Japan International Cooperation Agency

The Democratic Socialist Republic of Sri Lanka
Ministry of Plan Implementation, Ethnic Affairs and National Integration

The Master Plan Study For Southern Area Development In The Democratic Socialist Republic of Sri Lanka

Final Report

Sector Report 6
Land and Environment

February 1997

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International Development Center of Japan
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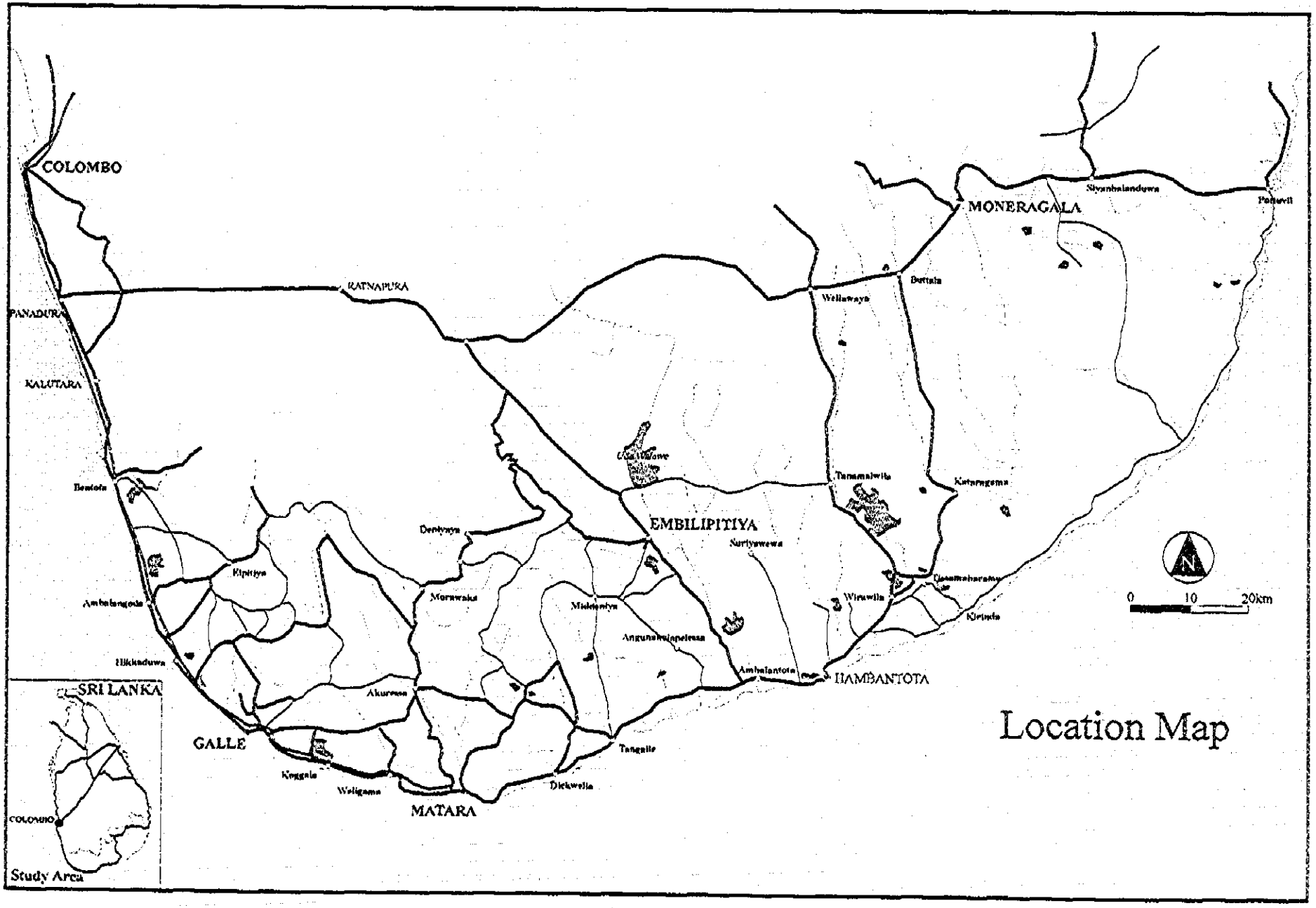
COLOMBO
PANADURA
KALUTARA
RATNAPURA
MONERAGALA
Wellawaya
Buttala
Siyambalanduwa
Pottuvil
Bentota
Deniyaya
EMBILIPITIYA
Tanamalwila
Kataragama
Kiriella
Ambalangoda
Morawaka
Hikkaduwa
Akuressa
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MATARA
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SECTOR REPORT 6 : LAND AND ENVIRONMENT

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ABBREVIATIONS

PART 1 LAND HUSBANDRY

DWLC	Department of Wildlife Conservation
FD	Forest Department
GA	Government Agent
GIS	Geographic Information Systems
LDO	Land Development Ordinance
LGV	Local Government Unit
LUPPD	Land Use Policy and Planning Division
NEFB	Non Wood Forest Products
NFMP	National Forestry Master Plan
NGO	Non Governmental Organization
OFC	Other Field Crops
RTA	Registration of Title Act
SEDZ	South East Dry Zone

PART 2 ENVIRONMENT

CEA	Central Environmental Authority
EIA	Environmental Impact Assessment
EPL	Environmental Protection License
GIS	Geographic Information Systems
MEPA	Ministry of Environment and Parliamentary Affairs
MTEWA	Ministry of Transport, Environment Affairs and Women's Affairs
NEA	National Environmental Act
NEAP	National Environmental Action Plan
NESC	National Environmental Steering Committee
NGO	Non Governmental Organization
PAA	Project Approving Agency
SEDZ	South East Dry Zone
UNESCO	United Nations Educational, Scientific and Cultural Organization

PART 3 FOREST AND PROTECTED AREA MANAGEMENT

ADB	Asian Development Bank
CBO	Community Based Organization

CTB	Ceylon Electricity Board
DFO	Divisional Forest Officers
DWLC	Department of Wildlife Conservation
FAO	Food and Agriculture Organization
FD	Forest Department
FD	Forestry Department
FSMP	Forestry Sector Master Plan
IIMI	International Irrigation Management Institute
KDN	Kanneliya, Dediyagala and Nakiyadeniya
MALF	Ministry of Agriculture, Lands and Forestry
MIP&E	Ministry of Irrigation, Power and Energy
MPAHAPIPA	Ministry of Public Administration, Home Affairs, Plantation Industries, and Parliamentary Affairs
NFP	National Forest Policy
NGO	Non Governmental Organization
NWFP	Non-Wood Forest Product
NWP	National Wildlife Policy
OSF	Other State Forest
PFP	Participatory Forestry Project
SCOR	Shared Control of Natural Resources
SEDZ	South East Dry Zone
STC	State Timber Corporation
USAID	United States Agency for International Development

Abbreviation of Measures

Length		
mm	=	millimeter
m	=	meter
km	=	kilometer
Area		
ha	=	hectare
km^2	=	square kilometer
Volume		
l	=	lit = liter
m^3	=	cubic meter
MCM	=	Mm^3 = million cubic meter
Weight		
mg	=	milligram
g	=	gram
kg	=	kilogram
t	=	ton = MT = metric ton
Energy		
kcal	=	kilocalorie
TOE	=	tons of oil equivalent
kW	=	kilowatt
MW	=	megawatt
kWh	=	kilowatt-hour
Gwh	=	gigawatt-hour
MVA	=	megawolt-ampere
MMBFOE	=	million barrels of fuel oil equivalent
Others		
%	=	percent
°C	=	degree Celsius
cap	=	capita
mil.	=	million
no.	=	number

Land Husbandry

SECTOR REPORT 6 LAND AND ENVIRONMENT

PART I LAND HUSBANDRY

CHAPTER 1 POLICIES AND EXISTING CONDITIONS

1.1 Land Use Policies and Legal Status

Although a comprehensive land policy document is not available, there are many Acts and Ordinances that collectively shape the land policy in Sri Lanka (Table 1.1). Important land policy issues include land alienation by the state, land allocation to landless for agriculture, encroachment, regularization and land grants to different groups to attract investments, short term leasing of land and privatization of land management, reclamation of low lying land for infrastructure development, and lack of minimum control on private land property.

It is important to understand and distinguish the legal situation affecting state land from that affecting private land. State ownership has on balance, remained steady covering about 80 % of Sri Lanka's land area since the independence. The Government owns majority of the agricultural and irrigated land, and all forest lands.

State lands

The Land Development Ordinance (LDO) No. 19 issued in 1935 (revised in 1946, 1955, 1961, 1969) is the principal text covering the use of state lands. It established the Land Commissioner's Department to oversee the management and allocation of state lands, and outlined the conditions under which state land could be alienated to individuals. In conjunction with the Crown Lands Ordinance proclaimed in 1947, the LDO defines the system of permits and grants which regulate individuals' access to state lands. Persons wanting land must obtain it at a "Land Kacheri", a public meeting held periodically at the Office of the Local Government Agent (GA) to examine applications for land. Successful applicants receive a permit to occupy a piece of land, and have to make annual payments to the GA to renew the permit's validity. When the land is developed, the holder is eligible to receive a "Swarnabhoomi" grant, which is issued, with signature of the President, after the land is completely surveyed; the grant is registered with the GA.

The grant has been renamed as a "Jayaboami grant" since 1994, and amendments have been made to the LDO in 1993 and 1995 accordingly. Provisions have been made on alienated lands for inter-generation transfers and transfers among the peasant class with the approval of Divisional Secretaries. They are now mortgageable at the People's Bank and other commercial banks.

The LDO specifies unitary succession under either the permit or the grant. The surviving spouse inherits fully, and subsequently, the inheritance passes to the oldest member of a group of relatives as specified in the LDO. This specification is at variance with the legal and customary systems that prevail on private lands, all of which recognize the inheritance rights of all children, including daughters. The intent of the LDO was to prevent subdivision of holdings whose initial size was determined to be adequate to support a single nuclear family.

Private lands

Private ownership of land is subject to a system of deeds registration as specified in the Registration of Documents Ordinance issued in 1927. Under deeds registration, the registry merely serves as a repository of documents relating to transactions rather than as a locus of guarantee of ownership. Therefore, a cumbersome title search must be conducted each time the land is transferred, even mortgaged or (in theory) rented. Families tend to be large and there is an universal desire to be fair to all children. Further, there is no statutory restriction in force concerning minimum size of holdings. The result of all this is that the courts are clogged with land cases, and undivided co-ownership and rotational systems of "thattumaru" (a form of farmer rotation where co-owners take turns in cultivating a parcel of land such that each has access to it for one season) and "kattimaru" (co-owners farm a number of different plots for one season each, and then move on to another of the family's plots in the following season) prevail on private land in the small-holder sector.

1.2 Land Tenure Policy

Agricultural use

Land tenure policy and legislation in Sri Lanka emerged from the recommendation of the Land Commission of 1927 for preservation of small holder agriculture through holding Crown land for the whole community. Successive legislation, in the form of Paddy Lands Acts of 1953 and 1958 and subsequent amendments, regulated tenant farming activities, with a heavy bias in favor of permanency for the incumbent tenant and fixing the maximum rent in terms of volume of output (15 bushels of paddy per acre). The Land Reform Act of 1970, and the 1975 Amendment to this, nationalized large estates including tree crop plantations and regulated the size of paddy farms nationwide, alienating excesses to the public sector for redistribution to small-holders as tenants in perpetuity. This has left a ceiling on private owner operated paddy land of 10 ha, a ceiling of 2 ha on tenant farming and in public irrigation schemes, and a ceiling of 20 ha on other cropland use such as tea, rubber or coconut.

The Agricultural Productivity Law of 1972 provided for dispossession of agricultural lands not used productively. Subsequently, the Agrarian Services Act of 1979 restricted the use of paddy land to the production of paddy only, but limited dispossession to only voiding the owner's right to cultivate such lands. The 1991 Amendment to the Agrarian Services Act provided for appeal against dispossession orders and eliminated the restriction on the cropping of paddy land.

Thus, as seen above, the primary objective of land tenure policy has been to provide fixed land for landless farmers.

Forestry and wildlife use

The National Forestry Master Plan (NFMP) proposes re-classification of all forest and wildlife areas into four classes. Class I and Class II forests come under the protected area system and include conservation forest reserves, national parks, sanctuaries, and other reserves under the management of either the Forest Department (FD) or the Department of Wildlife Conservation (DWLC), i.e. owned and managed by the state. Class III multiple use forests which may include buffer zones around Class I and II forests will be jointly managed by the state and local people. Tenure mechanism would be in the form of management agreements between the local people and FD. Class IV production forests would include forest plantations and agro-forestry areas. Management of forest plantations would be devolved from the state to rural people, communities and national industries (whose shares are open to ownership by local people). Tenure mechanisms proposed would be in the form of timber sales and land leases. Production forest areas targeted for agro-forestry would be managed by local people with appropriate tenure mechanisms in the form of land leases. The NFMP does not elaborate on the lease period and terms/ conditions of the proposed tenure mechanisms. More details are given in Part 3 of this sector report.

Existing management agreements between local people and FD in some social forestry projects in Southern Area are very restrictive. They are leased for a 25 year period after which they may be renewed annually. The land under the lease is not transferable and also cannot be used as a collateral for obtaining loans for land cultivation or improvement works.

1.3 Institutional Responsibilities

Implementation of land use policies and governmental responsibilities for management and development of state lands are very centralized and highly fragmented. Custody of state land, traditionally with the Land Commissioner, has been given to a large number of private and

public organizations, including ministries, departments and corporations. None has overall authority over land use decisions nor powers to enforce conservation measures.

The Report of the Land Commission (1990) stated the following.

(1) The long standing authority of the Land Commissioner in administering and allocating state land has been eroded by "increasing political interference in the selection of allotees for state land".

(2) Devolution of land and land settlement matters to the provinces under the 13th Amendment creates "an urgent need to develop a comprehensive land administrative system" based on sound scientific policy guidance that can be administered by the provinces.

The Land Use Policy and Planning Division (LUPPD) with district offices in Southern Area, the Survey Department, the Land Use Division of the Irrigation Department, the Forest Department and the Department of Wildlife Conservation can be identified as some of the key institutions in charge of land use mapping, suitability assessment and planning activities.

1.4 Existing Land Use

The land use maps at scale 1:100,000, prepared by the Survey Department from 1981 to 1984 for Southern Area districts have been digitized and updated using 1995 Landsat TM imagery and digital data using computer classification methods supported by limited field truth verification. Table 1.2 and Figure 1.1 present results.

Galle and Matara districts

Galle and Matara districts both being in the wet zone show very similar land utilization patterns and very little change since 1984. About 80% of the total land area in both districts is under agricultural use. About 14% of the total area in these districts is forested including dense and open forests and forest plantations. Homesteads (defined as "family residential units surrounded by garden and open space" cultivated with fruit trees, spices, vegetables, and small holdings of coconut, rubber, or tea) constitute 28 % of the total area of Galle and Matara districts respectively. Area under paddy cultivation constitutes 17% and 14 % of the total area of Galle and Matara districts respectively. Among the plantation crops, tea (9.6%), rubber (9.1%), and cinnamon (4.1%) are cultivated widely in Galle district. In Matara, 15 %, 5 % and 4.1% of the total area of the district is used for cultivation of tea, rubber and coconut respectively.

Some special aspects concerning land use in Galle district are as follows.

(1) Built-up areas along the coastal belt are mostly tourist complexes.

(2) Homesteads among coconut plantations, mainly along coastal belt of the district include coconut trees mixed with fruit and other trees. Homesteads among tea and rubber plantations include mixed tree crops with tea/rubber trees.

(3) Tea and rubber cultivation in the district consists mostly of small holdings (units of less than 20 ha managed by individual owners).

(4) Tea and rubber mixed with other tree crops like banana, jack, coconut and cinnamon are mapped as mixed tree and other perennial crops and occur mainly in Bentota Wallallawilli Korale South, Talpe Pattuwa South and Ganga Bada Pattuwa North AGA divisions.

(5) Some paddy fields in the coastal area of the district can only be cultivated in exceptionally dry years when excess water can be drained.

Some special aspects of land use in Matara district are as follows.

(i) Two main land form units dominate in Matara district influencing land use and agriculture of the region. In the hill country or highland in the north, forests and tea are predominant, while in the hilly lowland in the south, rubber, cinnamon, and coconut cultivation are the major land use types.

(ii) Some of the rubber plantations are mixed with cinnamon.

Hambantota district

In Hambantota district 60% of the total area is classified under agricultural land use while 18% of the total area is classified as forest lands and 13.6% as grasslands/shrublands. Hambantota comes under the dry and intermediate zones where rainfall is a limiting factor. This is reflected in the agricultural land use pattern with homesteads (14.1%), rainfed paddy (16.8 %) and sparsely used cropland (25.2%) constituting large portions of the agricultural land use. Plantation crop cultivation is negligible. Sparsely used cropland refers to chena (shifting cultivation), recently abandoned chena, sparsely used rainfed cropland, neglected or abandoned tea, rubber and coconut lands and land under development.

Some important aspects concerning Hambantota district land use are as follows.

(1) The important agro-ecological boundary between the intermediate zone in the west and the dry zone in the east, leading from Tangalle in a northerly line is revealed by remarkable differences in the land use pattern. From north to south the dry zone in the eastern 80% of the district tends to become dryer, thus creating a semi-arid area in the south along the coast.

(2) The largest irrigation project in Southern province, the Lunugamwehera scheme, falls mainly within Tissamaharama AGA division. Parallel with the commissioning of the Lunugamvehera reservoir in early 1986, major transformations in land use have taken place like constructions of new settlements and roads, and establishment of new paddy land at the expense of former scrub and chena land.

(3) Associated non-agricultural areas along the coastline east of Hambantota are salterns.

(4) The large forest area in the east of the district are largely protected being part of the Yala National Park.

Moneragala (five divisions) and Ampara (Lahugala division)

The five divisions of Moneragala district within Southern Area had about 46% and 44% of their total area under agricultural and forest lands respectively. Large part of the agricultural lands were classified as sparsely used cropland which included chena cultivation areas, recently abandoned chena and sparsely used rainfed cropland (permanent dry cropping). The land use in the five divisions of Moneragala district within Southern Area are distinctly different from other districts/divisions in the southeast dry zone (SEDZ) in that rainfed paddy cultivation area is relatively small (only 2.6% of the total area) and crop diversification especially into sugarcane cultivation commenced in 1986 is well established by 1995 with Pelwatta and Sevanagala sugar plantations. Another important characteristic is the relatively low population in the agricultural areas.

