120	15.3
Other Croplands	-	-	580	-	460	1,040	0.3
Dense Forest	36,960	7,530	-	14,820	35,340	94,670	28.4
Open Forest	4,660	1,610	510	2,550	27,690	37,020	11.1
Forest Plantations	2,060	960	-	-	-	2,960	0.9
Scrubland	5,670	4,620	5,780	3,770	20,760	40,600	12.2
Grassland	1,010	200	790	180	8,570	10,750	3.2
Marsh	2,860	20	1,360	50	2,740	7,030	2.1
Water	4,290	4,120	970	430	11,750	21,560	6.5
Barren Land	280	160	10	110	1,510	2,070	0.6
Total Area	88,530	39,220	23,900	35,070	146,560	333,280	100

Note : All area figures are given in hectares (1 ha = 2.47 acres)
M = Medirigiriya, S = Sinhapura, L = Lankapura, E = Elahera T = Tamankaduwa
Source : Sri Lanka/Swiss Remote Sensing Project 1987

Minor Food Crops :

Next to the paddy cultivation, the most important crops in the district are minor food crops such as finger millet, maize, cowpea, greengram, gingerly, groundnut, manioc, sweet potatoes, chilies, red onion and big onion. Almost all paddy farmers cultivate few minor food crops on chena or in homestead gardens as a source of additional income and food. In the Mahaweli project areas, the farmers are encouraged to cultivate some minor food crops on paddy fields during the Yala season. The area under these crops in Maha 1986/87 and Yala 1987 is given in Table 3.

Table 3 - Minor Crops-Polonnaruwa District

	Maha 1986/87 (Acres)	Yala 1987 (Acres)
Finger Millet	658	17
Maize	1,511	96
Cowpea	879	212
Greengram	484	1,060
Gingerly	262	262
Groundnut	407	914
Manioc	2,680	658
Sweet Potatoes	241	57
Chilies	868	856
Red Onion	199	95
Big Onion	113	15

Source : Kachcheri, Statistics Branch, Polonnaruwa

Perennial Tree Crops :

There are no large tree crops plantations in the Polonnaruwa district except some coconut and fruit trees grown in homestead gardens. Of the small holdings in the district, 24.5 percent have coconut, and the total area under coconut is 5983 acres. While 80.6 percent of the coconut extent in the district is in small holdings, the rest is in estates.

Table 4 - Coconut Cultivation in Polonnaruwa District

Number of holdings reporting coconut	7,902
Total area of holdings reporting coconut	38,090
Area under coconut (acres)	5,985
Not yet in production (acres)	2,358
Under planted (acres)	746
Not underplanted	2,881

Source : Census of Agriculture, 1982

Livestock Farming :

Livestock keeping is very common among the farm households in the Polonnaruwa district. Buffaloes and cattle are the most common domestic animals. Of the total number of small holdings, 43.5 percent have buffaloes and/or cattle. While 11.05 percent of holdings have cattle only, 17.55 percent have buffaloes only. On the other hand, 14.89 have both cattle and buffaloes. During the period 1981-1987, cattle population in the district has slightly declined whereas the buffalo population has increased. The main purpose of keeping cattle and buffaloes is for draught, and the next is milk. Other animal species which are kept by the farmers in the district are goats, pigs, poultry and ducks. Table 5 shows the increase of animal population during the period 1981-1987. It is evident that goats, pigs and poultry keeping is not very much popular when compared with cattle and buffaloes, because very small number of farm households keep these species. Percentage of small holdings keeping goats, pigs, and poultry are 1.12, 0.18 and 12.25 respectively.

Table 5 - Livestock Population in Polonnaruwa District 1981-1987

Year	Cattle	Buffaloes	Goats	Pigs	Poultry	Ducks
1981	81,400	60,800	10,112	318	102,358	153
1982	88,253	65,057	10,763	441	105,520	270
1983	41,101	57,869	5,339	775	52,334	232
1984	59,946	67,112	12,789	1,963	103,991	794
1985	60,316	66,158	13,414	1,832	112,950	259
1986	63,011	77,232	14,793	2,089	115,918	775
1987	66,719	136,795	13,395	1,811	127,719	766

Source : Kachcheri, Statistics Branch, Polonnaruwa

Industries :

Polonnaruwa district is not industrially developed. Only 5.61 percent of the total employed population is engaged in industries. Industries in the district are predominantly agrobased. While food, beverage and tobacco industries account for 33.6 percent of the industrially employed population, textile, wearing apparel and leather industries account for 26.2 percent. Manufacture of wood and wood products, fabricated metal products, and

manufacture of non-metallic mineral products comprise 19.8, 7.33 and 2.4 percent respectively. Table 6 shows the principle industrial activities in the district and a number of establishments.

Table 6 - Principal Industrial Activities in Polonnaruwa District

Major Groups	No of Establishments	No of Persons
Mining and quarrying	17	92
Manufacture of food, beverage and tobacco	608	1,872
Textile, wearing apparels & leather	35	1,238
Manufacture of wood and wood products	218	935
Manufacture of paper and paper products	-	-
Manufacture of chemicals	3	94
Basic metal industries	-	-
Manufacture of fabricated metal products	88	346
Other manufacture industries	13	29

Source : Department of Census & Statistics, Census of Industry, 1983 Preliminary Report

Population and Settlements :

The total population in the district at the census of 1981 was 261,563 persons. During the period 1971-1988, the average annual growth rate was 5.1 percent. Estimated population growth for the period 1982-1988 was 43 percent. Population growth rate in the district is relatively high and this high growth rate can be attributed to the in-flow of settlers into the newly established settlement projects in the district, particularly in the Mahaweli System B and G. While 87.2 percent of the total population is Sinhalese, 8 percent is Sri Lankan Moors. Tamil population accounts for only 3.8 percent.

Table 7 - Population density by AGA divisions

AGA Division	Total	Area (sq.km)	Persons/sq.km
Elahera	32,334	383.1	84
Hingurakgoda	62,994	372.7	169
Lankapura	41,344	248.9	166
Medirigiriya	50,897	910.4	56
Tamankaduwa	73,994	1,488.7	50
District Average	261,563	3,403.8	77

Source : Department of Census & Statistics, 1981

More than 36 percent of the population in Polonnaruwa district are below 15 years; and 61 percent are between 16 and 65 years. The average population density is 77 persons per sq.kilometer. While the population density in Hingurakgoda, Lankapura and Elahera AGA divisions is higher than the district average, it is lower in Medirigiriya and Tamankaduwa AGA divisions. The population of the district is predominantly rural (92 percent). In 1981 population in the major towns, Polonnaruwa and Hingurakgoda, were 11,636 and 8,859 respectively. The growth rate of urban population is much lower than that of the rural population. During the period 1971-1981, annual growth rate of urban population was 2.5 percent whereas it was 6.3 percent in the rural sector. However, it is evident that the growth of urban population has increased after 1981. According to the estimated figures, during the period 1981-1987 the urban population has increased at the

rate of 5.39 percent annually.

Housing construction :

Poor housing conditions is evident in the Polonnaruwa district since 60 percent of the total housing stock is semi- permanent and another 4.7 percent is improvised. Only 32 percent of the housing stock can be regarded as permanent dwellings. Although this is the general situation in the district, percentage of permanent housing units is higher in the urban sector than in the rural sector (Table 8).

Table 8 - Housing conditions in the Polonnaruwa District

	Urban %	Rural %
Permanent	44	31
Semi-Permanent	51	64
Improvised	3	3
Not classified	2	2

Source : Department of Census & Statistics, 1981

The average number of rooms in urban and rural houses are 2.6 and 2.5 respectively. Average number of occupants per room is 2.0 in the urban sector, and it is 2.1 in the rural sector. In both sectors, average occupants per room in permanent, semi-permanent and improvised housing units are 1.7, 2.4 and 3.1 respectively. In the rural sector 78.1 percent of housing units are owner occupied whereas it is only 59.2 percent in the urban sector, 15.1 percent of housing units have access to pipe borne water but in the rural sector only 1 percent of housing units have access to it. Percentage of housing units with electricity is 26.3 in the urban sector whereas it is only 1.8 percent in the rural sector.

Under the million housing programme, nearly 15,000 housing units have been constructed during the period 1984-1986.

Table 9 - Number of housing units constructed according to the million housing programme 1984-1986

Type of village	1984	1985	1986
Model village	-	370	1,986
Reawakening village	-	1,101	1,509
Either side of the road	-	1,029	4,701
Other	604	3,988	10,080

Source : National Housing Development Authority, Regional Office, Hingurakgoda

Infrastructure :

The district is well connected with the surrounding districts by roads and railways. The total length of the network is 560.9 kilometers; and 83 percent of the road network is paved (Figure 7). The density of the road network is 0.16 kilometers per sq. kilometer,

and it is relatively low when compared with other dry zone districts.

