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RESOURCE ASSESSMENT AND LAND USE PLANNING IN SRI LANKA: A CASE STUDY

By

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This has been a rapid and preliminary survey which must include errors of fact and judgement that are not the responsibility of our informants.

ACRONYMS and ABBREVIATIONS

AGA	Assistant Government Agent, in administrative charge of an AGA Division within a District
ADP	The UNDP/FAO Agricultural Diversification Project that operated from 1970 to 1975 within the Department of Minor Export Crops, Ministry of Plantation Industries
FAO	The Food and Agriculture Organization of the United Nations
IBRD	The International Bank for Reconstruction and Development
IRDP	Integrated Rural Development Project. Several Districts have such organizations which are externally funded and address rural poverty through a variety of agricultural and infrastructure programs
LUPDD	Land Use Policy Planning Division, set up in 1979 within the Ministry of Lands and Land Development. Now within the Ministry of Lands
MLLD	Ministry of Lands and Land Development. Now incorporated within the Ministry of Lands
NADSA	National Agricultural Diversification and Settlement Authority. Now the Hadabima Adikariya (Heartland Authority)
NGO	Non-governmental organization
PC	Personal Computer
UNDP	United Nations Development Program
VP	Vegetatively-propogated (clonal) tea, as opposed to seedling tea

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CHAPTER ONE

EXECUTIVE SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This review does not attempt to be comprehensive. Instead, we highlight:

- benchmarks in the evolution of land use policies in Sri Lanka;
- the actual contribution made to decisions about land use by systematic information on land resources.

Recommendations are made to provide better support for decision-makers at all levels. A summary of legislation, a list of agencies responsible for planning and land resources data and an extensive sourced bibliography are provided.

1.1 LAND USE POLICY AND LAND USE PLANNING

- In Sri Lanka, there has been a hesitant evolution of land use policy away from the simple attraction of capital for plantation industries, through successive attempts to promote and protect a peasant economy, to the present imperatives of employment creation and sustainable development of natural resources. This last goal remains elusive. In many areas, land use is obviously badly matched with the land which is being visibly degraded. It is well understood that the present pattern of land use is not sustainabled yet systematic information on land resources is scarcely used at any level of decision-making.

- The failure of land use planning stems from the Land Development Ordinance of 1935 which initiated centralized planning through legalistic controls on land use. A paternal bureaucracy has persistently tried to plan and control every activity on every acre, becoming overwhelmed in the process by the workload. One prerequisite of improvement is a switch from a regulatory system of planning to an advisory system.

- Since 1979, the lion's share of the development budget and managerial capacity has been absorbed by the Accelerated Mahaweli Project. Impressive achievements have been made in power generation and the extension of irrigated land in the Dry Zone. However, it has not achieved the aim of absorbing significant numbers of people from the crowded Wet Zone.

- In the Wet Zone, clouded land title remains a drag on development. A program of rural renewal must include summary adjudication of land claims, registration of title, consolidation of fragmented holdings, access to credit and improvement of infrastructure.

- The virtual absence of participation in the planning process by local communities and the supposed beneficiaries is striking. So is a lack of local commitment to many land development projects. People's participation in land use planning is a new concept in Sri Lanka but might be extended through empowerment of existing local water management groups to make decisions on change of water rights, land use and, even, land tenure.

1.2 LAND RESOURCES INFORMATION

- There is a lot of good information about land resources in Sri Lanka but limited use is made of it in the development of policy or in the management of the land. This may be attributed to the uniquely fragmented institutions responsible for provision of land information and land use planning, the limited capability of decision-makers to make use of technical information and the absence of any established place for natural resources information in the decision-making process. Rarely is this information carried to the point of decision by natural resources specialists and potentially valuable information is often lost on the way.

- It is difficult to see how a place for systematic land resources information can be established in the process of decision-making other than by land resources specialists. Policy-makers have called for this several times over the last 20 years. Institutions have been established but never adequately resourced.