Table 1.1. Legislation Affecting Land Tenure

Legislation	Main Contents Related to Tenure
Crown Lands (Encroachment) Ordinance 1840	- Crown has right to take over uncultivated land - burden of proof on claimant; encroachers can be ejected
Registration of Documents Ordinance 1927	- governs current system of deeds registration
Land Settlement Ordinance 1931	- settlement means that there is a distinction in tenure between public and private land
Irrigation Ordinance 1946	- assigns responsibility for operation and maintenance of dry zone settlement schemes
Land Development Ordinance 1935	- establishes Land Commissioner's Department - assigns responsibility for mapping state lands - permits alienation of Crown lands at Land Kacheri - establishes permit/grant system - specifies succession rules - codifies eviction procedures
Crown Land Ordinance 1947	- specifies procedures for grants and leases of state lands - specifies procedures to vest land in other government agencies - specifies procedures to vest land in village committees - establishes principle of reservations (occupancy prohibited, e.g. watersheds)
Paddy Lands Act 1958	- replaced by Agricultural Lands Law 1973 - protects tenant's rights on paddy lands
Land Reform Law 1972	- establishes Land Reform Commission (LRC) - imposes ceiling on agricultural land holdings; LRC controls land in excess of ceiling - only applies to individuals, families and private (unincorporated) companies - specifies procedures for alienation from LRC to people - authorizes compensation for LRC takeover of land
Agricultural Productivity Law 1972	- requires best use of land (private or state) - establishes Agricultural Productivity Committee - provides for dispossession in case of suboptimal land use
Sale of State Lands Law 1973	- sale (freehold) to allottees in Colonization and Village Expansion Schemes - restriction on sale, fragmentation, disposition and succession as in LDO
Agricultural Lands Law 1973	- replaced Paddy Lands Act - fixes maximum rents (15 bu/acre, 1/4 of paddy yield, or "custom") - establishes Cultivation Committees - increases tenants' security of access
Land Reform (Amendment) Law 1975	- extends Land Reform Law to public companies (corporations) - retains 50-acre ceiling on land ownership - exempts religious and service land - authorizes compensation, without specific details
Agrarian Services Law 1979	- replaces Agricultural Lands Law and Agricultural Productivity Law - limited to paddy lands and adjacent lands (not, e.g., chena land) - regulates rents as did Agricultural Lands Law
Land Grants (Special Provisions) Law 1979	- permits grants of LRC land to landless smallholders - allows clear title to be given, except for mineral rights and restrictions on transfer
Thirteenth Amendment to the Constitution (1991)	- land tenure is considered to be under the jurisdiction of Provincial Councils, except for questions of inter-provincial scale

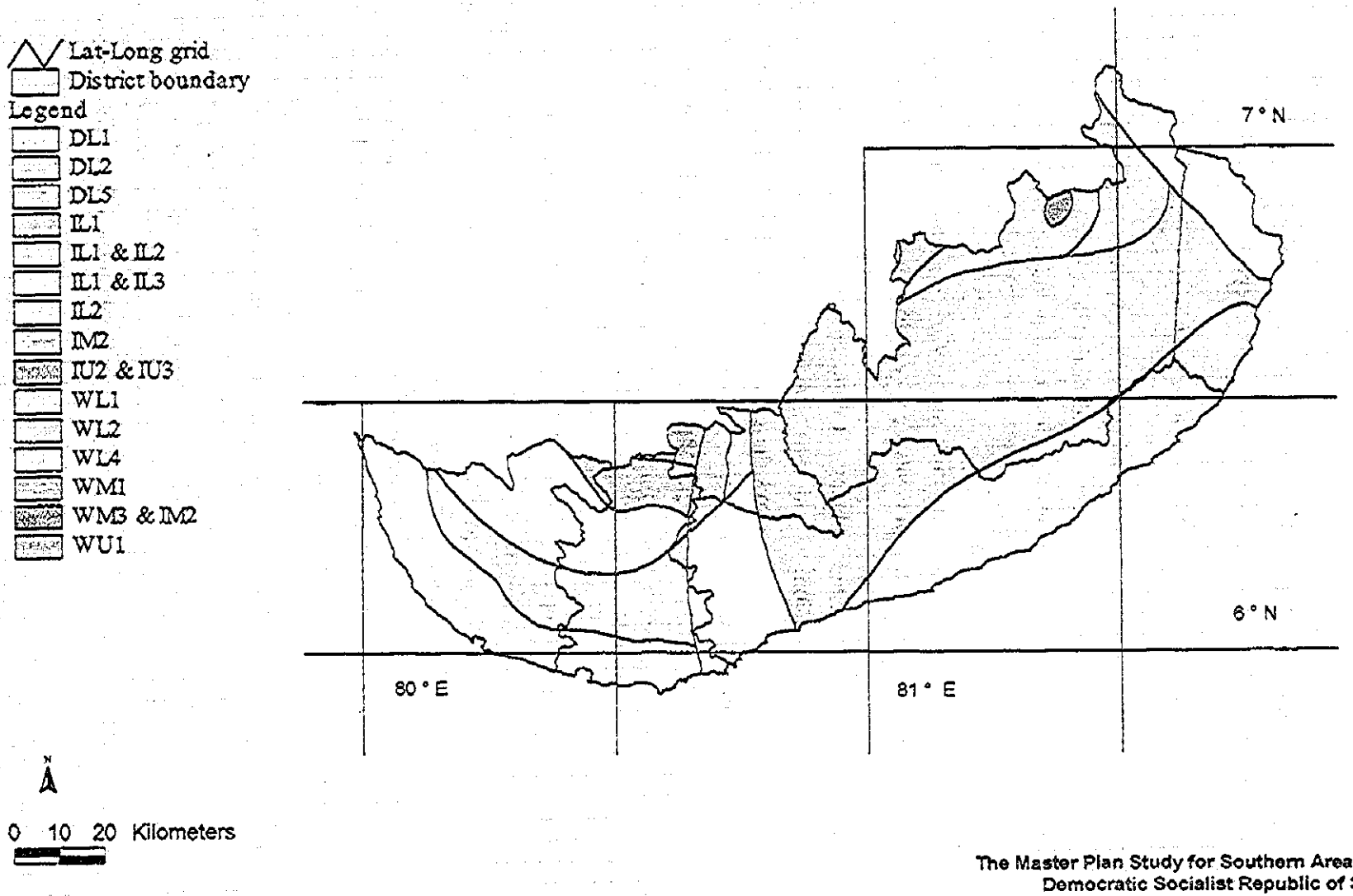
Table 1.2 Existing Land Use (1995)

District	Galle		Matara		Hambantota		Ratnapura (Embilipitiya & Kolonna DS)		Ampara (Lahugala)		Moneragala		Southern Area	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
1. Urban Land	719	0.45	584	0.45	1,047	0.39	55	0.10	0	0.00	311	0.04	2,716	0.25
2. Homesteads	45,085	28.19	37,144	28.63	37,307	14.07	14,392	25.20	2,464	2.90	25,496	6.30	161,888	14.74
3. Trees & Other Perennial Crops														
Tea	15,302	9.57	19,445	14.99	74	0.03	1,421	2.49	0	0.00	39	0.00	36,281	3.30
Rubber	14,515	9.07	6,426	4.95	604	0.23	401	0.70	0	0.00	2,262	0.47	24,208	2.20
Coconut	2,367	1.48	5,289	4.08	9,153	3.45	122	0.21	0	0.00	118	0.09	17,049	1.55
Mixed	3,068	1.92	3,747	2.89	943	0.36	71	0.12	0	0.00	377	0.00	8,206	0.75
Cinnamon	6,534	4.09	2,646	2.04	0	0.00	0	0.00	0	0.00	0	0.00	9,180	0.84
4. Crop Land														
Paddy	27,156	16.98	18,189	14.02	44,663	16.84	6,674	11.69	1,402	1.65	14,576	3.60	112,660	10.26
Others including sparesely used land	16,828	10.52	10,760	8.29	66,701	25.15	26,976	47.23	4,958	5.84	154,212	38.50	280,435	25.54
5. Forest - Dense	18,960	11.85	16,315	12.57	11,323	4.27	2,374	4.16	58,129	68.47	142,589	36.70	249,690	22.74
- Open	2,563	1.60	2,841	2.19	35,969	13.56	624	1.09	8,949	10.54	17,920	5.70	68,866	6.27
Plantation	224	0.14	455	0.35	411	0.15	593	1.04	526	0.62	4,130	1.50	6,339	0.58
6. Scrubland & Grassland	1,923	1.20	3,126	2.41	35,967	13.56	1,328	2.33	3,794	4.47	24,463	6.60	70,601	6.43
7. Wet Land	1,286	0.80	1,073	0.83	1,058	0.40	0	0.00	42	0.05	830	0.20	4,289	0.39
8. Water	3,047	1.91	1,484	1.14	16,565	6.25	1,986	3.48	3,605	4.25	10,222	1.80	36,909	3.36
9. Barren Land	370	0.23	222	0.17	3,424	1.29	94	0.16	1,027	1.21	3,506	0.90	8,643	0.79
TOTAL	159,947	100.00	129,746	100.00	265,209	100.00	57,111	100.00	84,896	100.00	401,051	100.00	1,097,960	100.00

Source: JICA Study Team (updating of 1981-84 land use maps with 1995 landsat TM satellite image interpretation)

*Moneragala : Buttala, Kataragama, Siyambalanduwa, Thanamalwila and Wellawaya DS areas

Figure 1.1 Agro-Ecological Zones in Southern Area



Source : Atlas by Survey Dept.

The Master Plan Study for Southern Area Development of Democratic Socialist Republic of Sri Lanka

Japan International Cooperation Agency

CHAPTER 2 PROBLEMS AND CONSTRAINTS

Various land degradation problems, both natural and manmade, can be identified in Southern Area. Table 2.1 lists the visible symptoms of land use problems and their underlying causes for Southern Area. Some specific issues are discussed in more detail in the following sections and in the other parts of this sector report.

2.1 Constraints on Agricultural Land Use

A combination of factors namely, land policy, tenure, ownership and transfer restrictions, small farm size, absence of an active land market and dominance of paddy in the non-plantation sector, act as constraints to efficient and productive agricultural land use. Main points are summarized.

(1) The Government owns or controls majority of agricultural and irrigated lands. LDO permits and Swarnabhoomi grants are very restrictive and cannot be mortgaged.

(2) Farm size is small and declining. Continued population pressure with no significant rural-urban migration, varying legislative codes, multiple user and inheritance rights, and protracted legal procedures, have all resulted in widespread informal multiple co-ownership and further fragmentation in privately owned land. Currently, 72% of farms in Southern Area are 1 ha or smaller. Despite legislative prohibition, the same forces have also led to informal fragmentation in state owned lands (irrigated settlements).

(3) Lack of a land market constrains long term agricultural sector performance. State lands are in effect only for lease; inter-generation transfers are permitted but not sale or sub-lease. In the absence of a land market, irrigation scheme settlers wishing to quit agriculture face a choice of abandoning a valuable farm or entering the uncertain informal market. Private sector land sales, the only ones permitted by law, are very few, as disputed titles make the transactions very difficult. Records show an extremely low turnover rate of private land.

(4) Cropping pattern is dominated by paddy in the non-plantation sector. Small farmers continue to grow paddy - a low valued commodity. Faced with the inability to sell land and leave agriculture or expand farm size and specialize in agriculture, the combination of paddy production and off-farm employment provides the common means for income earning. Labor force data and sample village surveys show that on

the average, farmers spend considerable time working off-farm, earning as much as 40% of family income from this.

(5) The 1972 Land Reform Law which nationalized large plantations adversely affected tea and rubber production as can be seen clearly up to 1984 and beyond. Businessmen who had investible resources found other investments like tourism and gem trade more attractive, mainly because of foreign exchange duty free entitlements, tax holidays and other concessions given to them. Several large rubber plantations in Moneragala district have been abandoned. The private small-holder plantation sector, with holdings less than 20 ha after the 1972 Land Reform Law, dominate in Galle and Matara districts. Here, the average yields of tea have been higher than in state plantations. Tea growers in these low country districts have had benefits of fertilizer as credit from government organizations, private factories, higher prices and higher proportions of cloned tea.

2.2 Land Problems Associated with Water Management

2.2.1 Nilwala Ganga case

The Nilwala Ganga Flood Protection and Reclamation Scheme, (NGFP&RS) was designed primarily with the objectives of providing flood protection to the town of Matara, important major and minor roads and property, and protecting 5,270 ha of rice lands on either side of the river in the coastal plain from floods and improving drainage. The latter was expected to reduce cultivation risks there by increasing rice production, ensuring stable farmer income and employment opportunities.

No provision was made in the scheme design for irrigation during drought periods or for developing the required agricultural technology. During droughts, the sharp lowering of the water table, exacerbated by excessive drainage, resulted in field drying and development of acid sulphate and saline conditions. Large extents of previously productive rice lands now give drastically reduced yields or have been abandoned. Thus although the project has realized the first objective of protecting Matara town and surrounding areas from floods, it has created new problems in the low land coastal rice cultivation areas. Major problems of rice cultivation prior to the NGFP&RS were (i) in wet weather, frequent flooding and water-logging; and (ii) during dry weather, coastal salinity and drought. After the NGFP&RS, drought development of transitory acid sulphate conditions and inland salinity have emerged as main impediments for rice production.

2.2.2 Uda Walawe irrigation and settlement project

In the Uda Walawe irrigation and settlement project, the following adverse effects have developed.

(1) The initially developed irrigated lands under the right bank (RB) canal system were subsequently found to have well drained soil with an unacceptable water use rate of about 18 acre feet per acre per annum for rice farming (two crops per year). Soil types within the irrigated command area were not studied in detail prior to implementation.

(2) The excessive return water from irrigated lands under the RB canal system has caused waterlogging or flooding in existing paddy lands in the lower Kucchigal Aru basin. The water empties into the ocean without being used.

(3) The excessive use of water in the irrigated lands under the RB canal system has made the Uda Walawe irrigation and settlement project into a water short system; consequently, the left bank (LB) canal system has to be terminated at Suriya Wewa, reducing drastically the potential irrigation command area of the main reservoir.

2.2.3 Lunugamwehera irrigation and settlement project

The Lunugamvehera irrigation and settlement project, alternatively called the Kirindi Oya irrigation and settlement project (KOISP), suffers from water shortage, and difficulties in implementing crop diversification, and management of livestock grazing area.

Reasons for water shortage include the following.

(1) The large evaporation loss from the extensive waterspread of the Lunugamvehera reservoir was not taken into account in planning studies.

(2) The location of the Lunugamvehera reservoir only two miles upstream of the existing Ellagala Anicut, has prevented the return water from the irrigated lands under the RB and LB canal systems of the Lunugamvehera reservoir being used for a second time to irrigate, on a free basis, the command area under the Ellagala Anicut. This return water empties into the ocean without being used.

(3) Soil types within the irrigated command area were not studied in detail in the first instance. This resulted in severe unexpected difficulties after settlers commenced paddy cultivation on well drained soil resulting in excessive water use. Thus the irrigation command area under the reservoir was considerably reduced.

Several reasons can be identified for failure in implementation in crop diversification as follows.

(i) Priority in access to water from the Lunugamvehera reservoir has been enjoyed by farmers of the Old Ellagala System (OES), while new settlers have been disadvantaged. The old settlers in the OES system for a number of reasons are adamant on growing rice during both Maha and Yala seasons and vehemently oppose crop diversification being promoted. Reasons for continued rice cultivation are: 1) fields of old settlers are more suitable for rice cultivation; 2) rice has a ready market; 3) rice is the staple food of Sri Lanka and growing it is a very personal and cultural tradition; 4) rice can be stored and sold at any time; 5) the know-how is available for rice cultivation; and 6) off farm work pays higher wages than the hourly return to family labor.

Frustration develops among new settlers when they have to watch helplessly while OES are given priority for rice cultivation during both seasons, although they have equal rights for water, leading to social unrest. This has become an obstacle to the process of promoting other field crops in paddy fields. Further, this aggravates the water shortages for both OES and the newly settled area.

(ii) Decisions on cultivation plans were made hastily, depending on the prevailing water situation in the reservoir. This did not allow sufficient time for quality seed of high productivity crops such as chilies and onions to be distributed. In such a situation, farmers use their own seeds which are inferior, resulting in lower yields and net returns.

(iii) Damage done by large herds of cattle roaming freely in cultivated areas has been a severe setback for OFC growers. The problem is acute as the OFC growers are concentrated in isolated areas under the 'Bethma' system and the extents cultivated are small, so that the slightest damage is considerable in terms of cash income.

(iv) Though not reported yet, high rate of evaporation over the rainfall, and saline drift due to the proximity to the sea coast, may act as limiting factors for growing OFCs. Most OFCs are very sensitive to high soil salinity. Accumulation of salt can be prevented by applying excessive irrigation water to leach them out from the root zone, but the scarcity of water does not allow such a course.

Problems concerning livestock grazing area are represented by the following.

1) In Hambantota district where a relatively thriving livestock industry is seen, lack of sufficient grazing land for cattle and buffalo often results in animal intrusion into chena cultivation land, paddy field and home gardens.

2) The Kirindi Oya irrigation and resettlement project cleared larger extents of forest lands and leveled hundreds of small tanks to develop land for cultivation. Apart from these project activities, land encroachment for chena cultivation and their land clearing activities have resulted in siltation of tanks. The water holding capacity of most of these tanks has declined and they dry out rapidly during the dry season. Animals have to walk long distances in search of water and along with their poor feeding, they lose weight and their milk production drops.

3) Another problem that emerged with the implementation of the KOISP resulted from the new possibility of cultivation during the Yala season. This drastically reduces the fallow period during which animals used to feed on stubble left in the field.

4) Among different types of livestock management systems seen in the Kirindi Oya area, village based and jungle based systems of management would disappear in the long run for these systems entail negative net profits. Migrating and traditional systems would remain but their sustenance depends on the rate of deforestation for other development activities and the rate of encroachment of jungle land by chena cultivators. A most important strategy in helping the livestock industry in the KOISP area is to allocate grazing land for the herdsmen in the three Cattle Owners Associations.

2.3 Poor Extension Services

2.3.1 Agricultural extension

A major constraint to agricultural development in Southern Area has been farmers' inability to respond to signals of an increasingly free market. Their access to available technology is severely hampered by the present state of extension service. When costs of operating the extension service became prohibitively high in the mid-1980s, the Government made drastic cuts in operating expenditures and later in staff. In 1987, the extension service was disrupted again by the devolution of authority to the province. In 1988-89 some 2,400 village level extension agents (Krushikarma Viyaptha Sevaka or KVS) were transferred to the Janasaviya (poverty alleviation) program to work as Grama Niladaris (GN). In addition, the extension service never really adapted its "single crop" (paddy) focus to the

"whole farm" approach needed to address other crops, especially after paddy yields leveled off. Problems related to extension services are summarized.

(1) Coordination is lacking among separate extension services, then programs, and staff at all levels.

(2) The extension services offered are largely based on "commodities" rather than "farming systems" in each area.

(3) The planning of extension programs is "top down" on the assumption that results of research on improved production technology are appropriate and beneficial to farmers, without adequately taking into account the cost benefit implications, the existing knowledge and skills of farmers, or the need to involve them in planning and decision making in relation to their real demands and problems. The result is the farmers are inadequately advised by a multiplicity of agents, with separate messages or technology that is often unrelated to their farming systems causing confusion and undermining credibility of extension.

2.3.2 Forestry extension

Forestry extension started formally in 1982 with the National Forestry Extensions Program (NFEP) and has gone through several transitions since then. These transitions reflect the continuing search for a "breakthrough" to solve the problems of deforestation, lack of cooperation of local people in official forestry programs, and general decline of the forestry sector. A number of constraints have hampered forestry extension services development as summarized below.

(1) There has been a weak political and institutional will to devolve the management of forests, or of state land for forestry purposes, to the local people.

(2) There is a proliferation of extension agencies, but forestry has rarely been included in their coordinating bodies, so that it has not been given adequate attention in actual extension work.

(3) Extension objectives are not always directed to the needs of extension and the preparation of extension packages does not always take full advantage of research results.

(4) Institutional resources are inadequate, both in terms of staff and facilities. The extension staff lack motivation. Scarce resources are dissipated instead of being put to work where they are most effective.

2.4 Limitations in Available Resources Information

The National Atlas of Sri Lanka which was the result of four years of sustained efforts from January 1985 to December 1988 presents the first concerted effort in preparing an update comprehensive resources database for Sri Lanka for use at national planning levels. Other than this, there has been no effort in developing a more detailed resources database for different regions other than in the Mahaweli Development Program Area. The Southern Area development master planning is in fact the first comprehensive integrated regional planning study in the Country. What is seen widely in Southern Area is a variety of projects and programs implemented in the past. They are typically characterized by the following.