Table 10 - Length of highways in Polonnaruwa district

Grade	Type	Distance in km
A	Metal	122.2
B	Metal	61.6
C	Metal	272.6
C	Gravel	52.7
D	Metal	10.6
D	Gravel	41.2
TOTAL		560.9

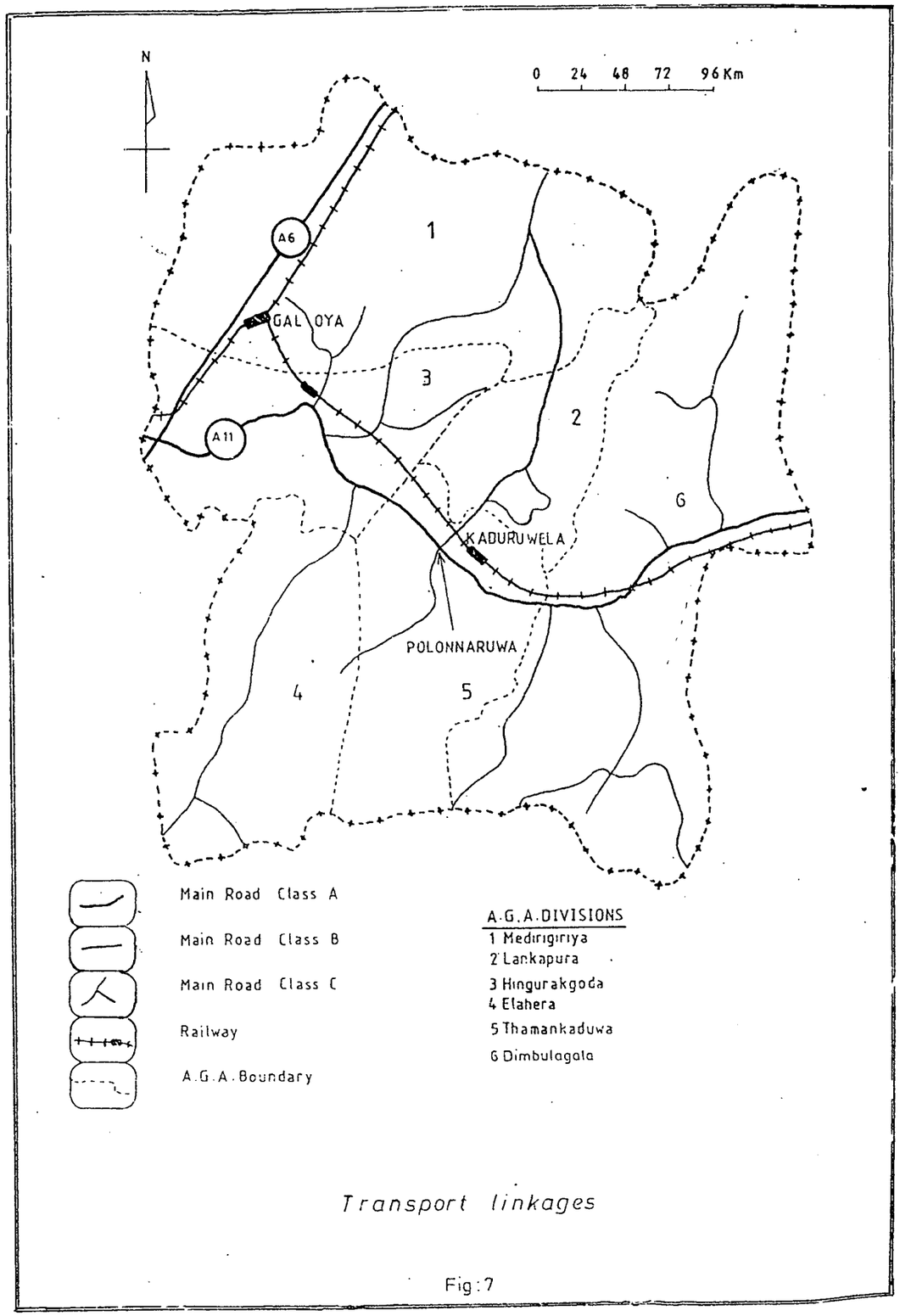
In 1987, there were 196 schools in the district with 76,996 pupils. The teacher - pupil ratio was 1:29. The literacy rate of the district has increased from 70.2 percent in 1963 to 87.0 percent in 1981. However, it is still lower than the country's average of 89.5 percent. The literacy rate among males (89.9) is higher than that among the female (82.8).

In the district, there is only 1 base hospital, 2 district hospitals and 4 rural hospitals. Apart from the hospitals, there are 2 maternity homes and 5 central dispensaries. The total bed capacity of all hospitals is 648. It is evident from Table 11 that the available number of health auxiliaries in the district is lower than the national average.

Table 11 - Health Personnel per 10,000 people 1986

	Medical Officers	Nurses	pH Midwives	Attendants
Polonnaruwa district	1.21	2.69	0.87	2.73
Sri Lanka	2.11	4.66	1.23	3.26

Source : Department of Health, Regional Director of Health



Transport linkages

Fig : 7

3 ENVIRONMENTAL PROBLEMS

The environmental problems in the district come into two distinct groups namely (1) those arising out of lack of development and poverty, and (2) those arising out of development activities (Table 12). While the problems in the first group have been in existence over a long period, the others emerged quite recently with recent development activities brought about by the irrigation development and settlement schemes. Table 13 depicts the major environmental problems identified according to AGA divisions as those had been ranked by the Agar of the respective divisions. It is evident from this table that while some environmental problems are common almost everywhere in the district, some problems are localized. For instance, the problems such as deforestation. , extinction of wildlife, environmental pollution by agrochemicals are common in all AGA divisions whereas air pollution by the waste disposed by rice mills, and floods are more localized.

Table 12 - Environmental Problems in the Polonnaruwa District

Problems arising out of lack of development and poverty	Problems arising out of Development Activities
Chena cultivation Encroachment on reservations Poor environmental health Drought Floods Soil erosion Illicit gem mining	Deforestation Extinction of wildlife Crop damage by wildlife Environmental pollution by mis-application of agro-chemicals Air pollution by burning of paddy husks

Table 13 - Environmental problems by AGA divisions in Polonnaruwa District

	(D)	(T)	(M)	(L)	(H)	(E)
Chena cultivation	-	-	2	-	-	-
Encroachments on reservations	-	4	4	-	-	-
Poor environmental health	-	-	-	3	-	-
Drought	-	-	-	-	-	-
Floods	3	-	-	1	-	-
Soil erosion	-	-	-	-	-	-
Illicit gem mining	-	-	-	-	-	3
Deforestation	2	3	1	-	3	1
Extinction of wildlife	1	-	5	2	2	4
Crop damage by wildlife	-	-	-	-	-	-
Environmental pollution by mis-application of agro-chemicals	4	1	3	4	4	-
Air pollution by burning paddy husks	-	2	-	-	1	-

Note : D = Dimbulagala T = Tamankaduwa M = Medirigiriya L = Lankapura
H = Hingurakgoda E = Elahera
The numbers indicate the significance of the problems in each AGA division, e.g. most important problem = 1 the next = 2 and so on.

Deforestation

The district had rich forest reserves until recently. Although reliable data is not available, the field evidence suggest that a large scale deforestation has taken place in most parts of the district, and even now felling of trees both legitimate and illicit is in operation in some parts of the district. The major causes for the deforestation in the district can be summarized as follows :

(1) **Mahaweli Settlements :**

Large scale clearing of forests for Mahaweli settlements has taken place in Dimbulagala and Elehera AGA divisions under the Mahaweli System B and G. Land clearing for Mahaweli settlements were undertaken by the State Timber Corporation (STC), and the STC employed private contractors for the purpose of felling trees. Although the areas to be cleared were demarcated, due to the lack of supervision by the STC and the Mahaweli Authority of Sri Lanka (MASL), felling of trees in the areas beyond the demarcated area was not uncommon. Therefore, the extent of areas really deforested was more than the extent of areas really required for settlements.

(2) **Illicit Felling :**

It was found that illicit felling of trees in the state's forests for timber is undertaken by organized timber merchants and contractors with the support of local power groups. Such large illegal felling of trees is evident in the areas such as Elahera, Manampitiya, Welikanda and Ambagahawewa and also in the catchment area of the Parakrama Samudraya and Ulpathhena. It is said that a ready market for illicit timber is available in the Mahaweli Project area where massive building construction works are undertaken by contractors. They organize or encourage illicit felling of trees in the surrounding areas.

(3) **Fuelwood Extraction :**

When the district is taken as a whole the most important cooking fuel consumed is firewood. In 1981, 96.5 percent of housing units in the district depended on firewood as the major source of cooking fuel. They almost exclusively use wood extracted from nearby forests. However, the field evidence suggest that extraction of fuelwood for domestic use is not so destructive as it is often complained, because the women who are engaged in the collection of fuelwood normally do not cut down trees. Instead they collect fallen branches of trees, and cut dead trees. But commercial firewood collectors seriously damage the forest resources. Unlike the collectors of fuelwood for domestic need, the commercial fuelwood collectors cut down trees, causing serious damage to the forest. Selling of fuelwood in small bundles is a common sight on the road-sides around townships in the district. Furthermore, fuelwood is used as a source of energy for some small scale industries such as brick-making, and pottery. The brick-making industry has rapidly developed since recent times due to the increased demand for bricks in the Mahaweli Project area, and it adversely affects the forest resources in the surrounding area. An ideal example for this is the brick kilns in the Flood Plain Wildlife Park. Although the Flood Plain of the Mahaweli Ganga was declared as a wildlife park, brick making

is still in operation in the area and the forest in the area is cut down for fuelwood for the brick kilns.