- The information available to decision-makers seldom answers the questions that they are asking. The information must be timely, in plain language, illustrated by clear figures and based on reliable, quantitative data. Equally, decision-makers need dynamic information to keep pace with changing circumstances and may need to draw on a particular set of data repeatedly. As a rule, they don't get this kind of information.

1.3 RECOMMENDATIONS

- Along with the present decentralization of authority, there needs to be an appraisal of the requirements for land information and the capability to use it. The kinds of natural resources surveys, land use planning and project management that have been undertaken up till now in Sri Lanka should not be continued. Greater emphasis should be placed on community participation in the establishment of issues and setting of priorities. Stronger institutions will be needed for planning and implementing land use at all levels, and these will need systematic information about land resources - very detailed at local level, generalised at provincial and national levels.

- The limited ability to use land information is as great a constraint as shortage of relevant information. There is a great need for training at all levels, both in the appreciation of land resources and to build up the capability to make use of resources information - particularly at the level of policy-makers who are frequently excluded from training under technical assistance projects.

- There is no prospect of professional surveys supplying the detailed land resource information needed at the grass roots. Local groups will have to fend for themselves, both in gathering the data they need and in interpreting them for day-to-day management and forward planning. They can be assisted by tailor-made survey and decision-support kits. Land resources specialists and planners should switch some of their attention from increasingly sophisticated technology to such basics that can be applied immediately in the field and which build on the knowledge of local communities.

CHAPTER TWO

ENVIRONMENTAL CONDITIONS AND THE AGRICULTURAL ECONOMY

2.1 BRIEF ENVIRONMENTAL PROFILE

2.1.1 Climate

Sri Lanka measures 430 km from north to south and 224 km from east to west. The land area is 65 200 km^2. A basic climatic and ecological difference is universally recognised by division of the island into the Wet Zone that occupies the southwest quadrant and the Dry Zone that occupies the north and east (Figure 1). The Wet Zone receives from 2000 mm to some 5500 mm mean annual rainfall, most during the two intermonsoonal seasons and, also, during the SW monsoon that brings heavy rain to the SW hill country. There is a weak dry season of about ten weeks, January to mid-March (Figure 2a).

Rainfall in the Dry Zone is mostly bimodal with the main rainy period from October to December and lesser rains from mid-March to mid-May for most areas. In the long dry season, May to August, there are strong, desiccating winds and mean monthly rainfalls of less than 50 mm (Figure 2b). In the driest enclaves in the extreme northwest and southeast, mean annual rainfall is about 1000 mm.

Mean annual temperature at sea level is 28°C with little variation. Mean annual temperature at 2000 m is 18°C.

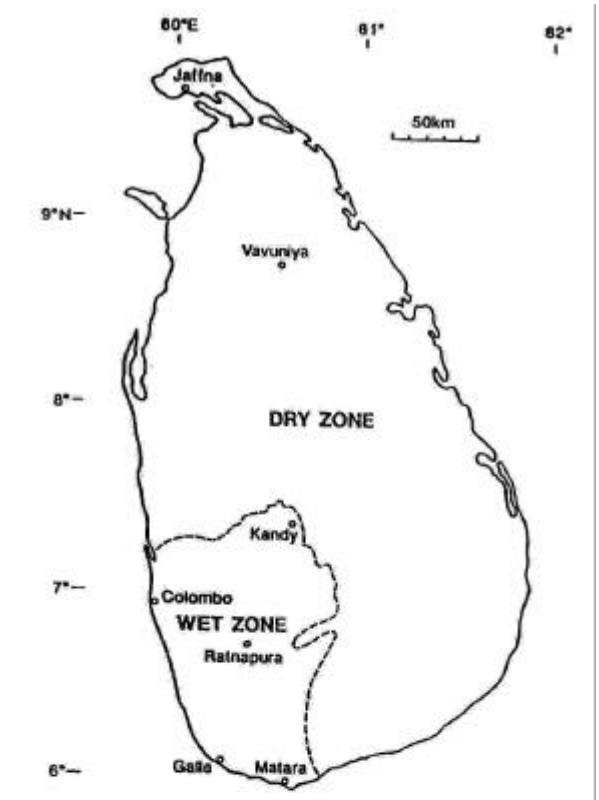
2.1.2 Landscape, Vegetation, Land Use and Population

The Low Country of the Wet Zone is hilly and dissected by many perennial streams. It supports a dense rural population in hundreds of villages amidst paddy fields, home gardens, coconut groves and plantations of tea and rubber. The main cities of Greater Colombo, Galle and Matara lie in the coastal strip.