(1) They cover smaller areas or districts;

(2) They generally use the only available national level resource data/information to carry out planning at the district or division level;

(3) They have hardly even updated any resource data information in the past two decades; and

(4) They also have no regular mechanism of regular updating of resource information.

For example, land use was last comprehensively mapped for the Southern Area districts in 1981-84. Updating and preparation of these maps have yet to be done completely by the Survey Department even in 1996. LUPPD has prepared indicative land use maps to cover three quarters of Galle and Matara districts and a few divisions in Hambantota district.

Soil information is central to land capability evaluation. The soil map of Sri Lanka available at scale 1:500,000 is good for national level planning, but has severe limitations when used as such for regional or district level planning as several major soil groups are grouped together and need to be distinguished for district or division level planning. Although, the base maps at scale 1:63,360 on which the major soil groups were originally mapped are available, no effort whatsoever has gone into further delineating details of soil groups by a comprehensive soil survey and mapping exercise in the Southern Area districts since the original soil map of Sri Lanka was prepared three decades ago.

Table 2.1 Land Use Problems : Symptoms and Causes

SYMPTOMS OF LAND USE PROBLEMS

Migration from wet zone to dry zone (agricultural land pressure)
Low rural incomes
Lack of employment opportunities
Poor health and nutrition
Inadequate subsistence production
Shortage of fuel and timber
Low unreliable crop yields
Low farm inputs
Lack of access to credit
Encroachment on forest and wildlife reserves
Conflicts among farming, livestock and wildlife
Visible land degradation e.g. eroded cropland, silted bottom lands, degradation of woodlands, salinity in *irrigation schemes, flooding*
Social dis-enchantment and rural unrest

UNDERLYING CAUSES RELATED TO LAND USE

Social problems
Population pressure on land resources
Unequal distribution of land, capital and opportunities
Restrictions on land tenure and land ownership
Cultivation - focus on paddy

Natural hazards and limitations
Inadequate water supply and distribution
Irregular relief
Drought prone soils (dry zone)
Poor land use potential with major physical limitations

Mismatch between land use and land suitability
Inadequate water control
Clearance of forests
Inadequate soil conservation practices
Inadequate periods of bush fallow in slash and burn (chena) cultivation

Related rural planning problems
Inadequate power
Lack of fertilizer and pesticides
Lack of markets, unsatisfactory price structure
Lack of finance
Inadequacy / poor quality of existing transportation infrastructure
Lack and/or inappropriateness of technical support and extension services
Limitation in available information on resources
Lack of 'bottom up' and participatory approaches

CHAPTER 3 LAND USE SUITABILITY

3.1 Land Characteristics

3.1.1 Topography

The soil map of Sri Lanka classifies the fourteen major soil groups into four topographic classes:

(1) flat to undulating (0 to 8 % slope),
(2) rolling to hilly (8 to 30 % slope),
(3) hilly and mountainous (30 to 60 % slope), and
(4) extremely steep (over 60 % slope).

3.1.2 Agro-ecological zones

Three major agro-ecological zones and 24 sub-zones are identified in the National Atlas of Sri Lanka on the basis of the amount and distribution of rainfall, elevation and soil groups (Figure 3.1). The three major agro-ecological zones are the wet zone, the intermediate zone and the dry zone. The wet zone demarcates the area which receives moderately high mean annual rainfall of over 2500 mm. The southwest portion of Southern Area largely coinciding Galle and Matara districts comes in the wet zone. In the wet zone, there is no pronounced dry period between the two monsoon periods. The intermediate zone demarcates the area which receives a mean annual rainfall between 1750 mm and 2500 mm with or without rain shadow effect. Parts of Ratnapura district and western part of Hambantota districts come under this zone. The dry zone is the area which receives a mean annual rainfall of less than 1750 mm with a very pronounced dry season from May to September which is agriculturally known as the Yala season in Sri Lanka. The southeast portion of Southern Area comprising eastern part of Hambantota district, and portions of Moneragala and Ampara districts within Southern Area come under the dry zone.

The differentiation of the wet zone into its distinctive sub-agro-ecological zones is governed primarily by rainfall and elevation. In the dry zone on the other hand, it is the nature of the soil that primarily determines the identity of individual agro-ecological sub-zones. In the dry zone, the northeast monsoon period from October to December is the major rainfall season and agriculturally known as the Maha season.

3.1.3 Soil

Soil map of Sri Lanka at 1:500,000 scale compiled by the soil survey staff of the Land Use Division of the Irrigation Department is the only comprehensive soil information available for the entire Southern Area. This map shows the spatial distribution of more important soil groups and sub-groups.

Soil map units are classified in terms of the three major agro-ecological zones. The main difference between soil types of the wet and the dry zones is due to perennial rainfall and resultant leaching that go on in the former, and seasonal drought of the latter. In the dry zone, leaching is intermittent; although soil salts are washed away or carried deep into the soil in the wet season, in the dry season salts and plant nutrients ascend through capillary action to accumulate in upper layers of the soil. Thus, wet zone soil is usually poorer and more acidic because of continual leaching, whereas dry zone soil whether sedentary or depositional, is more fertile. In the uplands of the wet and intermediate zones, lower temperatures result in slower weathering and slower deposition of plant remains, accentuating soil acidity. Sedentary soil of the wet zone is dominated by red and yellow podzolic types, while in the dry zone, reddish brown earths predominate. Several other soil types or associations of soil are also significant (Table 3.1 and Figure 3.2).

3.2 Land Use Potentials

3.2.1 Forestry and wildlife use

The NFMP proposes re-classification of state lands under the management of FD and DWLC into four classes for future use (Section 1.2). These classes are explained in Part 3 of this sector report.

Figure 3.3 and Table 3.2 present forestry and wildlife land use potentials for Southern Area. About 19.5 % (215,000 ha) of Southern Area is classified under protected forest lands for forestry and wildlife conservation purposes. Moneragala (100,000 ha; 24.7 %), Hambantota (60,680 ha; 23.1 %) and Ampara (27,700 ha; 33.1 %) districts have large areas under this category. Production forest lands constitute 6.9 % (75,400 ha) of Southern Area with large areas in Ampara (33,390 ha; 40%) and Matara (12,300 ha; 9.4 %) districts.

3.2.2 Agricultural use

For agricultural purposes soil capability or suitability, closely related to the landform they occur on, may be assessed by considering the number of the limitations they suffer from

(Tables 3.3). Areas with the highest intrinsic agricultural suitability are found in the dry zone lowlands. However, it is also clear that much dry zone land is poorly fitted for agricultural use due to rainfall limitations. The best dry zone soil, the sedentary reddish brown earths, lie above levels irrigated by conventional gravity methods. Inexpensive, assured water supply and soil conservation practices are prerequisites for their successful utilization.

In order to facilitate land use analysis, the soil map units which integrate information on soil type, terrain and broad agro-ecological zone, were evaluated and classified for their suitability for various agricultural crop group categories. Suitability ratings were as defined in Table 3.4. Results are presented in Table 3.5. The following need to be noted.

(1) Prime agricultural lands have a suitability rating of 1 or 2.

(2) Marginal agricultural lands have a suitability rating of 3 or 4.

(3) Lands unsuitable for agriculture have a suitability rating of 5 or 6. These would also include existing water bodies, miscellaneous lands and mountain areas.

(4) Lowlands are soil map units having the following terrain types: flat terrain, undulating terrain, undulating and rolling terrain, and rolling terrain. These are areas that in general have slopes varying between 0 and 10%, or are areas adjacent to the sea and river beds having a maximum elevation of about 60 m.

(5) Uplands are soil map units with the terrain classes hilly and rolling (slope between 4 and 30%, or rolling, hilly and steep terrain (slope between 30 and 60%). The elevation varies between 60 and 300 m.

(6) Mountain areas have slopes greater than 60% or have elevations greater than 300 m.

Figure 3.3 and Table 3.2 also present the agricultural land use potential of Southern Area.

Prime agricultural lowlands in Galle and Matara districts have limitations for integrated crop livestock development due to the very high rainfall and no dry period. These together constitute only 1.1 % (12,000 ha) of Southern Area. Prime agricultural lowlands in Hambantota, Ratnapura, Moneragala and Ampara districts within Southern Area are suitable for agricultural and pasture use (crop livestock integrated system). These constitute about 7.1 % (78,200 ha) of Southern Area with large areas in Hambantota (29,000 ha; 11.1 %), Moneragala (41,600 ha; 10.3 %) and Ampara (5,900 ha; 7.1 %) districts.

Prime agricultural uplands found in the southeast dry zone constitute a quarter of Southern Area (271,000 ha). Hambantota (80,600 ha), Moneragala (163,000 ha; 40.2 %) and Ratnapura (19,300 ha; 34 %) have significant areas under this category. These lands have significant potential for exploitation if water resources can be developed for suitable irrigation schemes.

Marginal agricultural lowlands constitute about 1.4 % (15,600 ha) of Southern Area and are low lying coastal areas along Galle, Matara and western part of Hambantota districts.

Marginal agricultural uplands constitute 29 % (320,000 ha) of Southern Area and are primarily in the wet and the intermediate zones. These large areas in Galle (121,000 ha; 75.5 %), Matara (102,000 ha; 78.2 %) and Hambantota (54,580 ha; 20.8 %) districts are being used intensively for cultivation of perennial crops. However, their intrinsic limitations should be recognized as significant yield and productivity increases are difficult without entailing higher input costs to overcome the limitations (mainly soil related).

3.2.3 Urban and industrial use

The following criteria were used to identify potential areas for urban and industrial use.

(1) Protected areas (Class I and II forests), water bodies and wetlands are excluded.

(2) Prime agricultural lands are excluded.

(3) All areas within 4 km of Class A roads or 2 km of Class B roads, or within 10 km of rank 1 urban centers, or 5 km of rank 2 urban centers are included.

Figure 3.4 presents the results. Prime agricultural lands in the dry zone region of Moneragala and Hambantota districts are also potential lands as water availability for agriculture is a major limitation here.

3.2.4 Mineral resource use

A study has been carried out in 1995-96 by the Geological Survey and Mines Bureau (GSMB) on potential mineral areas in Southern Area, and mineral resources inventories have been prepared. These identify locations of specific minerals and qualitatively assess their potential for exploitation (Figure 3.5). They are based on a literature survey of all previous exploratory surveys and studies as well as surveys conducted by GSMB as part of the above mentioned study.

This information reveals that large quantities of hard rock suitable for road metal and building stone/ dimension stone are available in Southern Area. Clays suitable for brick, tile and pottery are also available in large quantities. Several ceramic grade kaolin deposits were identified around the Meetiyagoda area and it seems that there are sufficient quantities to meet with future demands. Vein quartz deposits occurring at several locations may also be of industrial use. Promising gem yields have also been identified mainly in Moneragala, Ratnapura and Hambantota districts. These mineral occurrences can be exploited with manageable environmental impacts. Some inland occurrences of sea shells and coral limestone may be exploited under strict supervision. These have caused considerable damage to the coastal ecosystem in the past. Brick and tile clays are mainly exploited from paddy fields, tank beds and flood plains. Land use problems should be considered in excavation of clay from paddy fields. Some of the clay deposits may be excavated as tank deepening projects. However, such work needs to be undertaken in consultation with the irrigation authorities, as these tanks are intrinsically connected by a system of contour canals which constitute the ancient irrigation system of Southern Area.

Table 3.1 Distribution of Soil in Southern Area

	District		Galle		Matara		Hambantota		Ratnapura (Embilipitiya & Kolonna DS)		Ampara (Lahugala)		Monaragala		Study Area	
SOIL MAP NO.	SOIL TYPE	TERRAIN CLASS	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
	SOIL OF THE DRY ZONE AND SEMI-DRY INTERMEDIATE ZONE															
1	Reddish Brown Earths and Low Humic Gley Soil	U	0	0.00	0	0.00	21,752	8.29	19,679	34.59	19,850	23.72	171,598	42.31	232,879	21.16
2	Reddish Brown Earths and Solodized Solonetz	U	0	0.00	0	0.00	73,100	27.87	2,784	4.89	10,464	12.50	44,088	10.87	130,436	11.85
4	UReddish Brown Earths and Immature Brown Loams	R, H & S	0	0.00	1,960	1.50	29,879	11.39	13,180	23.16	0	0.00	16,730	4.12	61,749	5.61
6	Red Yellow Latosols	F to U	0	0.00	0	0.00	0	0.00	0	0.00	1,194	1.43	0	0.00	1,194	0.11
10	Alluvial Soils of variable Drainage and Terrain	F	0	0.00	813	0.62	44,076	16.80	1,638	2.88	17,551	20.97	54,507	13.44	118,585	10.77
11	Regosols on Recent Beach & Dune Sands	F	0	0.00	1,244	0.95	16,543	6.31	0	0.00	3,754	4.49	0	0.00	21,541	1.96
99	Reddish Brown Earths with Large amount of Gravel in Sub-Soil	U	0	0.00	0	0.00	36,888	14.06	0	0.00	3,438	4.11	2	0.00	40,328	3.66
	SOIL OF THE WET ZONE AND SEMI-WET INTERMEDIATE ZONE															
12	Red Yellow Podzolic Soils & Mountain Regosols	M	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	4,803	1.18	4,803	0.44
13	Red Yellow Podzolic Soil, steeply dissected	H & R	70,163	43.51	92,324	70.57	12,161	4.64	15,142	26.61	0	0.00	0	0.00	189,790	17.24
15	Red Yellow Podzolic (RYP) Soil with soft or hard laterite	R & U	44,280	27.46	13,081	10.00	0	0.00	0	0.00	0	0.00	0	0.00	57,361	5.21
17	RYP with semi-prominent A1 Horizon	H & R	11,344	7.03	5,900	4.51	0	0.00	2,028	3.56	0	0.00	0	0.00	19,272	1.75
18	Reddish Brown Latosolic Soil, steeply dissected	H & R	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
19	Immature Brown Loams, steeply dissected	H & R	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
20	Bog & Half Bog soil	F	22,619	14.03	7,799	5.96	0	0.00	0	0.00	0	0.00	0	0.00	30,418	2.76
22	Alluvial Soil of Variable Drainage and Terrain	F	7,671	4.76	5,018	3.84	0	0.00	0	0.00	0	0.00	0	0.00	12,689	1.15
23	Regosols on Recent Beach Sands	F	3,058	1.90	2,680	2.05	0	0.00	0	0.00	0	0.00	0	0.00	5,738	0.52
	MISCELLANEOUS LAND UNITS															
24	Rock Knob Plains and Eroded Lands	MI	0	0.00	0	0.00	20,330	7.75	0	0.00	27,430	32.78	77,890	19.20	125,650	11.42
25	Erosional Remnents	MI	0	0.00	0	0.00	3,041	1.16	1,594	2.80	0	0.00	27,741	6.84	32,376	2.94
26	Steep Rockland & Lithosols	MI	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
50	WATER BODIES	L	2,118	1.31	0	0.00	4,542	1.73	855	1.50	0	0.00	8,252	2.03	15,767	1.43
	TOTAL		161,253	100.00	130,819	100.00	262,312	100.00	56,900	100.00	83,681	100.00	405,611	100.00	1,100,576	100.00

UPLANDS
LOWLANDS
MOUNTAIN AREAS

TERRAIN CLASSES
U : UNDULATING
R: ROLLING
S : STEEP
F : FLAT
H : HILLY
M : MOUNTAIN
MI : MISCELLANEOUS

Source: Soil Map of Sri Lanka at Scale 1:500,000 as prepared by the Irrigation Department

Table 3.2 Potential Landuse of Southern Area

DISTRICT / Potential land use classes	Galle		Matara		Hambantota		Moneragala		Ratnapura		Ampara		Total	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
a Protected forest land	16,689	10.35	6,606	5.05	60,684	23.13	100,220	24.71	3,179	5.59	27,697	33.10	215,075	19.54
b Production forest land	10,483	6.50	12,296	9.40	13,394	5.11	3,091	0.76	2,759	4.85	33,388	39.90	75,411	6.85
c Prime agricultural lowlands (only agriculture)	7,128	4.42	4,879	3.73		0.00		0.00		0.00		0.00	12,007	1.09
d Prime agricultural lowlands (agriculture and pasture)	0	0.00	813	0.62	29,109	11.10	41,637	10.27	746	1.31	5,922	7.08	78,227	7.11
e Prime agricultural uplands	0	0.00	0	0.00	80,638	30.74	163,197	40.24	19,288	33.90	7,995	9.55	271,118	24.63
f Marginal agricultural lowlands	3,058	1.90	3,933	3.01	6,769	2.58		0.00		0.00	1,860	2.22	15,620	1.42
g Marginal agricultural uplands	121,777	75.52	102,301	78.20	54,580	20.81	12,504	3.08	28,872	50.74		0.00	320,034	29.08
h Unsuitable for agricultural use	2,118	1.31		0.00	17,138	6.53	84,959	20.95	2,055	3.61	6,819	8.15	113,089	10.28
Total	161,253	100.00	130,828	100.00	262,312	100.00	405,608	100.00	56,899	100.00	83,681	100.00	1,100,581	100.00

Source: JICA Study Team

Table 3.3(1/3) Soil Characteristics of Southern Area

Soil Unit No.	Soil Type & Terrain	Parent materials	Capa-bility class	Principal Limitation	Natural vegetation	Land use potential	Specific Management Requirement
1 2 3	Reddish Brown Earths & Low Humic Gley Soils; Undulating Terrain Reddish Brown Earths & solonetz; undulating terrain Reddish Brown Earths & Low Humic Gley Soils; Undulating Terrain	acid, intermediate and basic crystalline rocks of the Vijayan and Khondalite series	1	minor (some phosphorous deficiency)	Dry Zone mixed evergreen forest	forest, rainfed crops including vegetables, tobacco, cereals fruits; shifting cultivation	Supplemental irrigation at 1-2 week intervals (furrow, drip, sprinkler); good drainage facilities (main drains 2 meter deep); timing of tillage to moist conditions; soil conservation measures; nutrient supplementation by organics or inorganics
99	Reddish Brown earths with high amount of gravel in subsoil, undulating terrain	as above	4	gravel in sub-soil, ground water deficiency	as above	conservation, forestry, wildlife sanctuaries, shifting cultivation	
4	Reddish Brown Earths and immature Brown Loams; rolling, hilly and steep terrain	as above	3	steep slopes	as above in Dry Zone, once probably evergreen rainforest in Intermediate Zone	Forestry, rainfed vegetables, tobbaxo, maize	
*1, 3	Low Humic Gley Soils; Undulating Terrain	crystalline rocks	2	poor drainage, nutritional short-comings	Dry Zone mixed evergreen forest	paddy, pasture	Supplemental irrigation at weekly intervals (flooded basins); good drainage; nutrient supplementation
5	Non-Calcic Brown Soils on old alluvium and Solodized Solonetz, undulating terrain	acid crystalline rocks of the Vijayan series	2	poor structural stability of soils	as above	forest; diverse crops (except wet paddy) with erosion control; pasture; shifting cultivation	supplemental irrigation at weekly intervals (furrow, drip, sprinkler); good drainage facilities (main drains 2 meter deep); timing of tillage to moist conditions; soil conservation measures; nutrient supplementation by organics or inorganics
*5	Immature Brown Loams; rolling, hilly and steep terrain	gneisses and schists especially	4	shallow soils, steep slopes	evergreen forest	forestry; some medicinal herbs	soil conservation most important; steep slopes to be undisturbed because of landslide hazard; nutrient supplementation; irrigation if available and possible