(4) **Selective felling of trees by the STC in the Forest Reserves :**

The STC is given authority to cut down trees in the forest resources for timber. In this case, the STC is supposed to conduct selective logging on a sustainable yield basis. Blocks for logging operation are demarcated, and the trees to be cut are marked by the Forest Department. The logging operation should also be done according to the regulations and guidelines prescribed by the Forest Department. However in practice the contractors employed by the STC for logging hardly follow the given guidelines, because there is no thorough supervision by either the STC or the Forest Department. Therefore, the legitimate felling or in other words the so called "selective felling on sustainable basis" by the STC too leads to the destruction of the forest reserves in the district.

(5) **Fire :**

It is evident that there is a practice of setting the lowland savanna grassland (Damana) on fire during the dry season. This is primarily done as a mean of providing succulent grass for browsing buffaloes and cattle. This practice leads to the destruction of patches of trees in the grasslands and around the grasslands. Such fires occur frequently in the Manampitiya and Tamankaduwa areas during the dry season.

Extinction of Wildlife

As the forest cover diminishes, the wildlife population in the district comes under a very serious threat. The major species which are subject to extinction are elephants, leopards and spotted deer. This problem is acute in the Dimbulagala and Elahera AGA divisions where large scale deforestation has taken place due to the Mahaweli settlements. This problem is evident in Medirigiriya, Ambagaswewa, Pansalgodella and Madinagala.

Field evidence suggest that the rapid deforestation affect the extinction of wildlife in two different ways.

(1) Deforestation leads to the destruction of the habitat required for wildlife. Consequently, the wildlife population declines due to the decreased rate of natural regeneration.

(2) As deforestation proceeds, the wild animals which have lost their habitat, tend to migrate to the nearby populated areas and are subject to killing.

Decline in elephant population is fully evident, and it is said that recent development activities have been the major contributory factor for the declining elephant population in the district. Eviction of elephants from their native forests deprived elephants of their natural food, and crowded them into the remaining areas of their habitat. Then, pocketing and excessive crowding have led to habitat destruction and further reduction of food. Consequently, when they go out of the forest in search of food to the settlement areas, they get killed, and also excessive pocketing has been recognized as a reason for the

decline of elephant population due to inbreeding. Furthermore, elephants often become victims of illicit timber cutters and hunters. In future, due to the conflict between elephants and the Mahaweli settlers, there is likely to be a reduction in the breeding male elephant population. It has also been pointed out that 75 percent of elephants which have been killed in and around the Mahaweli area were males. This would degrade the quality of the future of the species.

Although hunting and selling the meat of the protected wild animals is strictly prohibited, it is evident that there are professional hunters and selling of the meat of protected wild animals is also common in the district. There are settlements in close proximity to the wildlife parks and forest reserves. Poaching and hunting are in operation along the boundaries of the wildlife parks and forest reserves, and therefore the conflict between the villagers and the wild animals leads to destruction of the wildlife. Meat of the hunted wild animals such as spotted deer, elk, and wild boar are sold wholesale to the rest houses and circuit bungalows in the area. Normally the usual customers are informed when and animal is killed and they come to the spot where the animal is killed or butchered and transport the meat in their own vehicles.

Apart from the destruction of habitat due to the development activities, modification of habitat too has adversely affected the wildlife which live in that particular habitat. TAMS report (1980) points out that the decrease of water flow due to dam construction on the Mahaweli Ganga is expected to reduce the size of villus (Wet Grasslands) by about one half. This would deplete the ecological resources required by several wildlife species, particularly birds. At present, the wildlife in the villus in the district have been adversely affected by the ecological changes which took place due to the decrease of water.

Crop Damage by Wildlife

Crop damage by wild animals has become a very serious problem since recent times in the district, especially in the Mahaweli Project areas. The species which cause serious damage to crops are elephants and wild boars. The elephants not only damage crops but also destroy human lives and properties. A summary of damages caused by elephants in the System B of Mahaweli in 1989 are given Table 14.

Destruction of habitat of the wild elephants where they lived over centuries has been the major reason for the damage caused by them. In fact, the Mahaweli Project has allocated a fairly large forest area as wildlife parks and jungle corridors. Apart from the wildlife parks such as Somawathie, Wasgomuwa and Maduru Oya, corridors were planned to link all these wildlife parks to facilitate the unhindered movement of elephants from the one park to another. While the flood plain area was declared as a national

Table 14 - Damages caused by elephants in the System B of Mahaweli

Date	Zone	Block	Type of Damage
01.09.89	01	Dimbulagala	Two settlers killed and damage caused to houses crops
24.11.89	01	Ellewewa	One settler's house destroyed
28.11.89	05	Wijayabapura	One settler killed
15.07.89	05	Damminna	One settler killed
28.08.89	02	Senapura	One settler killed and some houses damaged
08.09.89	02	Sevanapitiya	Damaged caused to crops
20.10.89	05	Wijayabapura	One settler killed and 5 houses damaged
18.11.89	04	Aselapura	One settler killed
01.12.89	05	Wijayabapura	Six settler's houses damaged
18.12.89	04A	Aselapura	One settler killed

Source : Environmental Division, Mahaweli Development Authority

park to facilitate the movement of elephants from Somawathie to Wasgomuwa National Park and vice-versa, another corridor was proposed to join up Wasgomuwa National Park and Maduru Oya National Park. However, while the latter corridor has been abandoned due to the fact that the irrigation canals and roadways would have to go through this corridor, the former, the Flood Plain Park has not yet been protected. A wide range of human activities are still going on in the area coming under the Flood Plain National Park. According to the Mahaweli Authority of Sri Lanka (MASL) the major reason as to why the wild elephants come to the settlements of System B, is that they cannot use the Flood Plain National Park as a corridor to go to Wasgomuwa National park from Somawathie National Park as there is intense human activity. Other reason is the shortage of food in the National parks and other forests at certain times of the year. Some wild elephants got used to eat paddy, plantain and papaw which are grown in settlement areas.

The wild boar comes next to the elephant as an agricultural pest. the increasing crop damages caused by the wild boar can be attributed to the loss of biological control over this species. It is said that wild boar is the most preferred of all leopard prey. With the decrease of leopard population, the wild board population has remarkably increased and has become a serious problem. the increased number of parrots which cause damage to crops in the are is also a consequence of the habitat destruction. Extensive deforestation in the district had favored the parrots by reducing bird population which compete with the parrot for food and nest holes.

Chena Cultivation and Encroachments on Reservations

Chena cultivation is often mentioned as a contributory factor for deforestation. Until recently, forest lands were cleared in a large extent for chena cultivation in the district, but at present clearing of forest for chena cultivation is not common due to the restrictions imposed by the state for conservation of forests. However, chena cultivation is still practiced in already cleared lands, and it leads to the degradation of soil due to the reduced fallow period.

At present, chena cultivation is practiced in areas such as Habarana, Giritale, Kantale, Medirigiriya, Minneriya, Bakamuna and Elahera. The major factors which contribute to the practice of chena cultivation in the district are as follows :

(1) **Lack of irrigation water :**

In a situation where irrigation water is not adequately available, paddy cultivation

is virtually impossible. Therefore, the farmers in such areas have to depend on chena cultivation.

(2) **Low yield of paddy :**

Due to the low yield of paddy, in some areas the farmers have to engage in chena cultivation as an additional source of income and food.

(3) **Uncertain weather conditions :**

Chena cultivation provides diversity and thereby stability for the farming system under the uncertain weather conditions prevailing in the area.

(4) **Population pressure :**

As population pressure increases, the only alternative for those who have no land of their own, is the chena cultivation in the neighbouring forest.

In the past, when the population pressure on land was not acute, long fallow periods were permitted, and therefore chena cultivation was not ecologically disadvantageous. However, at present such a long fallow periods are not possible and consequently the shortening fallow period leads to land degradation and low productivity.

In the Polonnaruwa district, there are 9 major forest reserves covering more than 2,000 acres, and minor reserves along irrigation canals and road-sides, and also upon the catchment areas of the minor irrigation tanks. With increasing population pressure on land, people who live in close proximity to the forest reserves, tend to encroach the forest reserves for cultivation. This problem is acute in Aluthwewa-East, Gallella and Onegama in the Tamankaduwa AGA division, and Etabhaoya, Manikhorowwa, Bisobandara, Yudhaganawa, Meegaswewa and Wadigawewa in the Medirigiriya AGA division.

The problem is a reflection of the lack of alternative employment opportunities, and lack of suitable lands for farming. Forest resources are also cleared for settlements by the inhabitants in the vicinity when they find no adequate lands for successive generations. In the newly irrigated areas under the Mahaweli project, encroachments on reservations are evident. The squatters come from distant areas and encroach on the reservations with the support of their relatives who are already settled there. Declining productivity of paddy fields due to poor management practices also sometimes compel the farmers to encroach on forest reserves in order to expand the cultivated area.