The High Country of the Wet Zone rises in steps to plateaux at about 450 and 750 m, higher ranges rising to 1500-1800 m, and peaks like Pidurantalagala (2524 m), Sri Pada (2238 m), and the Knuckles (1863 m). At elevations up to about 1000 m, natural vegetation is lowland evergreen and semi-evergreen rainforest, giving way above 1000 m to montane rainforest, but only fragments survive. Most of the land has been cleared for tea plantations, rubber at lower elevations, terraced rice fields and vegetable gardens.

The Dry Zone Plains are undulating with isolated hills, drained by a few large rivers and many seasonal streams. Agriculture is dependent on water storage in tanks and systems of irrigation canals that were developed from the first millennium BC to the 13th century. Decline and abandonment of these lands and depopulation lead to regrowth of monsoon and thorn forest over much of the Dry Zone until reclamation by new irrigation schemes over the last 30 years.

Figure 1: Sri Lanka, Broad Climate Zones



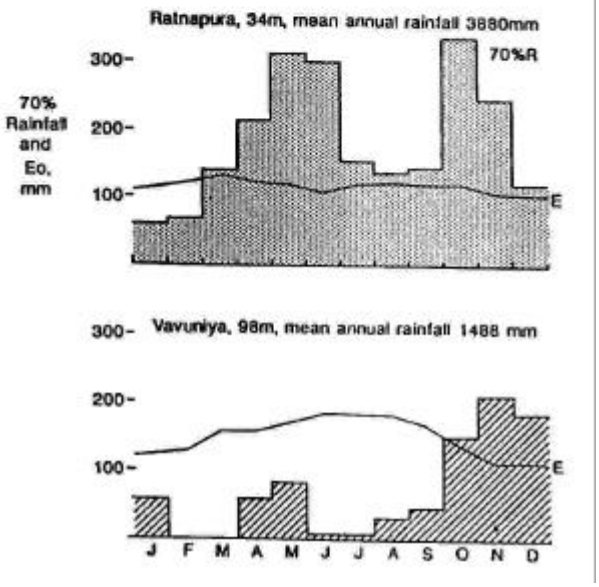


Figure 2: **70% Rainfall Probability, 70% R mm; and Evapotranspiration, E, mm a) Ratnapura b) Vavuniya**

The Jaffna Peninsula in the extreme north is dry, limestone country almost surrounded by sea and lagoons. But it supports some of the most intensive farming, making use of groundwater for irrigation.

The population of Sri Lanka was 17.2 millions in 1989 and growth since 1980 is estimated to be 1.3 per cent annually (Dept. Census and Statistics 1989). 57 per cent live in the Wet Zone, 43 per cent in the Dry Zone; 21.5 per cent in urban areas (c 1.2 million in Greater Colombo) and 78.5 per cent in rural areas. This represents 0.4 ha/person, but only 0.17 ha arable land/person, even allowing the whole area of *chena* (shifting) cultivation (Table 1).

Table 1. Land Use in Sri Lanka, 1990

Land Use	Extent (000s ha)
Urban area	20
Forest	2071
Forest Plantations	79
Scrub and grassland	452
Swamp	35
Paddy, irrigated and bunded rice	753
Homestead gardens	970
Chena (shifting cultivation of rainfed crops)	1224
Coconut	326
Rubber	230
Tea	220
Minor export crops	72
Palmyrah	27
Sugar cane	17
Unused	22

	6520

(Source Land Use Division, Irrigation Dept.)

2.2 THE AGRICULTURAL ECONOMY

2.2.1 Historical Trends

In 1989, agriculture employed half of the workforce, directly or indirectly supported three quarters of the population and produced one quarter of the gross domestic product.