Table 3.3(2/3) Soil Characteristics of Southern Area

*8	Solodized Solonetz, Solochaks and Soils on recent marine calcareous sediments; flat terrain	Colluvium, river alluvium, coastal alluvium (with salts)	5	acid soil, alkaline subsoil	salt tolerant grasses, thorny scrub, or dry grassland with bushes and low trees	pasture; wild life, paddy cultivation with chemical amendments and irrigation	reclamation by gypsum addition and flushing or repeated flushing by calcium rich irrigation water; supplemental irrigation at weekly interval (flooded basins); good drainage; nutrient supplementation, supplemental irrigation at weekly intervals (flooded basins); good drainage
*8	Solodized Solonetz, Solochaks and Soils on recent marine calcareous sediments; flat terrain	coastal alluvium (saline)	5	saline soil, high water table	salt tolerant plants	pasture & paddy after long term reclamation	nutrient supplementation; soil conservation measures
9	Grumsols; flat terrain	lacustrine clays	4	intractable, sticky racking clays; poor drainage	grassland & scrub; evergreen forest	paddy, vegetables, pulses; with drainage improvements and irrigation	
*8	Solodized Solonetz, Solochaks and Soils on recent marine calcareous sediments; flat terrain	reef nearshore & lagoonal sediments	5	saline soils	salt tolerant	recreational purposes after reclamation	
10	Alluvial soils of variable drainage and texture; flat terrain	terrace deposits	3	very rapidly draining	evergreen forest	forests, shifting cultivation, paddy, sugarcane, pasture, with irrigation	
10	Alluvial soils of variable drainage and texture; flat terrain	river alluvium of varying texture	1	minor problem associated with periodic flooding and drainage	grassland, gallery forests	forests, grasslands, grazing paddy, sugarcane, pasture, with irrigation	
6	Red-yellow Latosols; flat terrain	beach zone sands	4	very rapidly draining soils	evergreen forest	forest, shifting cultivation, wildlife reserves, cashewnuts chillies, citrus, onions, tobacco; if irrigation available	supplemental irrigation at weekly intervals (furrow, drip, sprinkler); soil conservation measures; nutrient supplementation by organics or inorganics (small doses at frequent intervals).
7	Calcic Red-Yellow Latosols; flat terrain	marine sands and silts	2	very rapidly draining	dry mixed forest thorny scrub	intensive cultivation of chillies, onions, tobacco, vegetables, fruits, with irrigation	
11	Regosols on recent beach and dune sands; flat terrain	beach and dune sands	3	very rapidly draining	littoral vegetation	palmyrah, coconut, cashewnuts, scrub jungle, parkland, tourism	

Table 3.3(3/3) Soil Characteristics of Southern Area

13 14	Red-Yellow Podzolic Soils steeply dissected RYP (strongly mottles subsoil) and Low humic Gley soils	weathered crystalline rocks	3 4	steep slopes, depletion of nutrients	lowland to montane evergreen rainforest	forestry; tea, coffee, cocoa, fruits, other tree crops, soil conservation essential	Supplemental irrigation at 1-2 week intervals (furrow, drip, sprinkler) good drainage facilities; nutrient supplementation by organics or inorganics
15	Red-Yellow Podzolic Soils with soft or hard laterite; rolling and undulating terrain	as above	3	hardpans or laterite near surface; depleted soils	evergreen rainforest	rubber, coconut, fruits, cahsewnuts, vegetables	
16 17	Red-Yellow Podzolic Soils with dark B horizon and Red-Yellow Podzolic Soils with prominent A1 horizon; hilly & rolling terrain	as above	3	soil acidity poor drainage	wet montane savannah and grassland	pasture, potatoes, soil essential; recreation, tourism	
18	Reddish Brown Latosolic Soils; steeply dissected, hilly and rolling terrain	intermediate basic crystalline rocks	2	steep lopes, erosion hazard	evergreen rainforest	tree crops, vines, pasture; erosion control required	Supplemental irrigation at 1-2 week intervals (furrow, drip, sprinkler) good drainage facilities; nutrient supplementation by organics or inorganics
19	Immanture Brown Loams; steeply dissected, hilly and rolling terrain	micaceous gneisses & schists	4	steep slopes, rapid draining shallow soils, erosion hazard	as above	pasture, shallow rooted crops; soil conservation measures necessary	
20	Bog and Half-bog Soils; flat terrain	organically enriched (15-30%) soils upon gley alluvium	4	poor drainage, soil acidity, salt water intrusion in places	swamp	poor paddy; vegetable cultivation with artificial drainage	controlled drainage; flood controls; salinity control; flushing out of acidity; liming to correct acidity; nutrient supplementation including zinc and copper; prevention of subsidence and oxidation, conservation
22	Alluvial Soils of variable drainage and texture; flat terrain	river allluvium	1	minor problems, flooding	galery forests	paddy, vegetables	supplemental irrigation at weekly intervals (flooded basins); good drainage; nutrient supplementation; flood control
21	Latosals and Regosols on old red and yellow sands; flat terrain	Pleistocene sandy raised beaches	3	very rapidly draining	once probably rain-forest	coconut, cinnamon, fruits	
23	Regosols on recent beach sands; flat terrain	Recent sandy raised beaches	3	as above	littoral vegetation	coconut, cashewnuts tourism	supplemental irrigation at weekly intervals (drip, sprinkler); soil conservation measures; nutrient supplementation by organic and inorganic (small doses at frequent intervals)

* Not delineated as a separate group in Soil map of Sri Lanka

Source: Compiled from various sources including 'Soil map of Sri Lanka' and 'Sri Lankan Mosaic - environment, man, continuity and change, by Bernard Swan, published by Marga Institute, 1987'

Table 3.4 Agricultural Suitability Classes

Suitability class	Limitations Degree	Characteristics
1 or 2	Minor	Slopes averaging 6 to 10. Moderate nutritional deficiencies. Periodic Flooding. Other minor shortcomings
3	Serious	Slopes averaging 10 to 20. Laterite or abundant gravel in subsoil. Acute nutritional deficiencies. High alkalinity or salinity. Poorly structured soils within 100 cm of surface. Very sandy excessively draining soils. Poor drainage
4	Very Serious	Slopes averaging > 20. Severely eroded soils. Soil very thin : < 30 cm. Saltwater impregnation. Very poorly drained soils.
5,6	Extreme	No soil or soil too thin or too patchy. Dominated by rock surfaces and outcrops, boulders or gravel.

Source: JICA Study Team

Table 3.5 Crop Suitability of Different Soil Units

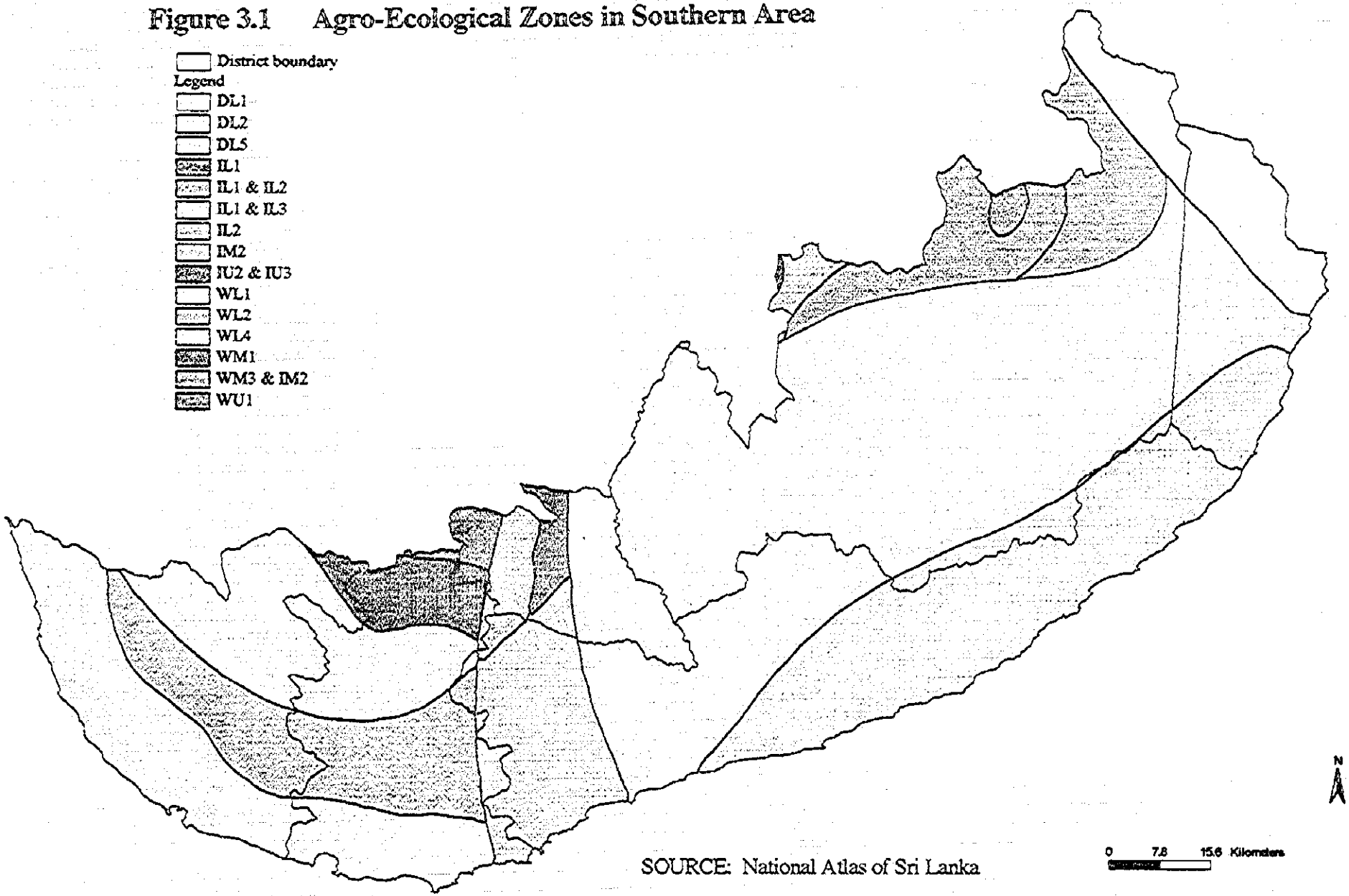
Soil No.	Soil Type	Terrain	AREA (ha)	AREA (%)	CROP OR LAND USE OPTIONS											
					a: LOWLAND PADDY	b: LOWLAND - OTHER FIELD CROPS	c: VEGETABLES, LEGUMES, CEREALS, ROOTCROPS	d: RAINFED UPLAND CROPS	e: TEA	f: RUBBER	g: COCONUT	h: CINNAMON	i: OTHER PERENNIAL CROPS, TREE CROPS, FRUIT TREES	j: PASTURE	k: FORESTRY & WILDLIFE	l: NON AGRICULTURAL USES
	SOILS OF THE DRY ZONE AND SEMI-DRY INTERMEDIATE ZONE															
1	Reddish Brown Earths and Low Humic Gley Soils	U	232,879	21.16		1	1						1			
2	Reddish Brown Earths and Solodized Solonetz	U	130,436	11.85		1	1						1			
4	UReddish Brown Earths and Immature Brown Loams	R, H & S	61,749	5.61			3	3							S	
6	Red Yellow Latosols	F to U	1,194	0.11		4	4						4		S	S
10	Alluvial Soils of variable Drainage and Terrain	F	118,585	10.77	1	1								S		
11	Regosols on Recent Beach & Dune Sands	F	21,541	1.96							3		3			S
99	Reddish Brown Earths with Large amount of Gravel in Sub-Soil	U	40,328	3.66			4							S	S	S
	SOILS OF THE WET ZONE AND SEMI-WET INTERMEDIATE ZONE															
12	Red Yellow Podzolic Soils & Mountain Regosols	M	4,803	0.44											S	
13	Red Yellow Podzolic Soils, steeply dissected	H & R	189,790	17.24					3				3		S	
15	Red Yellow Podzolic (RYP) Soils with soft or hard laterite	R & U	57,361	5.21			3			3	3		3			
17	RYP with semi-prominent A1 Horizon	H & R	19,272	1.75			3							S		S
20	Bog & Half Bog soils	F	30,418	2.76	4		4									
22	Alluvial Soils of Variable Drainage and Terrain	F	12,689	1.15	1		1									
23	Regosols on Recent Beach Sands	F	5,738	0.52							3		3			S
	MISCELLANEOUS LAND UNITS															
24	Rock Knob Plains and Eroded Lands	M	125,650	11.42												
25	Erosional Remnents	M	32,376	2.94												
50	WATER BODIES	F	15,767	1.43												
	TOTAL		1,100,576	100.00												

NOTES:

1. CLASSES 24 and 25 HAVE EXTREME LIMITATIONS FOR ANY LANDUSE (AGRICULTURAL SUITABILITY 6) & CLASS 50 IS WATER BODIES AND HENCE IS NOT SUITABLE FOR ANY OTHER LAND USE
2. *ONLY AGRICULTURAL CROP GROUPS ARE GIVEN A SUITABILITY RATING BASED ON NO. OF LIMITATIONS*
3. SOIL SUITABILITY RATINGS ARE AS FOLLOWS:
   MINOR LIMITATIONS : 1 OR 2
   SERIOUS LIMITATIONS : 3 — S: SUITABLE
   VERY SERIOUS LIMITATIONS : 4
   EXTREME LIMITATIONS : 5 OR 6
4. TERRAIN CLASSES ARE AS FOLLOWS:
   U UNDULATING S STEEP
   R ROLLING F FLAT
   H HILLY M MOUNTAIN

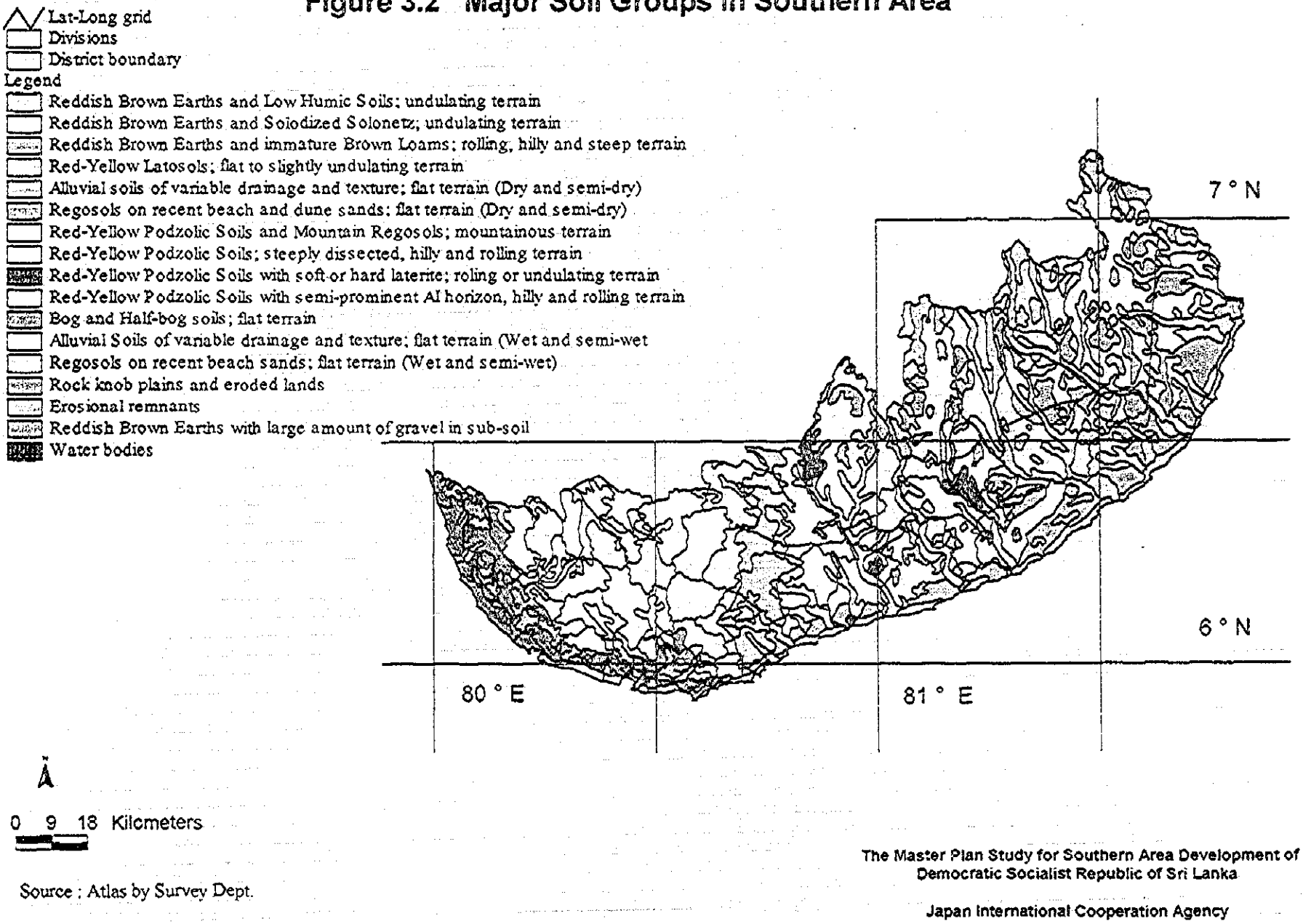
Source: JICA Study Team

Figure 3.1 Agro-Ecological Zones in Southern Area



SOURCE: National Atlas of Sri Lanka

Figure 3.2 Major Soil Groups in Southern Area



Source : Atlas by Survey Dept.