Table 15 - Major forest reserves in Polonnaruwa district

AGA Division	Name of the Reserve	Area (Acres)
Elahera	Elahera	25,000
Hingurakgoda	Minneriya	3,751
	Giritale	5,500
Medirigiriya	Medirigiriya	16,450
	Ambagaswewa	30,450
Tamankaduwa	Polonnaruwa	26,850
	Manampitiya (System B)	36,850
	Welikanda (System B)	55,600
Hingurakgoda	-	1,334

Source : Forest Department, Polonnaruwa

Environmental Pollution by the Mis-application of Agrochemicals

Contamination of water ways by pesticides and weedicides is an environmental problem prevalent almost everywhere in the district. More than 75 percent of the asweddumized lands in the district is planted with HYVs which are highly vulnerable to pests and insects. therefore, application of pesticides has become inevitable, and also due to the increased labour charges, weed control by chemical means has become popular since hand weeding is very costly. Although there is no argument about the yield-increasing effect of the use of agrochemicals, its adverse effects on the environment is widely recognized. The problem lies not in the application of agrochemicals itself but their mis-application. In most cases, due to their poor knowledge in the application of agrochemicals, the farmers apply weedicides and pesticides indiscriminately regardless of the real requirement. It is also evident that there is a habit of washing the sprayers in water ways. In come cases, empty bottles and can are thrown into canals and tanks. such habits leads to the contamination of water ways with poisonous chemicals. Use of pesticides to kill fish in water ways is also evident. Field evidence suggests that contamination of water ways by agrochemicals has brought the following hazards.

(1) Contamination of irrigation water by the agrochemicals makes the water bodies unsuitable for the survival of fish. This is the major cause for the extinction of some indigenous fish species which lived in the water ways and in the flooded paddy fields. This results in reduced supply of fish (Wel Malu) which provided low-cost nutrition for the rural people. Furthermore, extinction of insectivorous fish species which control the harmful insect population aggravates the problem of insects.

(2) Contamination of water ways by agrochemicals create health hazards when the contaminated water is used by people for drinking and bathing. Although there is no evidence to prove any direct link between the use of agrochemicals and public health, there may be long-term effects. It is said that approximately 5 persons per year are hospitalized in the district due to poisoning insecticides.

(3) Application of pesticides is sometimes more toxic to the helpful species than to the

enemies. With the disappearance of such helpful species, i.e. predators or parasites of a pest, after the continuous application of pesticides, pest species increase in number and become more harmful to the crop. The insect also develop resistance to insecticides. Therefore, more and more insecticide has to be applied to control insects.

Environmental Health

This section deals with human activities which have direct bearings on the environmental pollution and health. Waste disposal is one of this human activities which cause the environmental pollution. It is evident from the table 16 that 25.26 percent of housing units in the district have no toilet facilities. This figure is as much as 74.73 percent in the improvised houses. While 57.71 percent of housing units have pit latrines, water seal and flush toilets account for only 12.05 and 1.85 percent respectively. It can be noticed from this table that a significant number of toilets are shared. Due to the absence of latrines, open air defecation is a common practice, and it leads to environmental problems. Major towns in the district, Polonnaruwa and Hingurakgoda, have specific problems relating to garbage disposal, sanitation and safe drinking water.

Table 16 - Occupied housing units by type and toilet facilities

	Total	Flush		Water seal		Pit		Bucket		None	Not stated
		Exc.	Share	Exc.	Share	Exc.	Share	Exc.	Share		
Total	48,183	1.5	0.35	9.83	2.22	52.68	5.03	0.98	0.43	25.26	1.63
Permanent	15,666	3.69	0.82	25.99	4.59	47.10	5.64	2.73	1.20	6.81	1.88
Semi-permanent	30,911	0.43	0.14	2.22	1.07	57.70	4.83	0.14	0.06	32.05	1.32
Improvised	1,607	0.68	-	0.37	1.74	13.93	2.92	0.18	0.06	74.73	5.35

Source : Census of population and housing, 1981

Table 17 - Occupied housing units by type and main source of drinking water

	Total	Pipe water		Protected well		Unprotected well	River/ tank	Not stated
		In	out	In	out			
Total	48,183	1.0	1.4	23.4	24.5	39.5	8.7	1.6
Permanent	15,666	2.8	2.3	36.3	22.7	30.6	3.0	2.3
Semi-permanent	30,911	0.2	0.9	17.7	25.6	44.3	10.2	1.1
Improvised	1,607	0.2	0.6	7.5	21.8	32.6	32.6	3.9

Source : Census of population and housing, 1981

The access of people of safe drinking water aggravates the problem of environmental sanitation in the district. Table 17 indicates that 48.2 percent of the housing units in the district depend on unprotected wells, rivers and tanks for drinking water, and this figure is as much as 65.8 percent in the case of improvised housing.

Both the absence of toilets and dependence on unprotected wells for drinking water lead to the spread of water borne diseases, because open sources of drinking water are subject

to contamination by bacterial and other polluting sources caused by open air defecation. It is evident that water borne diseases such as dysentery, typhoid and infective hepatitis are common in the district.

Malaria is an epidemic which spreads in the district periodically. It has seasonal peaks during the North-East monsoon where the rains caused water collections which are congenial for breeding of mosquitoes and also optimum environmental conditions for the outbreak of malaria which include high temperature (30C) and high relative humidity (65-90 %) exist during this period. Mosquitoes also breed in irrigation tanks and water ways during drought when pooling of river beds and canals take place. The mass movement of people from areas free from malaria into those in which the disease has been endemic appears to be one cause of severe epidemic. This is considered as a cause for the severe outbreak in 1986 in the district which followed the settlement of 3416 families from Kotmale, Teldeniya and Pallekele in Mahaweli System B between 1982 and 1985. It has also been pointed out that the mosquitoes have developed a sort of resistance to DDT and melathine which were widely used to control malaria. All that factors contributed to the increased malaria.

Other Environmental Problems

(1) **Drought and Floods :**

Drought is a natural hazard which affects all parts of the district during the period June-August. During the drought, people are encountered with the problems of shortage of drinking water, shortage of food and reduced income due to loss of expected harvest. Domestic animals are also badly affected by the shortage of water and fodder. During the drought, high incidence of water borne diseases is in evidence. Effects of the drought is particularly serious in the areas where the people live below the poverty line. During the drought, the poor people become poorer due to the loss of expected harvest, loss of domestic animals and sickness which prevent them from working at least as hired laborers.

Flood hazard is a common problem during the rainy peak season in the flood plain of the Mahaweli Ganga. The major flood-prone areas are Sungawila and Jayapura in the Lankapura AGA division, and Manampitiya and Peletiyawa in the Dimbulagala AGA division. Floods cause damages to properties, crops and domestic animals and also flood is often followed by health hazards such as spread of epidemics.

(2) **Soil Erosion :**

In Polonnaruwa district where the landscape is almost flat or undulating, soil erosion is not a serious problem as it is in slopy areas. However, soil erosion occurs in the minor catchment areas where natural vegetation cover is removed. As the rainfall is erratic in this area, once the vegetation cover is removed, severe erosion take place. Siltation which is a common problem in many small-scale irrigation tanks in the area indicates the erosion of soil in their catchment areas. Clearing of forest cover in the catchment area has been the major cause for the erosional problem and siltation. Overgrazing by domestic cattle and buffaloes in the flood plain has led to extensive sheet erosion and also it is evident that gem mining on the river bank of the Amban Ganga in the Elahera AGA division has caused

severe erosion during the rainy season. Pits for gem mining are dug on the bank of the river and soil is thrown into the river, and therefore the river bank is becoming unstable.

(3) **Air Pollution by Burning Paddy Husks :**

It is evident in Tamankaduwa and Hingurakgoda AGA divisions that large volume of paddy husks disposed by the local rice millers are dumped on road sides. The rice millers are in the habit of burning the large piles of paddy husks. This practice leads to the pollution of air with smoke.

4 EXISTING METHODS OF ENVIRONMENTAL PROTECTION & MANAGEMENT

All human activities brought about by the economic development and population growth require increased use of natural resources. As the population increases, individuals compete for available natural resources. The needs of poor and the greed of rich both lead to excessive use of natural resources. Hence, it is the responsibility of the government to protect and manage the available limited natural resources for the benefit of all including the future generations. The constitution of the Republic of Sri Lanka states that "the state shall protect, preserve and improve the environment for the benefit of the community". An effective administrative machinery is an essential prerequisite for effective environmental management and protection. This chapter examines the existing administrative machinery in the district with special reference to the factors which constrain its capability for environmental management and protection.

Existing District Administrative System

At the time of the field survey, the administrative system in the district represented a transitional stage from the conventional district administrative system to the new provincial administrative system, because the District Development Council which was the district level policy making authority was inactive and the new provincial administrative system had not started to function in its full capacity.

Table 18 - AGA divisions and Grama Sevaka divisions in the Polonnaruwa District

AGA Division	GS Division	Villages
Dimbulagala	18	99
Elahera	11	55
Hingurakgoda	19	111
Lankapura	12	38
Medirigiriya	15	127
Tamankaduwa	23	84
Total	514	98

Therefore, the conventional district administrative system headed by the Government Agent (GA) still administers the district. The GA who is an officer of the Ministry of Public Administration, is the representative of the central government at the district level. The district is divided into 6 divisions which are under the administration of Assistant Government Agents (Agar). Each division is again sub-divided into the Grama Niladhari Divisions (GN Divisions), and these are at the lowest level in terms of the administrative hierarchy. This is the level at which the administrative system really impinges on the people. For most of the people, the effective point of contact with the government is at the GN division level where they meet the GN and other field level officers. This is also the level at which most of the people's institutions such as Rural Development Societies, Cooperative Societies etc. are organized. The nucleus of the Government's administration

at the district level is the GA's office. In addition, there are regional offices in Polonnaruwa to represent almost all the main departments. These line departments operate vertically as separate entities of their own. Some departments have their offices at the divisional level.