The nationalized plantation sector has declined continually since the 1970s when tea, rubber and coconut together contributed 90 per cent of exports. The figure is now less than 40 per cent, partly thanks to diversification of the national economy but mainly due to an absolute decline in production and a dramatic fall in Sri Lanka's share of world markets (Ministry of Plantation Industries 1989).

Decline may be ascribed to a lack of opportune investment; rising interest rates and wages while carrying the social burden of a huge labour force of some 425 000 workers; and land degradation, since many plantations were established on marginal steeplands and standards of soil conservation have not been maintained. Over recent decades, Sri Lankan exports have faced competition from newer plantation industries in better-suited areas and run on more strictly commercial lines. Privatization of plantations is now government policy.

Economic and political pressures on the new management of tea and rubber estates are forcing them to think seriously about land use planning. New commercial investment is likely to be restricted to the best-suited land. Indeed, there has been a significant revival in tea production over the last five years as a result of rehabilitation of plantations, particularly for low-grown tea, and better marketing in the Middle East.

Diversification of land use in uneconomic plantations has been government policy since the 1970s. It has not proved easy although the volume of minor export crops, notably cinnamon, has increased. A case study of the Tree Crop Diversification Project is included in Chapter Four.

In the small farm sector, farms of less than 2 ha comprise 90 per cent of holdings and two thirds of the farmland. Farm size is decreasing: the average size of holdings less than 8 ha was 1.3 ha in 1946, 1.1 ha in 1962, and 0.8 ha in 1982. Fragmentation of holdings is increasing: the number of parcels per cultivator was 2.5 in 1962 and 3.1 in 1982 (Wanigaratne 1989). As farm size and fragmentation approach the limit of viability, heirs do not subdivide further but take turns in using the land. This kind of co-ownership probably affects one third of privately-owned land in the Wet Zone (West 1987). State land alienated under various schemes since the 1930s has been allocated under forms of restricted tenure in an attempt to maintain viable farm units without subdivision.

The private sector accounts for about 18 per cent of land in Sri Lanka. Of this, 68 per cent is farmed by owner cultivators, whereas in the 1930s three quarters of farmers were tenants. However, absentee ownership remains common, especially of coconut groves where city-based owners keep land as a refuge and return mainly for harvesting.

The small farm sector, like the plantation sector, has absorbed a large measure of underemployment and landlessness at the cost of restricted capacity to attract capital or effect structural change. In the absence of alternative employment opportunities, marginal land is continually encroached by squatters who do not have the incentive or resources to manage it in a sustainable way.

2.2.2 Agricultural Expansion and Intensification

In the last 15 years, 400 000 ha of land has been brought into production, mostly in the Dry Zone. The biggest single contributor is the Accelerated Mahaweli Project that now irrigates some 50 000 ha in the *maha* or main rainy season and 35 000 ha in the *yala* or lesser rainy season. 64 000 families have been settled,

mostly on small farms with 1.0 ha of irrigated paddy and 0.2 ha of upland. A case study of the Accelerated Mahaweli Project is included in Chapter Four.

Further expansion on this scale, relying on irrigation, cannot be repeated. Karunatilake (1987) estimates that maximum use of irrigation capacity in the Dry Zone would increase arable land by a further 12-13 per cent. The Land Commission (1987) estimated that a further 2 million hectares might conceivably be brought under cultivation but much of this is currently under forest, much is marginal and needs improved methods of dry farming, and much of is already subject to encroachment - perhaps 500 000 ha. The Presidential Task Force on Land Utilisation and Distribution (1990) set up to identify and distribute State land that could be used for cultivation, estimates that no more than 400 000 ha could be developed, 80 per cent in the Dry Zone.

There remains scope for intensification of land use if a further phase of investment can be financed. Crop yields are modest by S.E. Asian standards, average yields are held down by the large areas of *chena*. Irrigated paddy yields reach 10 t ha^{-1} yr^{-1} in double-cropped areas of the Uda Walawe irrigation scheme but, even in the Mahaweli scheme, it is estimated that 20 per cent of settlers cannot cultivate their irrigated plots for want of credit, or through deficiencies in land preparation or water supply (Scudder and Vimaldharma 1989).