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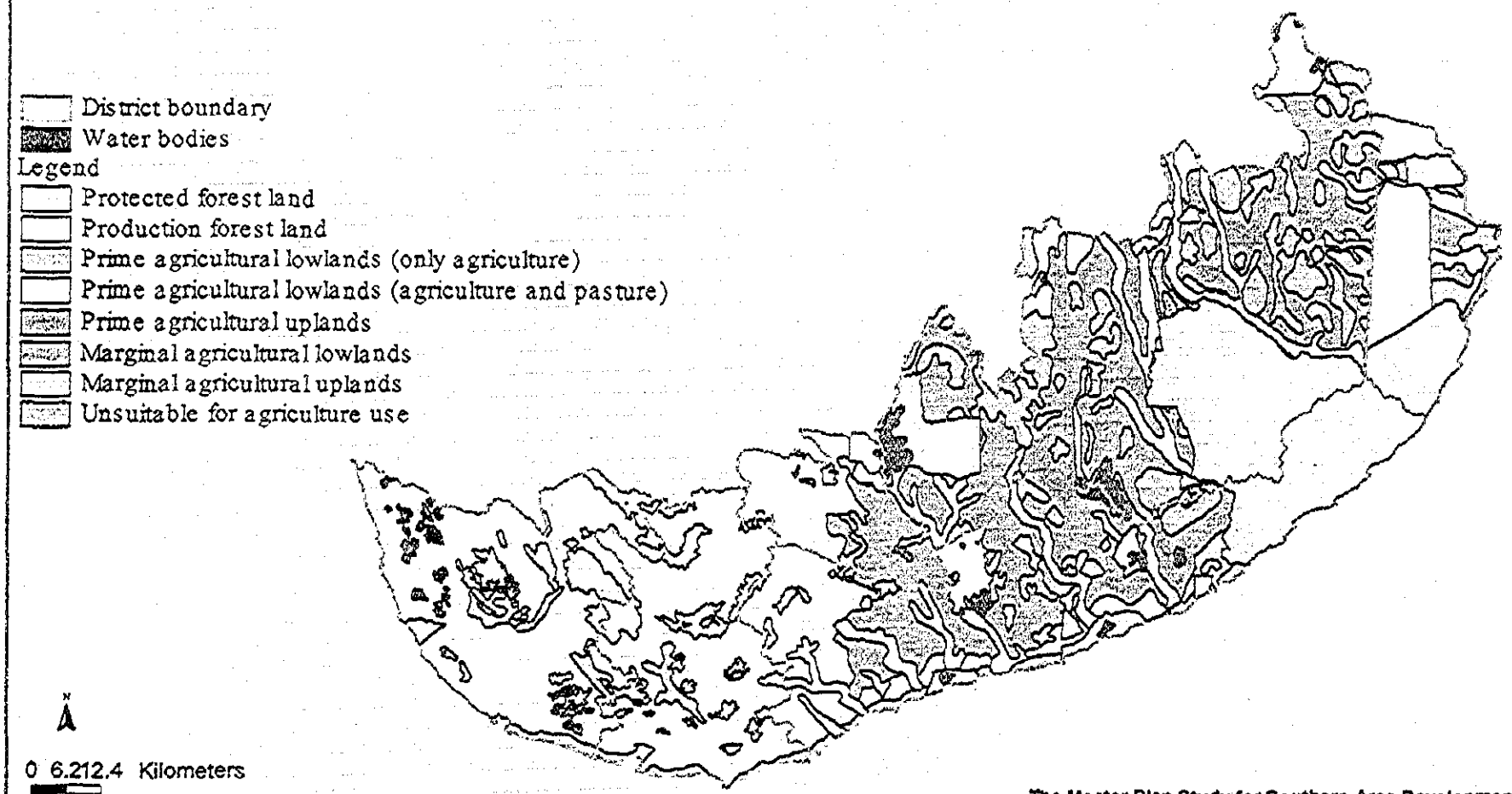
Figure 3.3 Land Use Potential of Southern Area



Source : JICA Study

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Figure 3.4 Urban/Industrial Land Potential in Southern Area

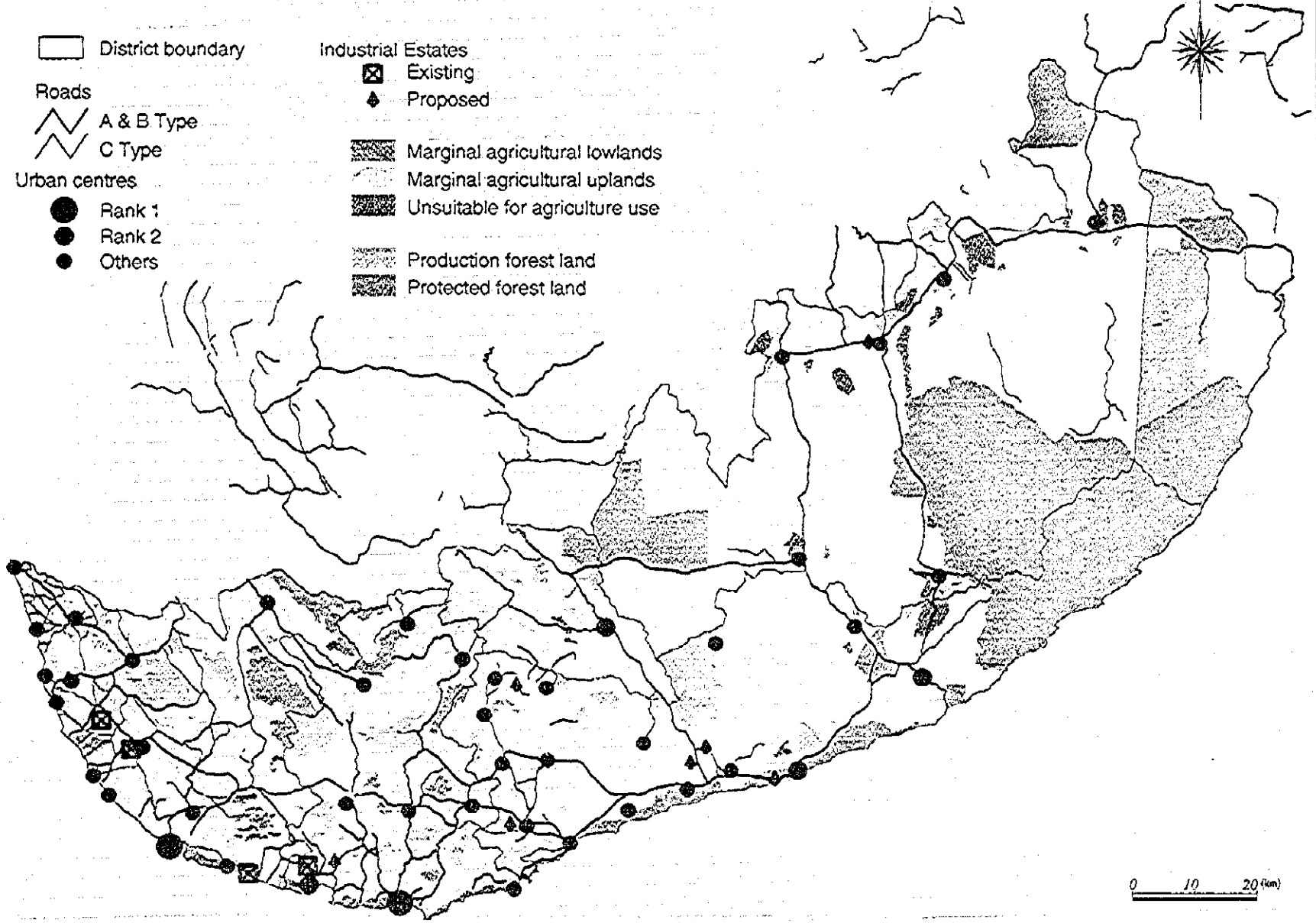
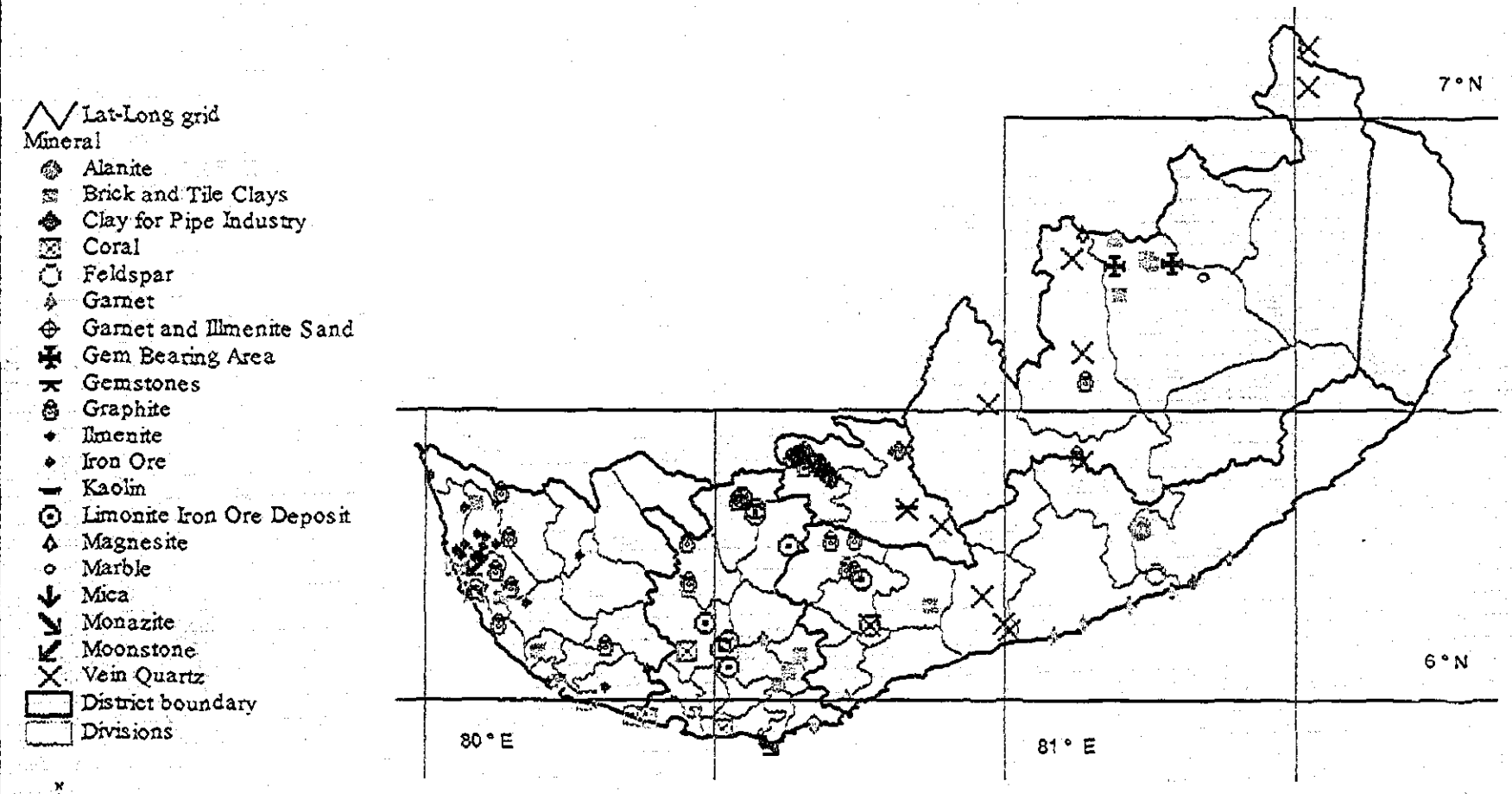


Figure 3.5 Mineral Resources Locations in Southern Area



Source : JICA Study

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Chapter 4 LAND USE AND DEVELOPMENT PLAN

4.1 Criteria and Procedure for Land Use Zoning

The root causes of land resources degradation are unwise or inappropriate land use and excessive use of land beyond its supportive/assimilative capacity for development and maintenance of acceptable quality of environment. Land husbandry is to realize sustainable use of land resources in line with their potential and carrying capacity. To achieve this, first of all, priorities are set by defining the long term objective, i.e. determining the proposed land use in the year 2015 for Southern Area based on a set of rational criteria. Strategy and policy measures for applying land husbandry to Southern Area are then elaborated for transforming existing land use towards the proposed land use by the year 2015.

Policy background

The Land Policy and Planning Division (LUPPD) of the Ministry of Lands has worked out a land supply demand balance for the Country for two basic needs - agriculture and housing. State land availability to fulfill these two needs have in turn been identified by the Survey Department based on criteria given by LUPPD (Table 4.1). As seen from Table 4.1, there will be a deficit of land even before the year 2001. Hambantota, Moneragala and Ratnapura districts have an excess of land, but the areas available in these districts largely fall in the dry zone where water availability is a severe limitation.

Table 4.2 summarizes the provincial distribution as of December 1994 for the Government program of providing land for the landless from available alienated state lands. These figures are reliable, reported by the field staff of the Survey Department at the central and provincial levels, from actual field work. In Southern Area, 16,346 ha of state land is available for redistribution as of 1995. The following may guide policy formulation for the redistribution.

(1) There is little room for further horizontal expansion of agricultural land.

(2) There exists the need for assessing use of available agricultural land not just in terms of increasing yields and production and diversifying crops but more in terms of how these relate to providing employment opportunities and substantial income generating activities and are acceptable to the youth and population in general. In other words, agro-industry linkage development which are economic and socially acceptable should be a key for the regional development and land development strategy.

(3) The need exists also for a careful assessment of what should be the main thrust of development -environment friendly high tech service industries and information technology, suitable agro-industries, or a combination of both.

Land use zoning procedure

An overlay of the existing land use map and the land use potential map was made and proposed land use classes were defined using the matrix in Table 4.3 by successively eliminating areas once classified. The sequential order in which the proposed land use classes was determined is as follows: water bodies and wetlands, production forests, protection forests, non-productive areas, prime agricultural lands, marginal agricultural lands and finally urban/ industrial areas. The following features are incorporated.

(1) Water bodies and wetlands are the same in existing and proposed land use.

(2) Proposed protected forests include all protected forest lands identified in the land use potential map and having any existing land use other than water bodies and wetlands, and all dense forest cover areas in existing land use having potential land use other than production forest lands. The rationale behind this is that all existing remaining dense forest cover areas should be conserved or protected for future use, considering the scale of deforestation that has already occurred in Southern Area.

(3) Proposed production forests are all production forest lands identified in the land use potential map having any existing land use class other than water bodies and wetlands.

(4) Proposed agricultural lands are first identified into two broad groups. The first group (proposed intensive use) includes areas which are presently being intensively cultivated or used (groups 3a, 4a and 5a), while the second group (proposed diversified use) includes areas which are presently under-utilized or which are presently sparsely used (groups 3b, 4b and 5b). The latter is potential land remaining after determination of water bodies and wetlands, protection forests, production forests and non-productive areas, where land at present is sparsely used as well as other cropland, open forests and plantations. The former includes all remaining potential agricultural lands having existing land use as homesteads, trees and other perennial crops or paddy. The two broad proposed agricultural land use groups are further classified into prime or marginal agricultural lands, and in terms of whether they are lowland or uplands.

(5) *Marginal agricultural lowlands* are all along the coastline. These are classified under un-productive areas in the proposed land use due to the environmental sensitiveness of their ecosystems.

4.2 Development Targets

Forestry and agricultural land use

Table 4.4 and Figures 4.1 present the envisioned land use in 2015 for forestry and agriculture. About one third of Southern Area is collectively classified under protected and production forest land use. About 8.1 % of Southern Area is not suitable for productive use from the point of view of forestry or agriculture. Water bodies and wetlands constitute about 3.3 % of Southern Area, while existing urban or industrial land accounts for only 0.24 % of the Area. Remaining 54 % of Southern Area is proposed to be used primarily for agriculture.

Proposed agricultural lands are identified into two broad groups. The first group collectively termed "intensive use" (land use classes 3a, 4a and 5a) identifies areas which are presently being intensively cultivated or used and where existing land use matches the land use potential. Agricultural development programs for these areas need to focus on increasing productivity, on making complete and innovative use of all agricultural products to minimize wastage and improve efficiency of resources use, and on implementing land and water conservation measures. Some crop diversification can be expected in these areas. Table 4.5 presents the crop land use potential of the proposed "intensive use" areas.

The second major group is termed "diversified use" areas (land use classes 3b, 4b, and 5b). These include areas which are presently under-utilized or sparsely used, or areas where present land use does not match its potential, or areas which offer significant potential for crop diversification. These areas provide opportunities for development of suitable agricultural programs focusing on increased productivity and agricultural value-added through crop diversification. Development of water resources tailored for irrigating uplands is necessary as large areas in Moneragala district (99,200 ha) and Hambantota district (48,200 ha) have been identified under this group. The water resources sector report presents a water balance for Southern Area in 2015, and identifies necessary water resources development projects to develop about 25 % of the identified "diversified use" areas in Moneragala and Hambantota districts (i.e. about 40,000 ha). The water balance analysis has determined this to be the upper limit for irrigation development. Agricultural crop choices and crop rotation schemes would be determined by adequate research in the first phase of the master plan implementation, and actively promoted to create a green belt of productivity and prosperity in the southeast dry zone areas. Complete use of agricultural products as well as

land and water conservation measures would be an integral part of agricultural programs under this group also. Table 4.6 presents the crop potential of proposed "diversified use" areas.

Urban and industrial use

Land development targets for urban and industrial use in 2015 are not specified. Results of potential lands (Figure 3.4) suitable for urban or industrial use indicate large extents of marginal agricultural lands in Galle and Matara districts, and prime agricultural lands in Hambantota and Moneragala districts which face limitations in sustained use due to lack of water, could be targeted for urban or industrial use depending on the requirements. Again, other factors like proposed new transportation network, kind of industrial development and water availability, would determine the potential locations more precisely.

Mineral resources development

Proposed areas for mineral resources development cannot be decided without further surveys concerning reserves and environmental impacts. Presently available information is largely qualitative in nature. Importance in determination of environmental impacts needs to be stressed before undertaking any mineral resource exploitation in Southern Area.

4.3 Strategy and Policy Measures

(1) Prevention of land degradation

Emphasis is to be laid on prevention of degradation rather than cure. Efforts need to be directed at protecting good or prime land first to be put to its most productive use. Reclamation of damaged land should be limited to cases where the cost of reclamation can be justified by the reduction of off-site downstream damages rather than by the value of the reclaimed land, since this is usually low.

Degradation of coastal land by sea erosion tends to be aggravated by human activities. Strict control should be enforced to prevent coral mining, sand mining and illegal building construction along the coast.

(2) Research into loss of productivity

Concern about land degradation needs to focus increasingly on loss of productivity, and economic justification for improved land husbandry needs to be based on quantifying future loss of productivity. Research in the past has been directed solely at determining the loss of soil, and there is a lack of information on effects of erosion on productivity. Trying to

quantify erosion in relation to permissible soil loss has always been a weak argument , as it was not possible to correlate soil loss with any measurable effects on crop yields.

(3) Production as better incentive for better land use

Improving agricultural production in future should be offered as the incentive for improved soil management, water management and crop management. Recommendations for improving soil management, or techniques such as contour farming or ridging, as well as use of organic fertilizer, better seed and crop rotations, need to demonstrate improved yields and production to be acceptable by farmers.

(4) Extension

Traditional extension services developed on experiences of developed western countries have often not been adequate in addressing the needs of developing countries like Sri Lanka because of a large number of farmers involved. Innovative approaches like the FAO's bottom-up or "learning by doing" integrated pest management, and the Training and Visits System (T & V) approaches need to be considered in Southern Area.

The critical problem is how a limited number of extension staff can maintain contact with a large number of farmers. The T & V system uses selected "lead farmers" for the last stage of multiplying the dissemination of information. The system is also directed towards training of extension staff. The T & V system involves:

- regular training of all staff, received from the next upward level of seniority,
- imposition of an orderly work plan with a regular schedule for all officers, and
- contact of the extension agent with selected number of lead farmers on each of his two weekly visits, each of whom in turn takes the message back to a group of perhaps twenty farmers.

Advice to farmers need to be in the form of packages of practices which make up a farming system rather than concentrated on cropping or grazing or woodland in isolation. This is particularly important in Southern Area, where many of the above farming practices are being carried out on the same piece of land, and the difference between crop land and grazing land is a question of time rather than space in the dry zone.

(5) Water conservation

This strategy calls for more emphasis on water management and water conservation, and less on soil conservation. The preferred approach in the dry and intermediate zone needs to

focus on management for maximum infiltration and minimum surface run-off in order to achieve better yields, as moisture is a major constraint there.

(6) Combination of mechanical and biological conservation measures

This strategy calls for a combination of biological measures and mechanical works. The biological measures will offer benefits to be recognized by farmers within a short term. There is a tendency to assume that the most important benefit will be an increase in yield. However, in subsistence agriculture, there can be many other effects which a farmer may see as a benefit. An increase in the reliability of production, giving an increase in food security, may be more important than yield, or a desired benefit would be to achieve a better return per unit of input, whether seed, fertilizer or labor. In the non-plantation sector in Southern Area, it is seen that cultivation of low value added paddy combined with off-farm wages offers the farming family the maximum income as well as food security. Crop diversification or focus on improving paddy yields are of secondary importance.

(7) Local involvement, public participation and decentralization of decision making

This strategy calls for local community involvement at all stages. Farming communities and population living in sensitive ecosystems need to be involved right from the earliest stages, first to establish their aims, objectives and aspirations, and then to plan jointly for strategy and measures to achieve their own objectives. Roles of women in forestry and agriculture need to be recognized so that effective implementation of planned projects would take place. More women extension workers could also be used.