A part of the district falls under the System B and G of the Accelerated Mahaweli Development Project (AMP). The administration of the area under the AMP is done by the Resident Project Manager (RPM) of each system. Each system is divided into Blocks and each Block is administered by a Block Manager (BM). Blocks are sub-divided into units which are administered by Unit Managers (UM).

The field survey identifies 5 major factors which constrain the capability of the existing district administrative system for environmental management.

(1) Distribution of the management responsibility of natural resources
(2) Lack of inter-agency coordination
(3) Inadequate resources
(4) Political interferences
(5) Lack of people's participation and poor environmental awareness

(1) **Distribution of the management responsibility of natural resources among many agencies :**

It is evident that the responsibility of the management of natural resources in the district is distributed among many line departments. Department of Forest and Department of Wildlife are directly involved in the management of forest and wildlife resources. The Department of Agriculture and the Department of Irrigation which are involved in the exploitation of soil and water resources, also hold the responsibility for the management of these resources. The GA as the district level representative of the central government, has the responsibility for the management of all natural resources in the district, and so do the Agar in their respective divisions.

Nearly all the forests in the district are state-owned and they fall mainly within the jurisdiction of two departments such as the Department of Forest Conservation and the Department of Wildlife Conservation. Most of the natural forests that fall under the jurisdiction of the Forest Department are designated as Forest Reserves or Proposed Forests Reserves. There is another category of forest blocks called 'Other State Forests', and some of them (the larger blocks) are under the Forest Department, and the others are under the GA. There are certain extent of forest reserves under the custody of the Ceylon Government of Railway (CGR), Department of Highways and Department of Irrigation. It seems that such administrative bodies which have no interest in environmental protection and management tend to clear these forest lands for various other uses. In some cases they lease out the reservations for the public for various purposes. Neither the Department of Forest Conservation nor the GA/Agar have control over the these administrative bodies, and therefore they fail to prevent such environmental destructive actions. For instance, some blocks of forest reserves that belong to the DGR near Manampitiya New Town have been leased out to some boutique keepers.

Though the management responsibility of natural resources is distributed among

many government agencies, all natural resources in the environment are inter-related and inter-dependent. Hence, degradation of any resource leads to the degradation of others too. For instance, destruction of forest cover in any area adversely affects the wildlife, water and soil resources. The causal factors for any environmental problem, are so widespread that they can be found in the jurisdiction of many other departments. For instance, though the extinction of wildlife is considered as a problem to be treated solely by the Department of Wildlife, the major causal factor for the problem lie in the areas of many other departments so that only the Department of Wildlife cannot tackle the problem. Therefore, any single department cannot effectively manage the natural resource that it is responsible for. Hence, effective coordination is crucial to make the resource management a success.

(2) **Lack of inter-agency coordination :**

As the head of administration at the district level, the GA is supposed to coordinate the activities of all departments and other statutory bodies functioning in the district. He regularly meets the district level heads of these departments. However, the GA has no equal control over the activities of all line agencies in the district. According to their relationship with the GA, it is possible to categorize the departments and other statutory bodies in the district into two groups as follows:

- The departments on the activities of which the GA has direct control either as a result of statutory or administrative authority being conferred to him. Some of the departments under this category are Land Commissioner's Department, Department of Small Industries, Regional Development and Planning, Department of Cooperatives, Food Commissioner's Department, Agriculture Department, Forest Department and Agrarian Service Department.

- The departments on the activities of which the GA has no direct control are Irrigation Department, Building Department, Department of Wildlife, Survey Department, Department of Education, Health Department, Timber Corporation, Paddy Marketing Board and Urban Development Authority.

The fact that the GA has less control over the activities of some agencies of the government than others suppresses the GA's capacity for effective coordination. In theory, the Agar are expected to perform the function of coordination at the divisional level but in practice the effectiveness is even less satisfactory than at the district level. It is the same as in the case of GA that the Agar also have poor control over the activities of some line departments in their divisions. Furthermore, some important line departments do not have officers at the divisional level. Hence, the Agar have to deal with relevant problems through the GA at the district level. the lack of effective control of the GA and Agar over the activities of the departments with environmental concerns, i.e. Department of Wildlife, Department of Health and State Timber Control badly reduces the capability of the administrative system for environmental management. A major obstacle to a comprehensive or holistic approach to the environmental management is the traditional functional and hierarchical structure of public administration existing at the District level.

The District Environmental Agency (DEA) which was established to perform advisory functions in relation to environmental affairs has also failed to coordinate the departments with environmental concerns. The DEA represents the Central Environmental Authority at the district level. In terms of section 9(2) of the National Environmental Act, the GA is the chairman of the DEA. the Assistant Commissioner of Local Government (ACLG) acts as the secretary. The other members are (1) Director of Education, (2) Deputy Director of Irrigation, (3) Assistant Director of Wildlife, (4) District Forest Officer, (5) District Officer - Sarvodaya and (6) all Agar in the district. The DEA has also no powers over the activities of the other line departments in the district. Furthermore, some departments which are very important in environmental management i.e. Department of Agriculture, Department of Health are not the members of the DEA. Hence, coordination among the departments in the district with environmental concerns cannot be successfully achieved by the DEA too.

The following examples show how the poor coordination among the agencies of the government hampers the environmental management in the district.

- Forest conservation is the responsibility of the Department of Forest but forest harvesting is done by the State Timber Corporation (STC). As it has already been pointed out that the poor field level coordination between these two agencies leads to degradation of forest reserves in the district.

- There is no field level coordination between the Forest Department and the Department of Wildlife, for the protection of wildlife and forest. While the Forest Department is mainly interested in trees, the Department of Wildlife is mainly concerned with animals. Both departments have field level officers but there is no effective coordination among them. The poor coordination results in duplication of efforts and wastage of available limited resources.

- The poor coordination between the Department of Education and the Department of Health Service leads to low level of health education which is the major cause for the low level health and sanitation in the district.

- The problem of crop damage by wildlife also reflects the poor coordination among the Department of Wildlife, Department of Agriculture and the Mahaweli Development Authority. From the farmers point of view, it is the Department of Wildlife which should take action to prevent the wild animals from damaging their crops. However, the very roots of the problems lie beyond capacity of the Department of Wildlife. any sustainable solution for the problem calls for effective coordination among these agencies.

- There is no effective coordination between the Mahaweli Authority of Sri Lanka, Irrigation Department and the Anti-Malaria Campaign to control malaria. The Mahaweli Authority and the Irrigation Department are mainly concerned about the irrigation water supply and power generation, and therefore they are reluctant to release water to flush out the mosquito breeding puddles in the river and canal beds during the dry season.

(3) **Inadequate resources :**

Shortage of staff, trained personnel, funds, equipment and vehicles are common constraints evident in all departments and statutory bodies dealing with the environment in the district. It is evident that both Department of Forest Conservation and the Department of Wildlife Conservation in the district suffer shortage of necessary resources, i.e. staff, trained personnel, vehicles and equipment. When the extent of the area to be protected by both these departments is taken into consideration, the present staff is grossly inadequate. Lack of trained and qualified officers for research and development is also evident and it hampers the proper management of forest resources. On the other hand, though a large part of the other state forests are under the GA and Agar, they have no resources required for management and protection of forests in their divisions. Furthermore, these forests are in small blocks and are dispersed over a wide geographical area. Their boundaries are also not well-known. The AGA divisions in the district are very large, and therefore it is extremely difficult for the Agar to supervise or protect the forests in their divisions. There are no updated maps which show the exact location and boundaries. The GA and Agar have large number of day to day responsibilities and duties to fulfil, and hence the protection of forest reserves receives only little attention. Therefore, other state forests are susceptible to heavy damage. Lack of clear-cut boundaries for forest reserves that can easily be recognized in the field is also an obstacle to the protection of forest. Difficulties in recognizing the boundaries of forest reserves make it difficult for the concerned officers to take action against the encroacher. It is evident in the field survey that although boundaries of forest reserves are marked along the roads in some cases, they are not marked elsewhere.

It is also evident that the local staff and other resources of the Department of Wildlife are inadequate for effective management of the wildlife reserves. The wildlife parks in the district are inadequately manned and therefore poorly protected from habitat destruction, human encroachment, and poaching. The problem of inadequate staff is aggravated by the lack of vehicles and communication equipment. Furthermore, though habitat enrichment programmes are required for efficient management of wildlife parks, such programmes cannot be implemented due to the shortage of trained staff.

The department of health is also affected by serious logistical problems. The activities of the Department of Health in the district are directed by the Regional Director of Health Services. The shortage of staff, equipment and vehicles are some major constraints that affect their activities in the department. It is evident that the most of the medical officers are reluctant to serve in the Polonnaruwa District, because the district is considered as a harsh area without basic facilities required by the officers. the existing medical staff is also unable to conduct their regular services in all parts of the district due to the shortage of vehicles and communication facilities. There is no sufficient financial resources to implement health education programmes. Department of Health and the Anti-malaria Campaign are responsible for malaria control in the district but their capability is severely hampered by the shortage of staff, vehicles and financial resources. Spray of malathion is not done at an adequate rate, and also it does not cover the badly affected areas due to transport difficulties.