There are opportunities for more diversified cropping and agro-industries if markets and infrastructure are developed and land use is matched more closely with the qualities of the land. In the Wet Zone, land could be released by replanting with high-yielding tea and rubber (for example, 85 percent of tea plantations are still under old seedling tea), although the land released would be, at best, only marginal for farming. Better watershed management is essential to protect the reservoirs and downstream irrigation systems. There is also opportunity for inter-cropping of coconut groves with coffee, pepper, bananas and pasture (only about 20 percent of coconuts are interplanted now).

In the Hill Country, pressure on the land is visibly degrading natural resources - soil, water and forests. The present land use pattern is not sustainable, physically or economically, and this is well understood by government and people. Dissanayaka (personal communication) relates a statement by local farmers to the Land Commissioners, gathering evidence of dried up streams in the Hill Country as a result of cultivation of soil erosion under tobacco cultivation.

> "Sirs, we appreciate the problems, see the cause and effect, as well as you do. But how else are we to live ?"

Chapter Three reviews the succession of attempts to address this problem.

CHAPTER THREE

OVERVIEW OF LAND USE PLANNING

Acquisition of the greater part of the land by the State through the Crown Lands (Encroachment) Ordinance of 1840 and the Waste Lands Ordinance of 1897 paved the way for the establishment of tea, rubber and coconut plantations in previously-forested land. More than 80 per cent of land is still under some form of state control (Table 2). This has encouraged government involvement in land use planning, which has arisen independently on several occasions with remarkably little cross fertilization of ideas and experience.

A bumpy evolution of land use policy away from simple attraction of capital for plantation industries has seen successive attempts to preserve and promote a peasant economy, on the one hand, and to plan the fullest use of land and water resources on the other hand. The government now sees its task to be to integrate land use policy with the need for employment creation and with the need for conservation and sustainable use of natural resources.

Table 2: Land Ownership in Sri Lanka

	000s Ha	% of Total
1. Total land area	6 570	
2. Private land	1 166	17.7
- freehold	1 065	16.2
- land grants	101	1.5
3. State land	5 404	82.3
- alienated under various schemes[1]	818 - 1 000	12.5 - 15.2
- vested in Land Reform Commissioner[2]	406	6.2

1. Village expansion, colonisation, middle class allotments, highland colonisation, youth settlement, encroachment regularisation, special leases

2. Land nationalised 1972-75, mostly plantations, perhaps 20000 ha paddy

Source: Wijetunga 1991

3.1 GOALS OF LAND USE PLANNING IN SRI LANKA

3.1.1 Land Settlement

Stemming from the Land Development Ordinance of 1935, the strategy for land settlement in Sri Lanka has tried to promote the greatest number of self-sufficient smallholders. Policies to this end have included restrictions on sale and inheritance, land reform, village expansion schemes aimed at relieving overcrowding in the Wet Zone by developing swamps or expropriating plantation land, and settlement schemes based on the development of irrigation in the Dry Zone.

3.1.2 Land Reform

Land reform in favour of greater equity has been a recurring theme but has not been followed consistently. Land reforms initiated in 1956-1959, in particular the Paddy Lands Act of 1958, aimed to give greater security of tenure to tenant farmers and to facilitate their participation in planning the management of land and water resources through cultivation committees. Implementation was impeded by the landlords and the responsible minister (P. Gunewardene) was expelled from the government.

A different approach was adopted by the 1972 and 1975 land reforms that limited land ownership per family to 25 acres of paddy or 50 acres for other purposes. Most plantation land in the Wet Zone was taken into state ownership and management. Comprehensive top-down land use planning and resettlement of uneconomic plantation land was initiated by the UNDP/FAO Agricultural Diversification Project and implemented by the National Agricultural Diversification and Settlement Authority. In practice, however, plantation managers have been able to retain the best land and little use is made of natural resources information either in land use or settlement planning.