The design and implementation of agricultural, forestry, wildlife and integrated conservation and development projects benefit from the devolution of planning down to the local level. The government policy of devolution and decentralization needs to extend also to strengthening community self-management by supporting the formation of village development committees, village conservation committees, land apportionment committees, and less formal groupings such as cooperatives, farmers' associations, and women groups. This will effectively lead to the formation of a community infrastructure which can provide a vehicle for popular participation in the land use planning process. The main input of ideas, needs and aspirations of the people are thoroughly discussed at the community level and fed into the community plan (e.g. divisional secretary division level land use plan).

(8) Minimizing subsidies

It is difficult to justify land and soil conservation programs using conventional methods such as cost benefit analysis. This is because land conservation works are nearly always part of a package which includes other factors such as better seed, fertilizer use, and improved crop management. The difficulty in arriving at a convincing economic justification often results in the argument that land conservation is, like health or education, something that responsible governments need to provide for.

This strategy, however, calls for minimization of interventions or subsidies. Subsidies tend to undermine the extent to which farmers and local people identify with works, and may even encourage the idea that land conservation is something that the government pays you to do. A decreased sense of involvement and responsibility can also lead to poor standards of work, and poor maintenance.

(9) Land tenure

For improved performance of small holder agriculture the following are recommended.

(a) Adoption of policies that promote the efficiency and transparency of the land market. This is to ensure land goes to its best use, to the people willing and able to pay for the land and to use it productively. People unwilling or unable to use the land productively would be able to exit the sector with some compensation for assets they leave behind. This can be achieved by eliminating restrictions on purchase and sale of land held under permits and grants on land heretofore considered state land, and by instituting active dispute resolution mechanisms to clarify title on private lands.

(b) Adoption of policies that promote incentives to conserve and invest in land.
This is based on the premise that increased productivity and incomes will not be easily attainable without improved incentives, which in turn require improved tenure security. Similarly, maintenance of the quality of farmland requires appropriate incentives that are engendered by individual ownership or secure, unrestricted long-term leasehold. This can be achieved by improving the institutions that generate land market information and provide tenure security, such as titling and registration system, and by improving linkages between land markets and capital markets so that farmers can obtain credit for investment or conservation purposes.

Possible alternatives that could be adopted concerning changes in legal tenure status for farmers and other resource users on state lands include the following:

(a) Accelerating the conversion of LDO permits to Swarnabhoomi grants via block grants, as is possible under the Land Settlement Ordinance;

(b) Eliminating the LDO permit system altogether, and alienating land directly as Swarnabhoomi grants or the equivalent (or a reversion to LDO long term leases);

(c) Eliminating the LDO restrictions on transferability of title altogether, such that grants would approach the characteristics of freehold (fee -simple-ownership); and

(d) Replacing the Swarnabhoomi grant system with direct conversion of LDO permits to land titles under the proposed Registration of Title Act(RTA).

Alternatives (c) and (d) result in the benefit of greater security, incentives for investment and access to credit, and bring land hitherto owned by the state to a situation resembling freehold, or fee simple title. Alternative (c) could be accomplished without new registration, legislation or new institutions, but would require modification of the LDO and investment in upgrading the capacity of the Registries of Deed. Alternative (d) would require substantial investment in legal, human and physical infrastructure, but would probably yield the maximum positive impact. It could save needless duplication of administrative efforts, and also eliminate the need for the tedious Swarnabhoomi grant procedure of obtaining the President's signature on each grant document, because a "gazette notification indicating the President's approval" would be the only step of recognition required under the RTA.

Tenure provisions and land tenure issues in public forest lands could be tackled in various ways as follows.

(a) A census of forest or upland occupants needs to be conducted preferably by a non-governmental institution with no vested interests in these areas, first to differentiate the population to distinguish appropriate ways of solving their problems.

(b) Land tenure issues of indigenous groups with long established land claims need to be tackled by legally recognizing indigenous common management regimes, which offer collective tenure in return for cooperation in resource management and exclusion of new immigrants. Better established groups could be induced to form development corporations to undertake management or conservation programs within the public forest under contract from FD. Particularly impoverished groups might be the target for employment involving resource protection and facilities maintenance. Gatherers of forest products or fuel wood might have their access legitimized through licensing in return for observing some environmentally protective regulations. Farmers or communities in buffer zones could be offered a lease or contract which provides for

increased tenure security, and acts as an incentive for adopting appropriate and necessary conservation land use practices.

(c) The issue of new immigrants attracted by the prospect of tenured land occupancy, along with other economic improvements in upland areas, also needs to be addressed. Rather than restricting access to projects and programs, an alternative approach could be to require new immigrants to pay for their occupancy rights on terms comparable to those of lowland beneficiaries of land reform, allowing for lower land productivity levels.

(d) Pasture leases, or land leases should not be allowed near critical watersheds.

(e) All forms of tenure mechanisms in forest lands need to be revised to strengthen their incentive value in promoting conservation agriculture, agro-forestry or silviculture. They should be transferable, but only to land occupants, automatically renewable, heritable and probably divisible, subject to cancellation only upon failure of occupants to meet very explicit responsibilities, and should give rights to harvest or exploit all improvements made to land, such as planted trees. This would give the land leases or contracts market and collateral value, and the recipient considerable tenure security. The land leases should be available on a priority basis first only to established occupants, and after meeting their needs, be sold by the Government to new immigrants. The land leases need to be offered as a stimulus and full titling as a reward, for adoption of sustainable techniques in farming and silvicultural activities. Typically, a ten year transient period could be considered for the recipient to demonstrate use of sustainable land use practices, to be awarded by full land titling.

(10) Natural resources inventories

The starting point of any regional land and natural resources development strategy is an inventory of resources. This would facilitate formulation of land and natural resources use and development policies. The inventory must include not only physical data such as geology, soil, and climate, but also data on human resources. The latter would cover on-going activities, existing farming systems, intended uses of land, and social or economic constraints that could hinder agricultural development such as prices, market outlets, or land tenure.

(11) New techniques for data collection and compilation

The assimilation and compilation of physical information is a tedious and costly business. This strategy calls for use of new and well established techniques for resources mapping and data compilation in an efficient and rapid manner, fitting the needs of planning activities at various levels. Some of the old style field surveys can be done more quickly and more efficiently by the use of remote sensing. For example, soil survey is greatly aided by the interpretation of aerial photography. Geology, topography and land use/ land cover mapping is greatly facilitated by use of satellite imagery. A geographical information systems (GIS) allows the computerized compilation of a resources database, for improved storage, retrieval, updating and spatial analysis and queries. It also allows integration of data from a wide range of sources, scales and formats.

(12) Role of aid and technical assistance

There are several changes in approach to conservation projects which need to be kept in mind in formulation of aid and technical assistance projects to improve their chances of success in implementation. Projects to be prioritized include those searching for agricultural systems which will allow sustainable land use, projects which stress on control of land degradation by improved farming rather than through land conservation methods, and projects which stress on building up the capabilities of local staff and local institutions so that they can manage their own affairs without external technical assistance.

Aid and technical assistance projects in land husbandry should be formulated increasingly with significant direct assistance to NGOs as well as local government units (LGUs) to evolve a strong human community infrastructure for sustained participatory rural development. Lessons from past development programs in Sri Lanka and other developing countries need to be considered in design of projects. There must be a strong commitment to the program by donor agencies, the host government and implementing agencies. There must be an unequivocal assurance that long term funding will be provided. Agricultural systems change slowly and a ten-year horizon should be considered the norm. Project design should be based on limited attainable objectives keeping in view the capacity of the recipient and local institutions to be able to implement the project themselves.

(13) Public infrastructure investments - impact and direction

There is a need for better analysis of the impact of public infrastructure investments on land use and settlement patterns, such as roads, irrigation, electricity and markets. In the absence of direct control of land use (such as zoning in urban areas), decisions on public investment

and leasing of public land have profound land use impacts. More careful assessment of social and environmental impacts of investment projects is necessary, together with more careful attention to economic incentives for those coming in the tracts of infrastructure development.

Grants and concessional loans from international donors would be readily forthcoming for a well planned land and natural resources management program backed by institutional and policy reforms. Public investment programs to upgrade land and natural resources management in Southern Area need to focus increasingly on the following areas:

(a) Reforestation and bio-diversity enrichment of critical watersheds;
(b) Forest nursery establishment and assistance for production and distribution of plant propagation materials required in upland conservation farming and agro-forestry;
(c) Provision of equity to establish an extra-governmental development fund which would be used for: (1) community based NGO and local government projects to improve resource management and enhance livelihood among upland farmers and coastal fishing populations, and (2) enhanced private sector managment efforts to expand tree crops and tree plantations in uplands through nuclear estates and contract farming schemes; and
(d) Provision of vehicles, communication and monitoring equipment required to upgrade the efforts of regional line agencies and local government units charged with enforcement of national and local resource use regulations in forestry, and provide technical support for upland agriculture and community forestry.

(14) Pollution control approaches to making interventions more self-financing

Pollution control approaches are an important element of any land management strategy. The most fundamental approach is to expand the application of user charges and "polluter pays" principles. Another promising idea is to use revenues generated from "green" revenue producing policies, such as increased stumpage fees or land rents to cross-subsidize technical research and extension in more sustainable agricultural and forestry practices.

A third approach is to build on the Environmental Fund concept used in Europe based on earmarked revenue sources, to help finance pollution control projects. A fourth and perhaps most promising approach, is the use of "improvement levies" to help finance large infrastructure investments with positive environmental impacts such as mass transit, sewerage and sanitation, and water treatment plants. The idea of improvement levies is to broaden the tax base from those who directly use the investment to those who enjoy the positive externalities.

(15) Technical approaches

Matching existing land use with its potential is the objective of improving land husbandry. Technical approaches form an important part in achieving this objective. Before discussing technical approaches to land management, a change in emphasis in line with helping the poor subsistence farmers need to be stressed. Conventional land management approaches start with sound land use and appropriate mechanical protection works, followed by improved farming methods. However, the poor subsistence farmers cannot afford a large investment of cash or labor in mechanical works. Hence, first priority is to propose improved farming methods which help conserve land resources to be followed up with mechanical works where necessary to supplement good land husbandry. Changes in farming systems or methods which lead to improved land conservation need to demonstrate to a farmer as leading to increased production or as better optimizing the use of his resources.

For new farming systems or technology to be adopted enthusiastically by farmers, it must result in clear on-site benefits offering short term improvements with large increments. The improvement must also occur within the time span of the farmers' planning. For crops, this is typically one year or shorter. New technology must not require foregone benefits, particularly food. It must not increase risk but preferably reduce it. Lastly, a technology which is the development or improvement of an existing practice will be accepted more readily than something which is completely new.

Lowland prime agricultural lands

The objective is to practice sustained intensified agriculture in the prime agricultural lands, a significant part of which is irrigated. This is done by careful management of external input in order to achieve an equilibrium between high output and conservation of the resource base. Priorities include maximization of biological fixation, increasing efficiency of fertilizer use, improving weed control, improving water management at the farm level, and substituting agronomic and biological tools for chemicals to control pests.

Sustainable intensification of irrigated lands needs to be increasingly science based. More careful calibration of fertilizer needs, such as the balance between the three main components of fertilizer, can lower application rates while improving yields. Mixed and integrated farming systems, involving both foraging and use of manure need to be promoted in irrigated as well as rain-fed areas. Improved germplasm will contribute to local yields not only in food crops, but in specialty cash crops and perennials. An integrated approach to water resources management is necessary and ways to improve irrigation water use efficiency need to be promoted.

Uplands, hilly-lands and production forests

Aiming at development and promotion of appropriate cropping systems which are profitable, environmentally sustainable and in line with the land's potential is the priority for management of uplands, hilly-lands and production forests. Though inappropriate land use is to be avoided or corrected, it must be accepted that it will continue, and may even increase. Therefore sufficient attention needs to be devoted to developing technology for agro-farming and agro-forestry systems on steep lands. Upland dwellers need to be involved and convinced to adopt the developed technologies.

Various models exist for developing agriculture or agro-forestry on uplands, hilly-lands and production forests. Agro-forestry can be defined as the use of trees and shrubs with crops and pastures, and possibly livestock, in an integrated farming system. Perennial crops are ideally substituted for annuals, given their much greater drought tolerance and soil conservation characteristics. In degenerated chena lands and secondary growth forests, there are opportunities for taungya cultivation (See Part 3), fallow period management, intensive mixed cropping, multi-storey farming and perennial cropping. However it must be remembered that such cropping models are highly site specific, and need to be tested and adopted locally, preferably as part of a strengthened extension system. Extensive homegardens present in Southern Area are a form of low intensive mixed land use. There is a need to develop the right mix of crops, plants and trees in these homegardens to make them commercially viable while at the same time not losing out on any of the environmental benefits.

Poor farming methods which result in loss of vegetation cover are the main cause of soil erosion. Detachment of soil particles can be controlled by adopting appropriate soil management practices which will increase soil organic matter content, prevent the formation of soil crusts and compacted layers and improve the soil structure and water holding capacity. In terms of crop management and agronomic measures this involves making much and better use of crop residue for mulching, introducing better crop rotations, promoting relay cropping, improving pasture management, and implementing contour cropping and strip cropping as relevant.

Structural measures such as bench terraces, check dams, gully plugs, and diversion ditches used to control runoff on lowlands are not cost effective on marginal lands like degraded forest lands and steep lands. Alternative approaches that are low cost, short term and easily adopted by local communities need to be determined. Some of the promising approaches involve vegetative technologies such as contour planting, planting grass and legumes,

vegetative crop cover management, contour hedges and contour farming. Several species have been proposed for conservation use including napier grass and vetiver grass.

Vegetative methods have additional advantages over structural methods. Unlike structural methods which require detailed site planning, vegetative methods require relatively less technical input, and individual farmers can proceed under their own initiative.

4.5 Projects

Keeping in view both ongoing and past projects and studies in Southern Area, the following list of projects are recommended for implementation. Detailed project profiles are presented in a separate report.

Anchor projects

The following anchor projects have strong land related components.

SA-5 Uma Oya Multipurpose Development

SA-8 Paddy-Based Mixed Farming Promotion

SA-9 Home Gardens Based Multi-Storey Farming

SA-10 Small Holder Integrated Farming Promotion

SA-13 Industrial sites for Small and Medium Sized Industries

SA-21 GIS Oriented Regional Information System (GORIS) Establishment

SA-22 Environmental Fund for Southern Area

SA-25 Multiple Use Forest Management

Local projects

Of all the local projects, the following in the environment sector are more strongly related to land resources.

EN-4 Soil Resources Inventory at scale 1:50,000 for Southern Area

E-12 Integrated Watershed Management

E-17 Ecological Management of Soil Erosion and Minor Tanks in SEDZ

Table 4.1 Land Supply - Demand Balance for Agricultural and Housing Needs

District	Land available Jan. 1991	Land needed 1991-2001	excess (+)/ shortfall (-)
Colombo	187	3,412	-3,235
Gampaha	184	7,176	-6,992
Kalutara	538	4,949	-4,411
Kandy	1,715	6,623	-4,908
Nuwara Eliya	873	5,408	-4,535
Matale	7,846	6,071	+1,775
Galle	3,265	5,619	-2,354
Matara	2,190	3,649	-1,459
Hambantota	16,888	14,105	+2,783
Jaffna	1,273	12,681	-11,408
Mannar	233	6,353	-6,120
Vavuniya	757	6,123	-5,366
Mullaitivu	1,667	8,073	-6,406
Batticaloa	1,462	10,914	-9,452
Ampara	12,562	19,680	-7,118
Trincomalee	9,322	9,299	+23
Kurunegala	3,711	25,342	-21,631
Puttalam	6,209	13,904	-7,695
Anuradhapura	55,773	40,414	+15,359
Polonnaruwa	6,009	18,645	-12,636
Moneragala	34,952	20,056	+14,896
Baddula	1,991	13,088	-11,097
Ratnapura	10,476	9,480	+996
Kegalle	1,181	4,008	-2,847
TOTAL	181,264	275,072	-93,808

Source : T. Somasekaram in 'The Observer' dated 14 November, 1995

Table 4.2 Land for the Landless from Available State Alienated Lands

Province	Identified	Agriculture	Housing	Total	Balance
Northern	8,524	2,459	1,091	3,550	4,976
Eastern	26,476	3,559	771	4,330	22,146
North Central	115,518	32,570	10,208	42,778	72,740
North Western	34,911	34,911	27,857	1,232	29,089
Western	2,762	531	1,582	2,113	649
Sabaragamuwa	13,101	6,730	1,626	8,356	4,745
Central	12,704	6,213	303	6,516	6,188
Uva	45,140	11,262	827	12,089	33,051
Southern	28,520	10,365	1,809	12,174	16,346
	287,656	101,546	19,449	120,995	166,661

Source : T. Somasekera in 'The Observer' dated 14 November, 1995

Table 4.3 Land Use Zoning Criteria for Deriving Proposed Land Use

POTENTIAL LANDUSE	a. Potential forest land	b. Production forest land	c. Prime agricultural lowlands (only agriculture)	d. Prime agricultural lowlands (agriculture and pasture)	e. Prime agricultural uplands	f. Marginal agricultural lowlands	g. Marginal agricultural uplands	h. Unsuitable for agricultural use
EXISTING LANDUSE								
A. Built up land and associated non-agricultural land	1	2	6	6	6	6	6	6
B. Homesteads	1	2	3a	3a	4a	8	5a	8
C. Trees and other perennial crops	1	2	3a	3a	4a	8	5a	8
D. Paddy cropland	1	2	3a	3a	4a	8	5a	8
E. Sparsely used land and other cropland	1	2	3b	3b	4b	8	5b	8
F. Dense forests	1	2	1	1	1	1	1	1
G. Open forests and plantations	1	2	3b	3b	4b	8	5b	8
H. Scrubland and grassland	1	2	3b	3b	4b	8	5b	8
I. Water bodies and wetlands	7	7	7	7	7	7	7	7
J. Barren land	1	2	8	8	8	8	8	8

PPROPOSED LANDUSE

1 Protection forests
2 Production forests
3a. Prime agricultural lowlands - Intensification
4a. Prime agricultural uplands - Intensification
3b. Prime agricultural lowlands - Diversification
4b. Prime agricultural uplands - Diversification
5a Marginal agricultural uplands - Intensification
5b Marginal agricultural uplands - Diversification
6 Urban/ industrial use
7 Water bodies and wetlands
8 Non-productive areas