In some cases, though legal provisions are available, there is no institutional support to implement it. For instance, the control of Pesticide Act No 33 of 1980 has provided provisions required to control environmental pollution caused by contamination of pesticides, but the institutional framework for enforcing all aspects of the act on pesticides has not yet been developed. Furthermore, lack of resources such as trained and adequate man power, expertise and skills for evaluating and analyzing toxicological data and pesticide formulations, supporting laboratory facilities for monitoring toxic residues on crops are also evident. Attempts are being made by the Department of Agriculture and the Department of Agrarian Services to introduce the methods of Integrated Pest Management. But such programmes are also hampered by the shortage of adequate qualified staff and financial resources. Farmer education programmes have also faced with the same problems. Legal actions alone are insufficient to prevent the local people from committing environmental crimes. There should be programmes to educate farmers about the adverse effects of misuse of pesticides and how to use pesticides in the proper way. The extension officers are not provided with sufficient financial resources to implement farmer education programmes.

(4) **Legal and political constraints :**

In some cases, shortcomings of the existing legal system, and abuse of power by local politicians constrain the capability of the departments and other statutory bodies dealing with the environment. With regard to the conservation and protection of forest, it is evident that the Agar or the officers of the Forest Department have no powers to punish the offenders, instead when illicit felling is detected the officers involved in the operation have to make arrangements to transport the seized timber to be produced in courts. they are also responsible for the safe-custody of timber pending legal action. For all these trouble, they do not get any incentives but develops enmity. According to the Forest Ordinance, if a person is found guilty of a forest offence committed by himself or made to commit by him, all forest produce involved in the offence and all tools, boats, carts, cattle and motor vehicles used to commit the offence are liable for confiscation. But usually such cases are taken under the section 306 of the Criminal Procedure Code (CPC) and the produce is released. Therefore, the offenders cannot be adequately punished.

The legal procedure relating to wildlife protection is cumbersome and it discourages the officers. For example, according to the law, selling or keeping the meat of any protected wild animal is punishable. When such meat is detected if the offender pleads not guilty, the officer involved in the detection has to produce a certificate from the Government Analyst to prove that the meat produced in the court is that of a protected animal. To get this certificate, a piece of the detected meat has to be sent to the Government Analyst through the local veterinary surgeon. In some cases, delay caused by failure to contract the veterinary surgeon in time may lead to decomposition of the detected meat.

There is also no legal provision to maintain a certain environmental standard regarding housing conditions in rural areas. The legal provisions under the Urban Development Authority (UDA) Law are applicable only in urban areas. Therefore, in order to extend such legal provisions to the rural areas, it is necessary to put the rural areas under the UDA Law. If not, another agency has to be established to

take over the control of the health standard in rural areas.

Political interference often act as a very serious constraint in the implementation of environmental laws, because the field evidence suggest that some local politicians back the environmental offenders. The existing political system demands going back to the people once in six years, and therefore the politicians tend to abuse their political power to protect the environmental offenders with a view to get their political support. Hence, it is difficult for the officers to enforce the law. Furthermore, some local politicians help the encroacher to get the legal right to the land that they have encroached upon. Such incidents encourage further encroachment on reservations. It was learnt that there were some incidents in which the officers of the Department of Wildlife were prevented from taking legal action against the wildlife offenders due to the influence of local power groups. The penalties for the wildlife offenders from repeating the same offence. It was felt that the officers of the Department of Wildlife are unable to stop encroachments in wildlife parks in the district due to the interference of local power groups. Encroachments in the Flood Plain National Park is an ideal example. In this park, encroacher are conducting a wide range of activities such as brick making, tobacco cultivation, chena cultivation and grazing of domestic animals, but the officers of the Department of Wildlife fail to enforce the law due to the interference of local politicians.

(5) **Lack of people's participation and poor environmental awareness :**

Active participation of the local people who use the natural resources in the locality is an essential pre-requisite for the environmental management. It is evident that the existing methods of environmental management and protection is seriously hampered by the lack of people's participation. While some initiatives were taken by the DEA at the district level, some divisional level initiatives were taken by the Agar. Eassy competitions and tree planting campaigns are some of the activities organized by the DEA. At the divisional level, some people's organizations were established. Some of these organizations are 'Parisara Sanrakshana Parshadhaya' at Hingurakgoda and Environmental Committees in other AGA divisions. In order to get people's participation in Integrated Pest Management (IPM) and to popularized the IPM among the farmers in the district, the 'Association of the Users of IPM' has been established with the support of the District Commissioner of Agrarian Service in the district.

However, top-down approach is evident in all these activities. All these activities and organizations were initiated by either the Agar or other officials in the concerned departments. People's own initiatives have been poor. the above mentioned organizations have been mainly driven by officers rather than by the people themselves. Most of these organizations have been inactive since their very beginning. No attempts have been made to keep these organizations functional and no follow up action had been taken. Tree planting campaign is a classical example for a failure of the top-down process in environmental activities. Decisions on the dates of tree planting and the species to be planted are taken by the officers without consulting the local people. Most of the plant species distributed among the people were not acceptable to them, and therefore they showed only little interest in protecting the plants. On the other hand, the tree planting days were in the dry season. Therefore the survival rate of the plants was very low due to

lack of water.

If people's participation is to gain for the management of environment, people should be made aware of the consequences of the mismanagement of the environment. For this purpose, environmental education is vital. Poor environmental awareness is evident among the people as well as officers of the departments dealing with the environmental management. Both Forest Department and the Department of Wildlife have no adequate qualified professionals for research and development. The Department of Wildlife has no resources to implement programmes to educate the people around the National Wildlife Parks about the significance of wildlife conservation. Attempts have not yet been made to get the local people's active participation for wildlife conservation. The Department of Wildlife has not yet organized programmes to educate farmers on why the elephants should be conserved and also to train the farmers to organize themselves to protect their crops from the wild elephants. On the other hand, for environmental management and planning, it is necessary to know the existing states on the subject. The information and data already existing in diverse reports and records are insufficient for environmental management and planning. On the other hand, they have been collected for purposes other than environmental management. Therefore, efforts being make for environmental management are seriously hampered by the lack of environmental data.

5 ENVIRONMENTAL PLANNING

Environmental management needs an integrated planning approach, which is aimed at managing human activities in order to maintain an acceptable balance between the qualities of the human and natural environments. the environmental planning concept is rooted in the integration of environmental considerations in the economic development planning. Environmental planning attempts to facilitate economic development, while avoiding, as far as possible, concomitant environmental damage.

Existing Planning System in the District

District level planning includes (1) District Development Plan (2) Departmental Plans and (3) Sector Plans. In all these cases, the planing process passes a number of stages. It begins with the identification of projects as solutions for development problems. Then it passes the various stages such as project formulation, feasibility study, project appraisal, approval, implementation, monitoring and evaluation. Ultimately when the projects is completed, it is transferred to the normal administration.

(1) District Development Plan :

The District Development Plan outlines how to utilize the funds allocated for the district from the decentralized budget. Each electorate is allocated Rs. 2.5 million, and therefore the Polonnaruwa district which consists of 5 electorates receives Rs. 12.5 million every year. The plan is prepared by a committee attended by all MPs in the district, all Agar, Assistant Director of Planning, and all district level heads of other government agencies. This committee is headed by the GA. The Planning Unit of the Kachcheri provides technical support of preparation of the plan, and also it coordinates all the implementing agencies. With regard to the District Development Plan the project identification is done by the MPs in consultation with the people's organizations of their electorates. They may consult the GA, Agar and the district level heads of the line departments. Then the planning committee considers all identified project ideas and decide the priorities. At the next stage, the identified project ideas are referred to the appropriate departments for project formulation and budgeting. Then, after the approval is granted by the committee, the Planning Unit compiles all the approved projects and prepares the District Development Plan.

Implementation of the District Development Plan is undertaken by various government agencies. Individual projects are assigned to the appropriate government agencies for implementation. The Planning Unit undertakes the funds disbursement and coordination. The Progress Control Committee which meets monthly evaluates the progress of the on-going projects. This committee is attended by all MPs, heads of all project implementing agencies, all Agar and it is the GA who chairs the committee. The Agar are supposed to supervise the projects in their divisions and report their progress. Complaints made by the public with regard to the on-going projects are also considered at the meetings of the

Progress Control Committee. The committee evaluates the progress and takes measures to remove the bottlenecks. Progress is also evaluated when payments are made to the implementing agencies. In general, most of the projects are implemented by the Irrigation Department, Building Department, Department of Telecommunication, Electricity Board and the Department of Agrarian Services.

(2) **Departmental Plans :**

Most of the line departments also undertake some sort of planning when they prepare annual budget estimates. When estimates are being prepared for the budget of the following year, the district level officers have to proposed the projects that should be undertaken in the district. In making their proposals, they are guided by circular instructions which are issued by the head office. For departmental plans, projects are identified by the district level officers on the information provided by the divisional level and field officers. However, the MPs of the district and the GA may influence the officers when they identify projects. Then the project formulation and approval are carried out centrally by the head offices. When the approval is granted, monetary provision is made for expenditure in the votes of the department in the budget. While the departments in the district undertake the project implementation, they have to report the progress to their head offices which undertake the progress control.

(3) **Sector Plans :**

The sector plans are prepared by some ministries to fulfil the role assigned to them in the national plans. Though the sector plans are highly centralized, district level institutions undertake both plan preparation and implementation. the sector plans include both annual plans i.e. Agricultural Implementation Programme and Housing Development Programme and the long term plans i.e. Mahaweli Development Plan and Dairy Development Programme.