3.1.3 Transfer of Population

Transfer of population from the crowded Wet Zone to irrigated land in the Dry Zone is also a long-established policy. Actually, little transfer of population has taken place.

Since 1979, the Accelerated Mahaweli Project has taken the lion's share of the development budget and managerial capacity. There can be no denying the achievements in terms of land brought under irrigation yet, even within the Mahaweli development, families displaced by the Victoria Reservoir and families already in the Dry Zone waiting for allocation of land have absorbed most of the government's administrative capacity. Few people in the Wet Zone have been attracted by the terms of tenure offered, nor have there been significant tracts of land available to them. The security situation over at least half of the Dry Zone, and lack of educational and health facilities, are big disincentives to migration.

Agricultural development has been almost entirely for paddy smallholdings. This is in line with the goal for land settlement (see section 3.1.1) but, also, reflects managerial constraints to establishing a more complex pattern of land use. The big decisions were taken with just enough advance natural resources information. Since then, the speed of development has been such that it has consistently outstripped the provision of land information other than the topographic data essential for engineering works.

3.1.4 Optimal and Sustainable Land Use

The task of development is now more complex than was perceived just 15 years ago. Opportunities to increase the irrigated area are now less. Emphasis will have to change to intensification in both irrigated and rainfed areas, and there is a greater need for diversification of employment opportunities.

Sheer pressure on land resources has prompted a welter of legislation to promote good land use (Appendix 1). For example, the Agrarian Services Act 1979 makes it a legal requirement to cultivate all agricultural land intensively - if not, such lands may be made available to others. Again, legislation to promote soil conservation includes regulations concerning protection of forests, steep slopes and stream reservations. None can be implemented. Indeed, past policies have unwittingly encouraged encroachment and exploitative cropping systems.

The thirteenth amendment to the Constitution (1987) affirms the need for integrated planning of land use and development. This is encompassed by the National Conservation Strategy (1988). And yet the goal of sustainable development remains elusive. Innovative thinking and radical action will be needed by policy-makers, planners and natural resource specialists, and land users if it is to be achieved.

3.2 BENCHMARKS IN LAND USE PLANNING

This preliminary review of land use planning in Sri Lanka does not attempt to be comprehensive. Instead, we have selected some benchmarks in the development of land use policy and land use planning to illustrate their evolution in Sri Lanka. More details of some of these are given in the case studies in Chapter Four.

3.2.1 Mapping Out

A change in government policy away from exclusive promotion of plantation crops was foreshadowed by Clifford in 1927 and the First Report of the Land Commission, 1928/29, that recognised the need to provide both for plantation industries and for the burgeoning needs of village populations. The Land Development Ordinance of 1935 institutionalised a *'mapping out'* procedure involving assessment of village needs, physical land evaluation, land survey, broadly-based consultation, allocation (alienation) and subsequent administration of State Land (Box 1).

Stemming from the Land Development Ordinance, which remains in force, planning has been implemented primarily by legalistic controls on land use. For example, the Land Commissioner's Department has been responsible both for alienation of land and its subsequent administration through leaseholds and restrictions on sale and inheritance to prevent subdivision of holdings.

The government undertook an enormous technical and administrative load in the survey and registration of each individual plot and in embarking on the subsequent administrative management of the land. For colonisation schemes in the Dry Zone, it was found necessary to clear the land, to provide irrigation, planting materials and housing at public expense, and to subsidise activities for several years. The load soon exceeded the capacity of the administration despite increases in staff of the Survey and Land Commissioner's Departments.