Source: JICA Study Team

Table 4.4 Proposed Land Use for Southern Area in 2015

	Galle		Matara		Hambantota		Moneragala		Ratnapura		Ampara		Total	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
1 Protection forests	21,411	13.37	11,197	8.62	59,065	22.59	171,183	42.55	4,377	7.80	34,398	41.11	301,631	27.58
2 Production forests	10,473	6.54	12,278	9.45	12,902	4.93	3,076	0.76	2,746	4.89	33,293	39.79	74,768	6.84
3a Prime agricultural lowlands - Intensification	5,709	3.56	5,077	3.91	17,743	6.78	8,362	2.08	618	1.10	876	1.05	38,385	3.51
3b Prime agricultural lowlands - Diversification	1,170	0.73	371	0.29	9,452	3.61	22,614	5.62	72	0.13	2,608	3.12	36,287	3.32
4a Prime agricultural uplands - Intensification	0	0.00	0	0.00	27,791	10.63	23,281	5.79	11,500	20.49	421	0.50	62,993	5.76
4b Prime agricultural uplands - Diversification	0	0.00	0	0.00	48,264	18.46	99,224	24.66	7,005	12.48	3,392	4.05	157,885	14.43
5a Marginal agricultural uplands - Intensification	96,212	60.06	81,365	62.61	36,108	13.81	2,482	0.62	9,079	16.18	0	0.00	225,246	20.59
5b Marginal agricultural uplands - Diversification	15,635	9.76	13,159	10.13	15,726	6.01	7,809	1.94	16,932	30.17	0	0.00	69,261	6.33
6 Urban/ industrial use	704	0.44	572	0.44	1,050	0.40	241	0.06	25	0.04	0	0.00	2,592	0.24
7 Water bodies and wetlands	4,332	2.70	2,558	1.97	13,268	5.07	11,053	2.75	1,804	3.21	2,722	3.25	35,737	3.27
8 Non-productive areas	4,555	2.84	3,385	2.60	20,151	7.71	53,008	13.18	1,966	3.50	5,964	7.13	89,029	8.14
Total	160,201	100.00	129,962	100.00	261,520	100	402,333	100	56,124	100	83,674	100	1,093,814	100

Source: GIS analysis of the JICA Study Team

Table 4.5 Crop Landuse Potential of Proposed 'Intensive Use' Agricultural Lands and Their Extent in Southern Area

(Unit: ha)

	c	a or c	c or i	a or b	b, c or i	c or i
Galle						
3a Prime agricultural lowlands		5,708				
4a Prime agricultural uplands						
5a Marginal agricultural uplands	4,152	19,150	35,983			36,928
Matara						
3a Prime agricultural lowlands		4,392		685		
4a Prime agricultural uplands						
5a Marginal agricultural uplands	4,909	6,570	11,970			57,918
Hambantota						
3a Prime agricultural lowlands				17,755		
4a Prime agricultural uplands						
5a Marginal agricultural uplands	28,901		7,207			
Monaragalla						
3a Prime agricultural lowlands				8,362		
4a Prime agricultural uplands					23,278	
5a Marginal agricultural uplands	2,483					
Ratnapura						
3a Prime agricultural lowlands				618		
4a Prime agricultural uplands					2,167	
5a Marginal agricultural uplands						5,482
Ampara						
3a Prime agricultural lowlands				876		
4a Prime agricultural uplands					421	
5a Marginal agricultural uplands						

a Lowland paddy

c Vegetables, legumes, cereals, rootcrops

i Perennial crops, tree crops, fruit trees

b Lowland field crops (other than paddy)

e Tea

Source : GIS analysis of JICA Study Team

Table 4.6 Crop Landuse Potential of Proposed 'Diversified Use' Agricultural Lands and Their Extent in Southern Area

(Unit: ha)

	c	a or c	c or i	a or b	b, c or i	e or i
Galle						
3b Prime agricultural lowlands		1,170				
4b Prime agricultural uplands						
5b Marginal agricultural uplands	2,932	1,293	1,276			10,134
Matara						
3b Prime agricultural lowlands						
4b Prime agricultural uplands		243				
5b Marginal agricultural uplands		87				11,682
Hambantota						
3b Prime agricultural lowlands	1,184		206	9,451		
4b Prime agricultural uplands					48,272	
5b Marginal agricultural uplands	12,931					2,795
Monaragalla						
3b Prime agricultural lowlands				22,612		
4b Prime agricultural uplands	7,810				99,211	
5b Marginal agricultural uplands						
Ratnapura						
3b Prime agricultural lowlands				72		
4b Prime agricultural uplands					7,009	
5b Marginal agricultural uplands	9,489					7,444
Ampara						
3b Prime agricultural lowlands				2,608	3,391	
4b Prime agricultural uplands						
5b Marginal agricultural uplands						

a Lowland paddy

c Vegetables, legumes, cereals, rootcrops

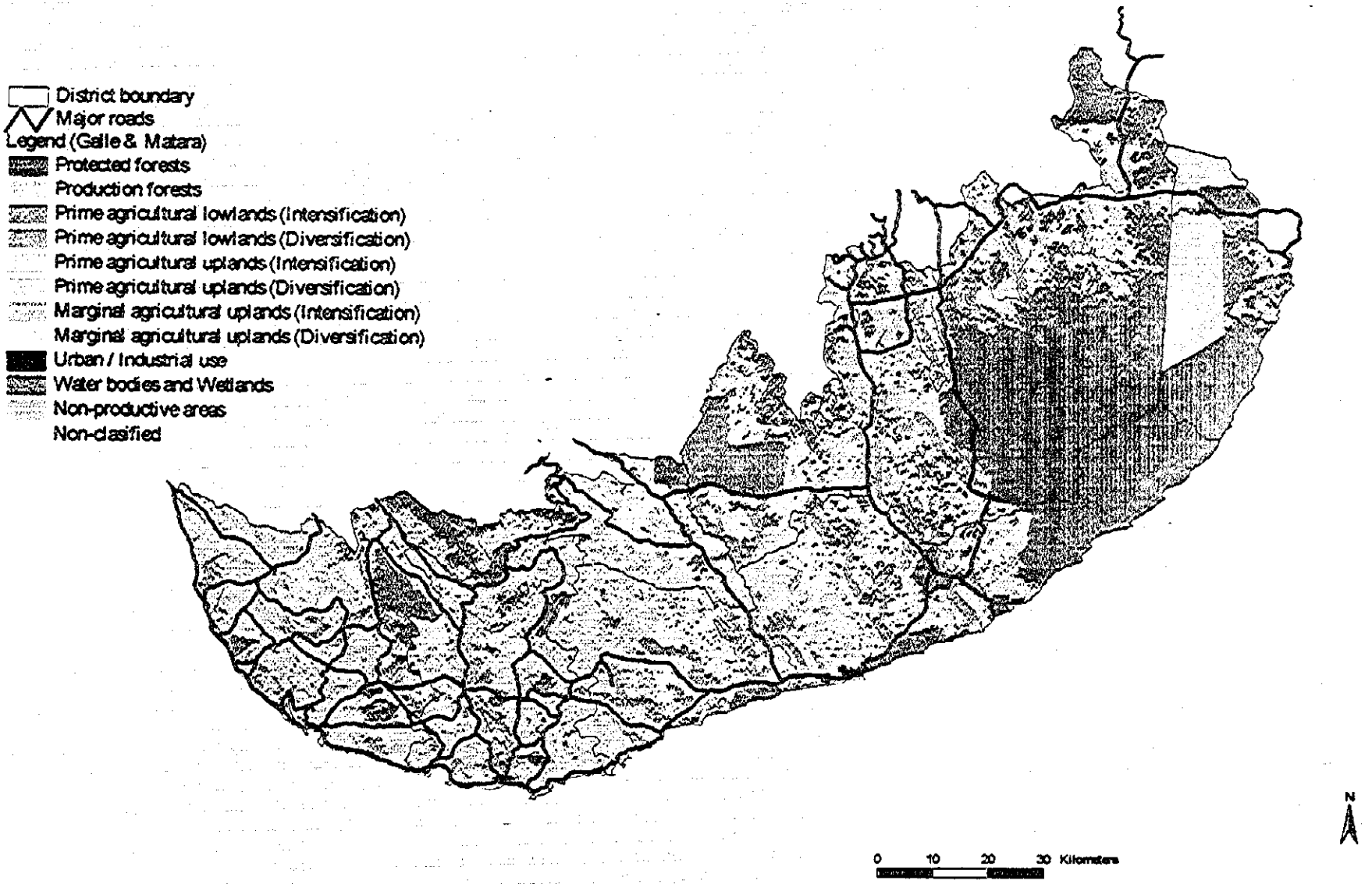
i Perennial crops, tree crops, fruit trees

b Lowland field crops (other than paddy)

e Tea

Source: GIS analysis of JICA Study Team

Figure 4.1 Proposed Land Use for Southern Area in 2015



Environment

SECTOR REPORT 6 LAND AND ENVIRONMENT

PART 2 ENVIRONMENT

CHAPTER 1 EXISTING CONDITIONS

1.1 Existing Environmental Policies and Administration

1.1.1 National policy

The Government has recognized increasingly that the protection of environment and the management of natural resources are major elements in socio-economic development of Sri Lanka. The Government has been considering the integration of principles of environmental economics into the national planning process to improve resource accountability in socio-economic development. An important outcome of this basic policy is the 1992 ~ 96 National Environmental Action Plan (NEAP) approved by the Ministry of Environment and Parliamentary Affairs (MEPA) and revised (but not approved) in June 1994 for 1995 ~ 98. It represents the broadest statement of the Country's environmental policies and programs, including high priority investments.

1.1.2 Legal and institutional framework for environmental management

In addition to MEPA reformed as the Ministry of Transport, Environment and Women's Affairs (MTEWA), there are more than thirty government agencies involved in the management and protection of environment and natural resources. Environmental policy formulation and implementation by these agencies are not effective as a result of diverse responsibilities and lack of effective inter-agency coordination. The National Environmental Steering Committee (NESC) was set up in 1991 to improve environmental coordination and establish an effective institutional framework for environmental policy making. This committee provided policy guidance and direction to monitor environmental initiatives, programs and projects. However, NESC has become less functional, and more involved in ad hoc operational activities than policy guidance.

The current legal framework for environmental management is based on the 1980 National Environmental Act (NEA, amended in 1988), which created the Central Environmental Authority (CEA). Environmental Protection Licenses (EPLs) are issued to polluting industries and constitute the principal current regulatory mechanism for pollution control.

Table 1.1 summarizes most of the environment-related legislations for planning, procedures, pollution control and resource management.

The single most important recent environmental policy reform was the 1993 passage of new regulations governing environmental impact assessment (EIA). Large projects are now subject to a full EIA. For instance, large scale and/or hazardous industries such as iron and steel industries, chemical industries, petroleum refineries, petrochemical manufacture, sugar, cement, paper and tanneries and others above a certain production capacity have been listed as prescribed projects requiring an EIA study prior to commencement. In addition, all industrial estates exceeding 10 ha are also required to undergo an EIA. The EIA regulations also identify 15 Project Approving Agencies (PAAs), and efforts are underway to establish environmental cells in each PAA to serve as focal points for EIA works as well as other sectoral environmental policy and program analysis.

The responsibility for environmental management has been partly decentralized to provincial and local bodies. Under the 13th Amendment of the Constitution, Provincial Councils have the power to enact provincial statutes and formulate policies on environment. These statutes should be within the framework of the national law or any law made by the Parliament. In addition, local authorities such as Municipal Councils, Urban Councils and Pradeshiya Sabhas have the power to enforce environmental laws, mainly related to pollution. Since January 1994, CEA has delegated the responsibility to local authorities for issuing EPLs to small and medium scale industries. The local authorities, however, do not yet have adequate institutional capacity resulting in poor enforcement of the law.

Legal and institutional framework for land management is described in Part 1 of this sector report. Part 3 of this sector report deals with forest and protected area management.

1.2 Existing Environmental Conditions

This section presents current conditions of natural environment including land and other natural resources. The information or data herewith is based mainly on existing official documents, and partially on the Study Team's own analysis.

1.2.1 Conditions at the national level

Status of the nation-wide environment is first outlined under six categories of environmental aspects, i.e. land and water, forests and biodiversity, urban and industrial pollution, coastal and marine resources, and energy and mineral resources.

(1) Land and water

"Land to landless" for agriculture and the dependence on agriculture for employment in the rural sector are policies still being followed in Sri Lanka. Lands recently alienated for agriculture under the Presidential Land Task Force include mostly degraded lands. The productivity of these lands remain very low, and there is little hope for reinvestments in land development and productivity improvement. In the dry and the intermediate zones, shifting cultivation (chena) still remains one of the main agricultural activities of a large segment of the population.

Forest cover in Sri Lanka has reduced to about 20% of the total land area (or less than 1.5 million ha) from 70% in the beginning of this century. Though illegal logging and state-sponsored land clearing have played significant roles in this trend, a major part of the clearing has been from chena. Once these lands are abandoned because of loss in productivity, they usually remain as scrub jungles. At present, clearing of lands with a well developed secondary or primary forest is not permitted, but it is difficult to contain the people within current farmlands, without solving the problem of rural unemployment.

High income generating crops such as tobacco, potato, red onion, and exotic vegetables are encroaching into most vulnerable areas in the hilly region. Agricultural and trade policies do not discourage the cultivation of these highly erosive crops on undeveloped lands.

Emerging problems relating to water are water shortages, deterioration of water quality, health problems, and lack of effective management mechanisms. The western zone is the only area with a water surplus, while the most acute water shortage exists in the dry zone. Available supplies are sometimes threatened by pollution, and the efficiency of utilization is sub-optimal due to poor management.

Another water-related problem in Sri Lanka is that the irrigation sector is not operated in a sustainable way. Soil salinity and waterlogging are major concerns in recently developed irrigation projects, due to insufficient efforts for proper drainage. Besides, in recent years, groundwater extraction for agriculture has expanded rapidly, and there is a growing concern about its sustainability and impact on the environment.

As for drinking water supply, in 14 out of 25 districts, more than one-third of the population do not have access to safe drinking water and are using unprotected wells, rivers and tanks. Main sources of drinking water to housing units are piped water (17.5%), wells (72.9%), and other surface sources (rivers, tanks, etc. 7%). As many as 20% of wells are unprotected and allow inflow of polluted water. Water supply and sanitation facilities are often in poor conditions, and water-related deseases have a very high incidence. About 120,000 hospitalizations per year are due to diarrhea.

(2) Forests and biodiversity

Sri Lanka's biological resources such as forests and wetlands have helped regulate micro-climates, recycle nutrients, protect soil and water, control pests and diseases, and provide essential habitats for wildlife.

Closed canopy natural forests cover an estimated 1.33 million ha or 20.2% of the total land area (compared to 44% cover in 1956 and 70 - 80% around 1900). Teak, eucalyptus and pine plantations cover a further 117,000 ha. The annual rate of deforestation is by 50,000 ha (4%). Deforestation has been most severe in the wet zone, where only small patches of undisturbed forest remain. Species-rich lowland rainforests are limited to less than 10% of the total forest area, and the remaining natural forests are concentrated in the intermediate and the dry zones. Even many of the remaining natural forests have been seriously degraded, leading to substantially reduced biodiversity and low productivity. Recent surveys indicate that undisturbed old growth forests represent less than 5% of the total remaining natural forests outside of protected areas.

As an island nation, Sri Lanka's isolation has led to the evolution of many unique or endemic species found nowhere else in the world. Because of the range of topography and climate in the island, Sri Lanka holds the distinction of having the greatest biodiversity per unit in Asia. Although over 12% of the land area has been set aside for conservation, most of the large reserves are in the dry zone, and not in the wet southwest region where plant and animal diversity and endemism are most significant. Many encroachments have incurred within these areas, some of the forests within these areas have been commercially logged, and most are becoming seriously degraded.

For Sri Lanka, the Directory of Asian Wetlands resulted from 1980s Asian Wetland Inventory Project indicates 41 sites as considered to be of national importance. An increase in environmental awareness among the Government as well as non-governmental

organizations has recently resulted in commitment to sustain the ecological significance of wetlands.

(3) Urban and industrial pollution

Limited resources of local goverments have contributed to neglect of urban environmental quality. As a result, certain areas have already deteriorated severely. Some examples are a large number of low-income settlements (shanty) in urban areas throughout the Country.

Industrial pollution is clearly a growing problem in the Country. Industrial risks are also increasing, and can be linked to both loss of life and property and health impacts. CEA has developed pollution discharge standards and criteria regulating industrial activities. These include liquid effluent standards and emissions standards for gaseous pollutions. Industries have been classified as "existing" and "new" with differential short term regulations. Existing industries are required to meet these standards fully, though they have been granted a phase-in period of several years. New industries are expected to meet the standards immediately.

(4) Coastal and marine resources

Sri Lanka's coastline stretches over 1,585 km of sandy beaches, extensive lagoons and estuaries, mangroves, coastal marshes and dunes. Seaward of the coastline lie reefs of coral or sandstone and shallow beds of coastal and estuarine seagrass. Beneath and beyond extends the continental shelf, covering 26,000 km^2, or nearly half the land area of Sri Lanka. Sri Lanka's Exclusive Economic Zone covers an even larger area (over 230,000 km^2 of the ocean).

Coastal environments are an integral part of the island ecosystem, including uplands, agricultural areas and various human activities along the coast. Resources and their supporting environment of the island ecosystem are already being exploited beyond their natural carrying capacity, resulting in deterioration of coastal and off-shore resources.

(5) Energy and mineral resources

Up to now, Sri Lanka has suffered relatively little environmental damage from energy production and use. This appears to be changing, as the Country increases its overall energy usage, particularly its use of fossil fuels for transportation, industries and electricity generation.

Biomass provides the largest share of energy in the Country (over two-thirds) and is the main energy source available locally. However, the efficiency of biomass use is as low as 5 to 10% at present, and this affects both the effective supply as well as the level of air pollution emissions. A national shortage of fuelwood has been forecast beyond the year 2000 if the present trend of demand growth continues. This would inevitably lead to encroachment of forest reserves. Efficient use of biomass produced in a sustainable manner has limited adverse impacts on the environment. The principal adverse impact is on air quality from particulate matter emissions. This can be minimized through efficient stoves, kilns and furnaces.

The rapidly increasing demand for electrical energy is the major potential cause of adverse energy-related environmental impacts. With limitations of available hydro-power sites, there also is a need to expand to other forms of electricity generation. Though there is some potential for wind energy and solar power, these generally remain more expensive alternatives compared to the use of fossil fuels for thermal generation. Likewise, only limited substitution of biomass energy for fossil fuel-based electricity is likely to occur (e.g. use of bagasse by sugar mills).

Adequate transport is an essential condition to support economic development. Energy usage in the transportation sector has increased significantly in the last ten years, as more and more vehicles have been imported and placed on the road. Little has been done to expand the highway system or more importantly from the energy-efficiency and environmental standpoint, to develop urban public transport systems. The result is that existing roads are jammed with vehicles, air pollution in parts of Colombo has been measured at dangerous levels, and emissions are increasing as more vehicles are added. The efficiency of existing vehicles is very low due to poor maintenance and extensive use of two-stroke engines. Future growth projections for transportation show a continued net increase in the number of vehicles and resulting pollution.

Environmental issues associated with mineral resources exploitation are water quality, sedimentation, land degradation, land deformation, and effects on habitats, health and stream flows. The estimated number of mines in operation in 1988 was 20,000 to 30,000. On an average, each pit is estimated to unearth 50 m^3 of soil and to destroy about 60 m^2 of vegetation, amounting 1.0 to 1.5 million m^3 of soil unearthed and 120 to 150 ha of vegetation destroyed annually. Similar magnitudes may be involved in clay and sand mining. About half of the land which is directly affected by the mining operations is permanently lost for future agricultural use, and the rest needs to be rehabilitated.

1.2.2 Existing conditions in Southern Area

Environment and natural resources of Southern Area encompass a complex geology of both highland and Vijayan series, undulating topography inland and narrow flat coastal strips, all three climatic zones, nine agro-ecological zones, five major soil groups, 30 river basins, 300 km long costlines with a series of bays and lagoons, and many species of fauna and flora. Characteristic features of Southern Area are outlined below.

(1) Climate

The climate in Southern Area is prescribed largely by northeast monsoons during October through January and southwest monsoons during April through June. By the amount and patterns of precipitation due to these monsoons, Southern Area is divided, from the west to the east, into a wet zone, an intermediate zone and a dry zone, with consequent variations in flora, fauna and scenery (Part I, Figure 2.1). The dry zone occupies more than a half of the total area and covers the most deprived area known as the South East Dry Zone (SEDZ).