Both the District Agricultural Implementation Programme (DAIP) and the District Housing Development Programme (DHDP) are prepared annually as parts of the annual national plans. At the district level, the District Agricultural Development Committee and the District Housing Development Committee undertake the preparation of DAIP and DHDP respectively. The administrative set-up for the formulation and implementation of the DAIP consists of a number of institutions from district level to the village level. At the district level, the GA coordinates the activities of the offices relevant to agricultural development through the District Agricultural Development Committee. the committee is the main instrument of plan formulation and implementation. At the divisional level, the Agar coordinate the activities through a divisional committee similar to the above. Furthermore, the field officers at the village level serve as a link between the organizations at the divisional level and the farmer.

The long term sector plans are prepared by a central agency or the officials of the appropriate departments. For instance, in the case of Accelerated Mahaweli Project (AMP), the Planning and Monitoring Unit (PMU) of the Mahaweli Economic Agency (MEA) undertakes planning and monitoring with the support of the local staff. With regard to the Mahaweli Environmental Project, while the PMU undertakes planning and monitoring, implementation is done by the Department of Wildlife. So, the

Department of Wildlife staff of the district implements the activities of the Mahaweli Environmental Project.

Environmental Component in Development Planning in the Polonnaruwa District

Table 19 shows the allocation of funds by the District Development Plan for the year 1990. It can be noticed from this table that greater priority has been given to the development of physical infrastructure which is required for economic development and employment generation. A large share of the total decentralized budget is allocated for the construction of physical infrastructure i.e. rural electrification, public housing, road construction etc.

Table 19 - Allocation of funds under the District Development Plan 1990

Item	Percentage (approx.)
Rural electrification	72
Public housing	12
Buildings for schools	4
Road construction	4
Water supply	4
Telecommunication	3
Other construction works	1

Source : District Development Plan, Polonnaruwa, 1990

There is no single project aimed at the major environmental problems in the district. This imbalance in resource allocation in the District Development Plan can be contributed to the following factors :

(1) Though a large number of agencies and officers take part in the planning process, the MPs of the district have the absolute power on deciding priorities. So, they make final decisions on the selection of projects. Political leadership is often more concerned about economic achievements and short term gains, and therefore they tend to overlook the environmental problems.

(2) Environmental problems are not immediately felt by the public. Hence, there is no heavy public pressure on the MPs to allocate the funds that they have received from the decentralized budget for environmental projects. Hence, environmental problems receive very little attention when the limited funds are allocated.

(3) Feasibility studies or Environmental Impact Assessments are not carried out as a part of the planning process. Therefore, there is no way to realize the possible environmental impacts of the proposed projects, and to adopt appropriate measures to mitigate them.

There is only little room for people's participation in the planning process. Local people can make complaints if they notice any on-going project that generates environmental

problems in their locality. Apart from this, there is no institutional arrangements to get people's participation in monitoring the on-going projects. There are few environmentally oriented NGOs in the district but they have no role in the planning process.

However, some policies of the planning committee shows its environmental concerns. According to their policy, all the construction projects in the district should utilize steel as a substitute for timber, and also in case timber is utilized they should be purchased only form the STC. These policies have been formulated with a view to protect the local forest resources. Apart from this, funds have been allocated from the decentralized budget to repair the drainage system in the Polonnaruwa town and to fill up the water logged parts of the Polonnaruwa market in order to keep it clean.

Lack of environmental component is again evident in the district level annual plans prepared by the line departments. Except for a few departments with environmental concerns, most of the other departments give very low priority for environmental problems when they prepare annual estimates. The development oriented departments naturally give high priority for development projects. As it has been mentioned above, all stages of the planning process i.e. project identification, project implementation, monitoring and evaluation, are mainly carried out by the bureaucracy. Because of their preoccupation with current and immediate economic gains and related problems, the administrators and planners do not spend time and resources on environmental problems. The existing administrative system is also designed to promote short term success and achievements. The Sri Lanka Centre for Development Administration (SLIDA) which trains the administrators, does not provide the courses designed to promote the environmental awareness of the administrators. The poor environmental awareness of the officers is also a reason for the lack of environmental planning.

Among the annual sector plans, the DADP and the DHDP are mainly development oriented, and therefore similar to the former case, where environmental component is poorly incorporated. However, the recognition of the environmental component can be seen in the Accelerated Mahaweli Project (AMP). At the initial stage of the AMP a comprehensive environmental assessment was carried out (TAMS Report) and recommendations were made to mitigate the possible environmental impacts of the project. The environmental action plan based on these recommendations identified eight environmental development areas such as (1) wildlife conservation (2) watershed management (3) forestry planning and management (4) water resources research and monitoring (5) fisheries development (6) health care and sanitation (7) water and soil management and (8) landuse planning. All these programmes are now in various stages of implementation.

There are institutional arrangements in the AMP to incorporate the environmental component into the planning process. There is an environmental division in the MASL/Mahaweli Economic Agency (MEA) which is headed by an Environmental Officer who undertakes the coordination of all environmental plans and programmes. The Environmental Officer collaborates closely with Project Coordinators for each irrigation system and with all the other implementing agencies which are involved in environmental related projects for the AMP. Policy issues are addressed by a Technical Sub-committee of the Environmental Division which meets at MASL monthly.

Selected Environmental Projects in the Polonnaruwa District

(1) **Mahaweli Environmental Project :**

The Accelerated Mahaweli Project (AMP) generates significant impacts on the social and physical environment. the major changes in land use and human settlement brought about by the AMP lead to destruction of the habitat required for the wildlife. In consequence wildlife is being displaced in the area, and it is subject to extinction. IN order to mitigate these environmental problems, the government has embarked on the Mahaweli Environmental Project (MEP), which is largely funded by the USAID. Its purpose is to ensure the stability of irrigated agricultural development and human settlements in the AMP area by providing alternative protected habitats for displaced wildlife in a manner that is ecologically sound and socially acceptable.

For this purpose, four national parks, two nature reserves and one sanctuary have been or will be established. A jungle corridor connecting Maduru Oya National Park and Gal Oya National Park has been proposed. Major components of the MEP are planning and infrastructure development of each protected area, improvements in the institutional capability of the MEP/Department of Wildlife, conducting basic research needed to protect the resources in each protected area, and the development of active community relation, conservation education programmes which promote the benefits of the system to the local people.

(2) **Fuelwood Plantation Project :**

Fuelwood is becoming a problem in the Mahaweli System B and G of the Polonnaruwa district where the forest cover has been removed for settlements. the fuelwood plantation project has been designed to mitigate this problem. Under this project, trees are planted on reservations to be used as fuelwood in the future.

According to the plan, the fuelwood plantation project will continue 12 years ahead. It is expected that the fuelwood supply from the plantations would be sufficient to meet the total fuelwood demand by the end of the projected 12 years period. The species being planted in fuelwood blocks are Acacia auriculiformis, Eucalyptus tereticornis and Eucalyptus camldulensis.

Table 20 - Areas under fuelwood plantations

System	Area in ha
B	524
G	54

Source : Environmental Division, MEA

(3) **Reforestation Project :**

The AMP undertakes three types of reforestation projects namely (1) Mixed Forest Plantations (2) Forest Plantations and (3) Bamboo Plantations on canal banks.

Under the mixed forest plantations, fruit trees and other trees with timber values are planted together, whereas under the other forest plantations only the other trees are planted. Some of the dominant species in forest plantations are Teak, Sooriyamara, Gammalu, Mee, Kumbuk and Halmilla. The existing deforested lands are used for both these types of forest plantations.

Table 21 - Forest Plantation in Mahaweli System B and G

Type of forest	System B (Acres)	System G (Acres)
Mixed forest	643	50
	265	33

Source : Environmental Division, MEA

It is evident that people's participation is poor in both these reforestation projects, and planning is solely done by the bureaucracy. It seems that local people have very poor interest in reforestation projects because such projects do not yield quick benefits. However, the bamboo plantation project is implemented with the support of local people. In this case, settlers who live in close proximity to the irrigation canals are given bamboo shoots for planting on the canal banks. It is their responsibility to look after the shoots that they have planted, and in return they are entitled to get the bamboo harvest on sustainable basis. Since January 1990, 2000 and 4000 bamboo shoots have been distributed among the settlers in System B and G respectively.

6 SUMMARY AND RECOMMENDATIONS

It is evident from the foregone chapters that the environmental problems in the Polonnaruwa district lead to rapid environmental degradation. While some of the environmental problems have arisen due to lack of development and poverty, others are the consequences of development activities. The problems of first category which are stemming from lack of development, low income, poor resource base, landlessness, insanitation and high population growth cannot be solved easily because the cause of the problems rather than the effect has to be treated. The problems of the second category which are arising as a result of development activities, can be solved by improving institutional and legal reforms, environmental education, and the incorporation of environmental component into development planning. It is also evident that the existing methods of environmental management and protection are poor in capability due to a variety of constraints such as administrative, logistical, financial, legal and political problems. The existing district level planning system has also failed to address the major environmental problems in the district because the environmental component is not sufficiently incorporated into the planning.