Box 1: The Mapping Out Procedure

Under Land Development Ordinance 19, 1935, Mapping Out Officers of Survey Department were responsible for earmarking land specifically for:

- village expansion
- village forest
- village pasture
- chena cultivation
- other village purposes
- colonization
- alienation to middle class Ceylonese
- alienation to any purposes irrespective o f class or race
- protection of sources and courses of streams
- prevention of soil erosion
- forest reserves
- archaeological reserves
- government purposes
- requirements of local authorities
- development of towns
- other prescribed purposes, eg, mining and gemming,
- fauna and flora reserves

Mapping Out Officers were to consult the Divisional Forest Officer about preservation of forests, the Department of Agriculture in order to select land suitable for farming, and the Irrigation Department about irrigation facilities. Village headmen were required to complete a schedule of village needs, specifically:

- population in last 40 years
- area of paddy land owned by villagers
- area of gardens of upland owned by villagers
- numbers of buffalo and cattle kept in the village
- localities on Crown Lands used to obtain timber and other forest products
- Crown lands suitable, or ever used, for paddy and lands that could be restored
- Crown lands used for chena cultivation at any time
- Streams upon which paddy lands depend, whence they rise and traverse
- Sources of water supply for the village

Officers were to check information in the field and produce a coloured plan for each village on 1: 3 168 village plans or 1: 12 672 record diagrams showing actual and recommended land use.

The Government Agent was empowered to appoint an advisory committee of five persons not in Government employ and to take representations from the public before submitting an agreed scheme to the Land Commissioner for confirmation and publication. For implementation, surveys were to be made to demarcate reservations and land for settlement. For village expansion in the Wet Zone, one acre lots were to be provided and a 'Land Kachcheri' held to receive applications and allot land, which was to be staked out on the ground and a plan prepared for registration and for the recipient. Also in the Wet Zone, larger estates were alienated to the middle class in 25 acre blocks for plantation crops. In the Dry Zone, colonisation schemes were organised, the usual allotment being five acres of irrigated land and three acres of upland.

2.9 million acres have been alienated under the Land Development Ordinance (Wijetunga 1991).

Subdivision of alienated land through sale or inheritance is not permitted in principle. However, subdivision to a minimum area of 1.5 ha is allowed and, in practice, dealings in tenancies take place without hindrance. The situation on the ground is sometimes far removed from the situation on official files. Today, in areas of the Mahaweli development scheme designated as 'commercial farming areas', blocks of 25 acres or more are leased out on submission of project proposals by entrepreneurs and trading in land takes place with government encouragement.

The mapping out procedure did not survive the political and social upheavals following independence and was removed from the Land Development Ordinance in 1973. Though it was reinstated in 1981, the means to undertake it in practice no longer exist.

3.2.2 Land Reform and Agricultural Diversification

Much of the steepland in the Wet Zone cleared for plantation crops was always unsuitable for cultivation and suffered serious soil erosion. As more suitable land in other countries was developed for plantation crops after the Second World War, the plantations on the eroded land became patently uneconomic. The Agricultural Diversification Project (ADP) was established with UNDP/FAO assistance in 1970 to promote diversification of land use in uneconomic tea and rubber lands. The project team was then called upon to provide technical support to the Land Reform Commission that took on ownership and management of expropriated plantation land in 1972.

Direction for natural resource surveys was given by Smith (1971) who recommended land capability mapping based on slope, stoniness, rock outcrops and drainage class. Desaunettes (1972-73) then introduced more sophisticated techniques of land systems survey and land evaluation that demanded more comprehensive data for landforms and soils. Wide-ranging socio-economic surveys, agronomic and market studies were also undertaken (see case study in section 4.1, Chapter Four). Models for settlement, mixed cropping systems and, ultimately, complex integrated development plans were produced - but were not implemented by the National Agricultural Diversification and Settlement Authority (NADSA) that was instituted to manage the project.

In terms of survey and publication, ADP was very productive yet it has left scarcely a ripple. The end of UNDP funding and technical support, a change of government and government priorities, and undisputed failures of management were all contributory factors. NADSA, now called *Hadabima Adikariya* (Heartland Authority), took over the work. It now makes use of only the coarsest characterisation of the land on an estate-by-estate basis (ADP staff 1977) (Box 2). An annual work plan is produced centrally with the simple tabular format developed in the early stages of the ADP project (McConnel *et.al.* 1974). Implementation is through the relevant line ministries.