(2) Topography and soil

Topographically the region is hilly towards the north and northwest (up to 1,200 m above sea level) while the terrain is quite undulating and flat in the south and southeastern coastal belt which widens eastward making a broad plain in the SEDZ. Attractive scenery is a particular feature of the coastal belt from Bentota to Pottuvil, which is sculptured by a series of beautiful beaches, bays, lagoons and natural harbors.

The region has six major soil groups : red-yellow, podsolic, reddish brown earth, non-calcic brown, alluvium and low humic gley soil (Part I, Figure 3.2). These are suited to a variety of different crops, depending on the available water.

(3) Land use and changes in use

Land use in the wet zone is dominated by plantation crops (tea with 45,900 ha, rubber 26,837 ha and coconut 55,900 ha in 1994). The dry zone is used extensively for irrigated paddy (98,900 ha). Other important types of agricultural land use in Southern Area are rainfed upland crops (47,300 ha), home gardens (48,600 ha), minor export crops (37,000 ha) and others (seasonal crops with 17,200 ha, fruits 5,400 ha and other uses including grazing lands 81,400 ha). A large part of the SEDZ is preserved as national parks covering some 120,000 ha.

In 1995 land use data as compiled from information by DS division and resource profiles were determined to be largely unreliable. These and other data, however, indicate that major changes in the decade have taken place in the SEDZ. Reliable land use data for this is available for 1992 which is used for describing major land use changes since 1984 as summarized below.

1) Coverage of home gardens increased in all DS divisions, notably in Moneragala, Siyambalanduwa and Ambalantota divisions.
2) Area under paddy also increased in all DS divisions for which data are available.
3) Another conspicuous change in land use in the lower Uva region is the increase in the area devoted to sugarcane as a direct result of the change in the Government's policy in 1980s to give land to private companies. Three large sugar companies came to the area. Pelwatte Sugar Company now controls 10,500 ha of land while Sevanagala Sugar Company has its operations on another 7,500 ha. Moneragala Sugar Company has ceased to function. The outgrower system operates in conjunction with these companies.
4) A decrease in the area under forest is seen in many DS divisions notably in Buttala and Siyambalanduwa while the area under scrublands increased over the period.
5) There is a sharp decrease in area devoted to chena in Moneragala, Buttala and Ambalantota. Non-availability of land as evident from shortened fallow periods, conversion of chena to permanent cultivation and restrictions in clearance of forests explains this situation.

(4) Flora

The natural vegetation in Southern Area varies from lowland tropical rainforest to sub-montane forests and tropical thorn forests depending upon elevation and amount of rainfall. Natural forests are confined mostly to the forest reserves and National Parks. Lowland rainforests in the southwest wet zone where dipterocarps dominate forest structure and composition contain most of the floral diversity with high endemism. Approximately 50 % of woody species identified in the wet zone are endemic to Sri Lanka. In the wet zone, dominant trees form a closed canopy at 25-30m with emergents rising up to about 45 m. In the dry zone, the dominant species often do not form a closed canopy and seldom exceed 20 m in hight. In the dry zone chena cultivation has badly degraded natural forests resulting in formation of savannah with fire resistant trees, or land dominated by coarse grasses. Coastal vegetation in association with lagoons is found on the coast (Table 1.2).

(5) Fauna

The Fauna of Sri Lanka also has very high endemicity, and Southern Area covers the most important part of thier habitats. Approximately 50 % of amphibians and reptiles are endemic to Sri Lanka, the most of which show restricted distribution in lowland rainforests. Majority of endemic birds are also restricted to the lowland rainforests. Among indigenous mammalian species, four species of shrews, five rodents, one carnivore and two primates are endemic to Sri Lanka with high concentration in the lowland and mid-montane rainforests. Asian elephant sub-species, a symbol of Sri Lanka, sustain viable population in Southern Area numbering one third of the total in the Country (Table 1.3). The Gin and Niwala river systems are two of the five most important systems in the Country for the freshwater fish fauna, of which one third are endemic.

(6) Mineral resources

Mineral resources of Southern Area cover a variety of potentially exploitable materials, like mineral sands, shell beds, clay, gem stones, crystalline limestone, vein quartz, ornamental and construction stones, laterite, graphite, feldspar, kaolin, serpentine, and salt (Part 1, Figure 3.5).

(7) Environmental advantages

Favourable conditions of Southern Area in terms of environment and natural resources are the following:

1) diversity in physical features including climate, vegetation, topography, water bodies and soil,
2) 300km long coastlines with a series of beaches, bays, lagoons and natural harbours, and
3) bio-diversity of global importance with a wide variety of flora (forest, savanna, grassland, mangroves and beach vegetation) and fauna (deer, buffalo, wild boar, elephant, leopard, crocodile, bear, and local and migratory birds) supported by extensive natural reserves.

1.2.3 Conditions by district

The following are the more local-level features of natural and environmental resources existing in the districts or divisions of Southern Area.

(1) Galle district

1) Four terrain types (i.e. flat, undulating, rolling and hills, and steeply dissected rolling and hills) exist in the district upto the elevation 700m. Charnockites and charnockitic gneiss rocks cover 80 % of the district and the rest includes the quaternary and recent deposits. All these geologic formations have a basic relationship with terrains, drainage and mineral resources.

2) A significant proportion of the district receives heavy precipitation of over 2,200 mm annually (Table 1.4) Double peaks are observed in April - July (southwest monsoon) and October - November (intermonsoon). Soil erosion and flood occurrence of the district are related to rainfall patterns and surface run-off.

3) Coastal features such as headland-bay-beaches, pocket beaches, incipient dunes and coastal water bodies are invaluable assets in the district.

4) Rich mineral resources in the district include heavy mineral sands, industrial clay deposits, graphite, iron ore, gemstone and coral.

5) Several types of natural vegetation grow in the district such as low evergreen tropical rain forest, swamp vegetation, marshlands and mangroves.

6) Tree-crop plantations spreading widely in the district contribute to environment by providing ground cover and addition to biomass production.

(2) Matara district

1) Topographically, 10 - 20 % of the district's land is considered to be hilly where the dominant elevation ranges between 300 and 750 m. In each of the divisions of Kotapola, Pitabeddera, Akuressa and Pasgoda, 40-50 % of the area comprise mountainous regions, dissected plateaus and steep slopes.

2) The oceanic influence is marked in regard of diurnal temperature conditions in the district, particularly in the months of February, March and April. The influence of the scorching sun's radiation is mitigated by the oceanic influence.

3) The district receives approximately 2,500 mm of rainfall annually. During the past two decades, the increasing rate of deforestation has accelerated the rate of surface runoff particularly in the divisions of Mulatiyana, Kotapola and Pasgoda.

4) A high proportion of the land area in the district is covered with red yellow podzolic soil. The most widespread and dominant soil group in the district has characteristics such as deep to very deep, well drained and occasionally having a stone at some depth. Highly productive and discontinuous aquifers are associated with 35 % of the geological structure. Discontinuous and moderate to low potential aquifers in fractured rock are associated with 65 % of the structure.

5) The natural forest cover of the district has been gradually dwindling since the beginning of the century. The remaining forest cover can be divided into three groups, i.e. tropical rain forests, tropical mountain forests, and dry mixed forests. As a conservation strategy, some of the forest areas have been designated as 'forest reserves'.

6) Matara being a district located in the wet zone, periodic setting of fire in chena lands prohibits the growth of a proper forest cover, and Talawa grasslands spread in the abandoned chena lands. Soils in Talawa vegetation zones is low in humus content and poor in water retention capacity.

7) Weligama and Matara possess ideal environmental conditions for the growth of mangroves in shallow lagoons and river deltas.

8) The purple-faced monkey is quite common in the thick rain forests in the district. The toque monkey is frequently found in the protected forest lands. Other large mammals common in the rain forests are wild pigs, Sambhur, mouse deer, barking deer, rats, shrews and squirrels. Another type of widely distributed mammals are bats that feed mostly insects.

9) The habitat needs of birds are provided amply by the wetland ecosystems and rainforest cover in Mulatiyana, Pitabeddera, Pasgoda and Kotapola divisions. Most bird species are habitat sensitive and likely to be eliminated if plant cover is disturbed.

10) The diverse ecosystems associated with rainforests and grasslands are environments conducive to the propagation of reptiles. Snakes and lizards are abundantly found in the divisions of Kotapola and Pitabeddara while Russell's viper is rarely found in grassland or secondary forest cover. The types of amphibians found abundantly are frogs and toads.

(3) Hambantota district

1) In general, the district is described as a low-lying rolling plain, except for a few mountain ridges in the west, the north-west and the north-east. Elevation varies to a maximum of 2,700 feet above sea level, at Rammalkanda, in the north-west. The central parts of the district, from approximately Weeraketiya to Tissamaharama, are almost entirely characterized by a gently rolling plains.

2) The district lies largely in a transitional zone between the Vijayan series and the highland series demarcated roughly by the Walawe river. The coastal area is covered predominantly by Quaternary deposits. These are evident along beaches, lagoons, lakes, and estuaries and in floodplains of rivers.

3) The district, for the main part, lies within the dry, semi-arid climatic zone. The average rainfall annually ranges between 888 mm in the east, to about 2,157 mm in the extreme northwest. The greater part of the district, covering approximately two-thirds of the total land area, receives less than 1,270 mm annually. At Hambantota city, the average annual rainfall is only 1,070 mm. Most of it comes during October, November and December.

4) A fairly obvious feature of the surface hydrology of the district is the existence of a very large number of tanks and inland reservoirs. Major tanks and reservoirs cover an area of approximately 3,328 ha.

5) There are eight main soil types in the district. The most widely distributed, and perhaps the most important among them are the reddish-brown earths and low humic gley soil. These types of soil are located mainly across the central part of the district, particularly in interfluvial areas. Reddish-brown earths and immature brown loams are found mainly in the intermediate zone, particularly on rolling, hilly terrains.

7) It is possible to classify natural vegetation of the district into six broad groups, i.e. woodlands with thorny scrub, mangroves, saline swamps, strand plants, coastal forests, and aquatic plants associated with inland water-bodies. One of the interesting features is that the northwestern hill, and particularly Rammale Kande, is the natural habitat for a large variety of medicinal plants and herbs. Many rare plants are found in this area. Some of these plants and herbs contain antiseptic properties.

(4) Southern and southeastern parts of Moneragala district

1) Moneragala district has undulating and flat terrains, which cover the broad eastern and southern plain occupying about three fourths of the district. The elevation is below 160 m and the terrains are underlain by Vijayan series.

2) The total rainfall in the district is around 1,500 mm a year. Over 84 % of rain is received during the seven rainy months of October to January and March to May. Rainfall varies significantly from year to year for any month.

3) A variety of soil types are identified in the area. There are two dominant soil groups in the area, namely reddish brown earth and red yellow padzolic soil.

4) A considerable extent of land in the area is under natural reserves and forests. However, the forest cover is mainly a secondary climax developed after a long period of earlier civilization based on irrigated agriculture. Since then the forest area has been disturbed by chena agriculture and in more recent times by a large scale of illicit felling. The grasslands are found in Buttala and Thanamalwila divisions, bordering forest areas. They are locally known as "dry patanas" and dominated by guinea grass (Panicum maximum), illuk (imperata Cylindrica) and Mana. Illuk is wide spread in flat and undulating dry areas, where extensive chena has been practiced.

5) The forested area is inhabited by diverse fauna which includes six endangered (elephant, leopard, Red-faced Malkoha, Esturine Crocodile, Bengal Monitor and Python) and two threatened (Purple-faced Langur and Togue Macaque) animal species.

6) Out of wildlife habitats most important areas are the Yala Park and the extensions of forest to the north inside the district boundary plus the adjacent Kumbukkan and Panama forest reserves and the Lahugala sanctuary to the east of the boundary. The other park habitats like Uda Walawe are mainly covered in chena and scrub jungle and less important compared to Yala.

(5) Embilipitiya and Kolonna divisions of Ratnapura district

1) Elevation of Ratnapura district ranges from 30 m to 2,135 m. Mountain ranges, high peaks, dissected plateaus, and escarpments cover a greater part of the district. From its height and slope characteristics the two divisions within Southern Area can be classified into the lowland (which includes mainly the basins of the Walawe Ganga

and/or the uplands with an elevation of 270 ~ 1,060 m, consisting of a ridge and valley topography). The Walawe Ganga flows across undulating terrains and drops gently from the foot of the Central Highlands. Many of the lateral tributaries of the Walawe Ganga in its western flank rise in the Rakwana massif, the Southern Platform and eastern part of the southern rim of Central Highlands.

2) The average annual rainfall in Ratnapura district is around 3,800 mm, but varies from 1,250 mm in the southern extremities to over 5,000 mm in the northern parts of the district.

3) Two main vegetation types occur in Ratnapura district, i.e. the tropical rain forest and the mountain forest. The tropical rain forest occurs in the Sinharaja forest. Towards the south there are stands of deciduous trees among the evergreens. Main organic or living resources in the district are found in forest resources and wildlife. In Embilipitiya division, the poor are drawn to reservations to collect medicinal plants and herbs and bee honey.

4) Quartzite (in Embilipitiya division), clay deposits (in Kolonna division) and graphite and mica (in both divisions) are the potential resources which are regionally distributed. The clay deposits are widely used for ceramics, pottery and the manufacture of bricks, but the mining of graphite and mica is limited due to the lack of transportation facilities. Gemming occurs in all divisions in Ratnapura district, but Embilipitiya division is where most activities are found.

5) Chena cultivation is a feature in both divisions. Traditionally chena cultivation had been a system of utilizing unirrigable 'high-land'. Hill slopes were cleared in small patches. However, chena cultivation in Embilipitiya division is characteristic of the more extensive system found in the lowland dry zone.

(6) Lahugala division of Ampara district

1) The average annual highest temperature is over 27 degrees C, while day-time temperature is lower than other places due to the sea breeze. The division belonging to the dry zone gets major rain only during one season from November to February (over 750 mm), with little rain received during March, April and September. The annual average rainfall is 1,500 to 2,000 mm.

2) The natural vegetation for this division is low-country salty forest. All the trees in the area grow during the rainy season. Two thirds of the total division area (about

900 km^2) is covered by forest trees. Forest resource is an important factor in the division. Valuable hard-timber tree forests like ebony and satin can be used for house-building and furniture-making, while there are medicinal herbs as well as bee honey. Kandal shrubs are found in and around tanks and rivers.

3) There are many rivers and tanks in Lahugala division. Lands closer to rivers and tanks are suitable for paddy cultivation and home gardening. The next important resource is clay which is used to make bricks and pots. Besides, abandoned areas after cultivation of food crops are full of grass resources, which can be very well used for animal husbandry.

4) Fresh-water fish varieties are also found in rivers and tanks, while a lot of animals and birds live in the natural surroundings. Birds from Australia and East Indies migrate to the area.

1.3 Environmental Problems

1.3.1 Nation-wide problems related to environment

The latest strategic document for environmental management authorized by the Government, "National Environmental Action Plan" (MEPA, June 1994) has analyzed that the most significant environmental problems presently facing Sri Lanka are : (1) deforestation, (2) land degradation (mainly through soil erosion, salinisation and mineral extraction), (3) fresh water management, (4) coastal zone degradation (mainly due to coral mining, pollution and over-fishing), (5) urban and industrial pollution to a lesser extent, and (6) environmental consequences of energy use. Many factors contribute to the Country1 s environmental problems. They include resource demands of a growing population, long-standing civil conflicts, sector and macro-economic development policies which often conflict with environmental sustainability, lack of infrastructure necessary for rapid urban and industrial development, an inadequate environmental policy as well as poor institutional and regulatory frameworks.

1.3.2 Existing environmental and land-related problems in Southern Area

Various environmental and land related problems exist in Southern Area. They may be classified into two types; problems caused by economic and other human activities, and problems of environmental administration.

(1) Soil erosion and deforestation

Soil erosion is serious particularly in Galle, Hambantota and Moneragala districts as a result of deforestation, encroachment of forest reserves, land reclamation, blasting of rocks and mining of clay. Chena cultivation and development projects are other major factors for the deforestation and soil erosion in Hambantota and Moneragala districts. In Hambantota, the area under chena cultivation has become larger, cultivation periods longer, and intervals of "rest" for the rejuvenation of the soil shortened from 10 to two years. Natural forest cover in Moneragala district has decreased by 70% since 1956 at an average rate of 16,000 ha annually. Mono-cropping of sugarcane and tobacco has also contributed to soil erosion and soil degradation in Moneragala.

Deforestation and encroachment of reserves are problems also in upland areas of Matara and Ratnapura districts. Deforestation has resulted in the depletion of medicinal herbs and rare species of trees and lianas both in the wet and the dry zones. Even the loss of fauna has been reported. Galle and Matara districts face shortages in fuelwood supply.

(2) Coastal zone degradation

Coastal erosion is a problem in Galle and Matara districts. The problem has been aggravated by the destruction of nearshore coral reefs, removal of sand from beaches, desultory use of coastal lowland and construction of ill-planned coastal structures. Coral and sand mining is particularly heavy in Galle. The national road No. A2 has been seriously threatened by coastal erosion in some sections such as the western coastal stretch of Galle district and Midigama in Weligama.

(3) Water pollution

Surface water is already seriously polluted by human activities in some areas of Galle, Matara, Hambantota and Ratnapura districts. The Walawe Ganga is frequently polluted by a discharge of effluent from the National Paper Corporation plant and a sugar factory. Other rivers are also polluted by agro-chemicals and discharges of wastewater.

Degradation of coastal and inland wetlands has also occurred particularly in Galle and Matara districts due to discharge of effluents, solid waste dumping in channels, application of chemical fertilizer and agro-chemicals, and other exploitation of wetlands. This affects the supply of drinking water and causes depletion of fish and insects, spread of weeds and depletion of some plants.

Groundwater in Hambantota district suffers from high contents of iron and fluoride. The western part of the district yields groundwater with a high iron content, while deep aquifers of the eastern part show high fluoride levels.

(4) Saline water and soil salinization

Intrusion of sea water is a problem in low lying areas along the coast of Hambantota and Matara districts, and also in some areas in Galle district. Paddy fields have been affected by the inflow of brackish water in Hikkaduwa Ganga, Thelwatta Ganga, Ratgama Lagoon and Urawatta Delta areas of Galle district. Paddy fields in Hambantota district have also been affected by sea water intrusion in the downstream area of Walawe Ganga.

Soil salinity is another inherent phenomenon constraining agriculture in dry areas of Hambantota district. Structural measures taken to alleviate the flooding problems in downstream areas of Nilwala Ganga have resulted in build-up of soil salinity and alkaline soil.

(5) Gem mining

Gem mining causes various environmental problems particularly in Ratnapura and Moneragala districts. Abandoned gem pits unfilled or partially filled provide a breeding ground for mosquitoes and cause malaria. Overcrowding under unhygienic conditions in some mining areas has raised the incidence of water-borne diseases such as typhoid, para-typhoid, dysentery, ineffective hepatitis and enteritis.

(6) Conflicts with wildlife

During the past few decades, agricultural development in the dry zone of Southern Area removed a significant portion of forest. Existing protected area system in Southern Area cannot accommodate the elephant population throughout the year, owing to limited fodder and water resources during the dry season. As a result, the majority of elephant herds are free-ranging in developed areas outside reserves. In some areas, whole herds have got trapped or isolated in small scrub forest patches surrounded by cultivations and habitations - phenomenon know as pocketed herds.

Seedlings for forest plantations are damaged by elephants, deer, and buffalo/cattle grazing as well as by the dry climate. The survival rates of seedlings are 20% in Hambantota and over 80% in Moneragala.