Therefore an environmental action plan is necessary for efficient management of environment in the district. This chapter provides feasible guidelines and recommendations for such an environmental action plan for the Polonnaruwa district. Recommendations are made herewith regard to 5 major aspects as follows :

(1) Strengthening the DEA
(2) Enhancing the capability of the line departments for environmental management
(3) Environmental legislation
(4) Environmental awareness
(5) Environmental planning

(1) **Strengthening the District Environmental Agency :**

Under the present system, the DEA plays only a very limited role in the environmental management in the district. It is recommended here to strengthen the DEA by providing wider powers and resources in order to enable it to play a central role in relation to environmental management. For this purpose the following measures are recommended.

1.1 A Senior Environmental Manager should be appointed as the secretary of the DEA.

1.2 Membership of the DEA should be widened by including representatives from the Department of Agriculture, and the Department of Health.

1.3 Divisions should be set up in the DEA for Environmental Education, Environmental Planning & Monitoring, Legal Affairs and Environmental Research Studies.

1.4 The DEA should be provided with office space, financial resources and other logistical support.

Apart from the above it is recommended that Divisional Environmental Committees be formed at the AGA division level. The membership of the proposed Divisional Environmental Committees should include all the divisional level and field level officers functioning in the AGA division and representatives of the local NGOs. the AGA should act as the head of the Divisional Environmental Committee, and he should link it with the District Environmental Agency. It is also recommended to set up Village Environmental Committees at the GN division level. The Village Environmental Committees should be the organizations of the local people with environmental concerns. The village schools, temple, and local NGOs may play a dominant role in the Village Environmental Committees. The DEA should extend its activities upto the village level through the Divisional Environmental Committees and Village Environmental Committees.

It is recommended to form Environmental Cells in all government agencies functioning in the district. Each environmental cell should be manned by an officer trained in the field of environment who is directly responsible to the DEA, and the Environmental Cells should feed the DEA with the environment related information within the purview of the government agency which they represent. Such a network of Environmental Cells in all line departments and statutory bodies in the district will enable the DEA to effectively coordinate all government agencies with regard to environmental affairs. The Environmental Cells should also review all projects and other development activities of their departments and should report the environmental implications to the DEA. It should also assist the project formulation and planning with a view to minimizing their possible environmental impacts. The Environmental Cells should be able to act independent of their departments so that they could critically comment on the environmental impacts of the departmental plans. In this regard, the proposed Environmental Cells may act similarly to the External Audit Units in the government agencies.

(2) **Enhancing the capability of the line departments for environmental management :**

It is evident that the poor capability of the line departments in the district for environmental management is a contributory factor for the environmental degradation. This is particularly true with regard to the departments with environmental concerns viz, Department of Wildlife Conservation, Department of Forest Conservation, Department of Agriculture and the Department of Health Services. All these departments should be provided with adequate resources to enhance their capability for environmental management if effective environmental management is to be achieved.

Both Department of Forest Conservation and the Department of Wildlife Conservation should be provided with trained personnel required not only for the protection of forest and wildlife, but also for the effective management. In order to improve the coordination among the Department of Wildlife Conservation, Department of Forest Conservation and the State Timber Corporation, it is a good idea to form a Forest Development Authority, assimilating all those agencies. Apart from these measures, all forest lands in the district should be surveyed and mapped, and the boundaries should be demarcated and marked. The forest lands under the jurisdiction of the Department of Forest Conservation. Department of Wildlife Conservation, the GA, Department of Highways and Department of Railway should have boundaries with specific signs.

Technical support should be provided for the appropriate line departments, because without such support it is not possible for some departments to implement the existing environmental laws. For instance, a laboratory is required for the Department of Agriculture if the Pesticide Act is to be implemented because it is necessary to identify and measure the toxic residues on crops and the degree of water pollution by pesticides for effective implementation of the Pesticide Act. Such technical support services are required for environmental monitoring too. It is recommended here to use the proposed network of Village Environmental Committees as an environmental monitoring system. Such a monitoring system is necessary for alerting the DEA and other concerned agencies about any environmental degradation occurring in the locality. The proposed Village Environmental Committees can serve as observers of environmental quality in their respective GN divisions.

(3) **Environmental Legislation :**

It is recommended here to implement the following legal reforms in order to remove bottlenecks evident in the legal system pertaining to the environmental management.

3.1 A legal branch should be set up in the DEA to assit the agencies which enforce the environmental legislation in the district. This division should be headed by a lawyer trained in the field of environmental law.

3.2 A District Environmental Tribunal should be set up with powers to adjudicate on environmental offenses within the framework of the existing judicial system.

3.3 The officers such as the GA, the Senior Environmental Manager, and the district heads of the Department of Forest and Department of Wildlife should be granted powers to charge penalties on certain categories of environmental offenders.

3.4 It is evident that the punitive measures are inadequate in the case of illicit felling of timber, killing of protected animals, selling or keeping their meat. In these cases, penalties should be substantially increased if offenders are to be prevented from repeating the same crime.

3.5 The Housing and Town Improvement Ordinance is not applicable to the rural sector which represents more than 95% of the district. Therefore, there is no authority similar to the UDA to maintain the environmental standard in rural settlements. It is recommended here to form such an authority for the rural sector too.

3.6 The anti-malaria campaign should be given powers to impose spot fines on environmental offenders, and it should also be provided with resources required for effective implementation of such powers. It should also be granted powers to force the MASL and the Department of Irrigation to take appropriate measures to control malaria.

(4) **Environmental Awareness :**

Poor environmental awareness among the local people as well as the officials and politicians is evident. Since the poor environmental awareness among all these categories is the main cause for many environmental problems, the following measures are recommended to enhance their environmental awareness.

4.1 The Environmental Education Branch of the DEA should undertake environmental educational programmes for school children as well as for adults.

4.2 The Divisional Environmental Committees and the Village Environmental Committees should organize environmental educational programmes in their localities. The DEA should provide necessary resources for these local committees to implement such programmes. The officials of the conservation oriented department, i.e. Department of Wildlife Conservation and Department of Forest Conservation could be used as resource persons for such environmental educational programmes.

4.3 The educational programmes should focus on the environmental problems in a particular locality. For instance, in areas bordering the wildlife parks, the educational programmes should focus on the environmental significance of the wildlife conservation, and for this purpose the officers of the wildlife parks should be provided with necessary resources to organize such educational programmes.

4.4 The DEA should also provide short-term in-service training courses on environmental management for the administrators in the district. Such courses should be offered not only to the officers in the departments with environmental concerns, but also to the officers in other departments in order to raise the environmental consciousness among all public officials in the district.

4.5 A comprehensive Environmental Data Base should be set up in the DEA. All local level environmental committee and the Environmental Cells in other line departments should feed the Environmental Data Base with environmentally significant information.

4.6 The DEA should maintain a separate branch for research studies on environmentally significant problems in the district. This branch should be headed by a qualified environmental scientist. The proposed research branch should also undertake feasibility studies for the projects proposed by the Planning Branch of the DEA.

4.7 The indigenous methods of environmental management have been used over centuries by the local people, and therefore they are very much appropriate for the local conditions. They are also time tested. Therefore it is recommended here to assemble the information on indigenous methods of resource management and to disseminate them among the administrators and planners so that the indigenous knowledge could be used for modern environmental management and planning.

(5) **Environmental Planning :**

For environmental planning, it is recommended to have a District Environmental Plan, in addition to the incorporation of the environmental component into the conventional district planning viz, District Development Plan and Annual Departmental Plans. The DEA should undertake the preparation of the proposed District Environmental Plan annually. The planning process for the District Environmental Plan is proposed to be as follows :

1. Project identification should be done by the local people through the Village Environmental Committees and the Divisional Environmental Committees.

2. The DEA should study all the project ideas identified by all local environmental committees and should decide the priorities. Then the Planning Division of the DEA should formulate the selected projects and prepare the District Environmental Plan.

3. Then, the DEA should undertake implementation with the support of local environmental committees. Only the project which need specific technical know how and equipment may be given to other appropriate government agencies for implementation. Participation of the local people should be gained for implementation through the local environmental committees. Participation may be by means of donation of labour, material or funds.

4. Monitoring of the on-going projects should be done by the Environmental Officer of the concerned AGA division with the support of the local environmental committees. He should report the progress to the DEA monthly.

It is evident that the environmental component is poorly incorporated into the District Development Plan and the departmental plans. Therefore it is necessary to adopt appropriate measures to incorporate the environmental component into the district level planning. For this purpose, the following measures are recommended.

1. The project proposals which have been prepared by the district level officers of the line departments for annual plans, should be reviewed by the Environmental Cell of the concerned department and should report the possible environmental impacts to the DEA.

2. All development plans of the line departments should obtain approval from the DEA before implementation. The DEA should study the project proposal and should suggest suitable modifications before the approval is granted. The District Development Plan should also get the approval of the DEA before administration.

3. Monitoring of the on-going projects should be undertaken by both the local environmental committees and the Environmental Cells of the concerned departments. They should report the environmental impacts of the on-going projects to the DEA which should enforce the appropriate implementing agencies to take corrective measures.

4289

In conclusion, it should be mentioned that there are serious constraints such as (1) poverty and (2) political interference, which cannot be removed by environmental planning alone. It is evident that poverty is a major cause for many environmental problems in the district. Therefore as long as poverty exists, the environmental planning alone cannot solve the environmental problems. On the other hand, it is evident that the abuse of power by local politicians often impedes the implementation of environmental law. Hence, if such political interference continue to exist, the proposed institutional and legal reforms would be