The essential technical recommendations of the Agricultural Diversification Project were to establish smallholdings on the gentler slopes and to afforest the steeplands. The plan to diversify production away from tea and rubber to minor export crops such as cloves, cocoa and peppers was supported by both market and agronomic research. It was hoped that the diversified smallholdings would develop into Kandyan forest gardens - a traditional multi-layer mixed perennial land use that provides good soil and water conservation and spreads the individual's production risks.

Pinus caribaea was the main forestry species recommended. No research was undertaken on the assumed soil and water conservation benefits. It is now known that soil and water conservation depend mainly on management of ground cover (Stocking 1992) which is not good in most exotic forests.

The project has not yet established thriving communities based on diversified production by smallholders, not has it had much positive impact on soil and water conservation, even within the pilot catchments. The recommended land use is unpopular. Market prices for minor export crops have fallen and no extensive market or agronomic studies have been carried out since the 1970s.

Box 2: Example of Estate Data and Physical Plan Produced by the Agricultural Diversification Project

(Source: McConnel et al 1974. These data are accompanied by a sketch plan of the estate at 1:12 000 scale showing roads, streams, field boundaries, field numbers and, sometimes, land capability units).

Reference Sheet to Land Capability Classification Map

REPORT ON THE FIELD RECONNAISSANCE SURVEY

Name of the estate:Ambalama
Access: Through Galaha Group - 18½ miles from Peradeniya
Elevation Range: 2400 - 3800 feet
Average rainfall: n.a.
Natural water resources: 3 main streams
Wind: Some season small part ½ it get affected
Soil pH: 4.0 - 5.5
Soil organic matter: Poor

Extent of estate in acres		Present Land Use in acres	
Original extent:	500	Tea, Seedling:	447
Acquired by L.R.C.:	500	Jungle/Patana:	11
Extent covered by survey:	500	Other crops:	
		Vegetable	2
		Paddy	17
		Building & Road:	23

LAND CLASSES STATEMENT

Field No.	Extent	A1	$A2^1$	$A2^2$	$A3^1$	$A3^2$	$A3^3$	A4	
Upper Div.									
1		32	6	22	-	-	-	4	-
2		42	-	28	-	5	-	8	1
3		22	-	11	-	-	-	8	3
4		24	-	20	-	-	-	4	-
5		45	-	30	-	1	-	2	12
6		42	12	28	-	2	-	-	-

Box 2: Continued

Field No.Extent	A1	A2[1]	A2[2]	A3[1]	A3[2]	A3[3]	A4	
Lower Div.								
7	29	-	28	-	1	-	-	-
8	30	-	22	-	8	-	-	-
9	40	-	18	-	16	-	-	6
10	18	-	14	-	3	-	-	4
11	12	-	5	-	7	-	-	-
12	31	-	26	-	-	-	-	5
13	12	-	9	-	-	-	-	-
14	29	-	29	-	-	-	-	-
15	39	-	35	-	-	-	-	-
Total	448		325	-	43	-	26	31

Proposed Settlement

Estate: Ambalama

Type of Settlement: Model A & B

Units	Fields included		Area for settlements (Ac)	Area for forestry (Ac)	No. of Settlers	No. of Clusters	Extent for a settler
	No.	Acres					
Model B							
A	7,9,11,12,13,14 & 15	132	118	13	44	3	2.7
B	2,6,7 & 9	124	110	14	41	3	2.7
C	3,4,5,6,8,10,& 12	155	125	30	47		2.7
Model A							
D	1	36	32	4	11		2.7
		447	386	61	143	11	

With hindsight, it can be seen that the detailed land resources survey and land evaluation begun by the project, especially the costly and time-consuming laboratory analyses of soils, were not appropriate to the kind of land use planning that could be achieved. Planners and managers have not been able to use them, or indeed much of the other technical information produced by ADP.

A critical management problem may have been the hiatus between the end of the FAO ADP project and implementation of its recommendations. The team of specialists which gathered the data had, by then, dispersed. As a result, the recommendations could not be carried through to the point of implementation by

the people who knew all the technical background. The new management team was unable to deal with the mass of technical literature and the library cupboards remained closed. Planning appears to be going on mechanically, without using natural resources information.

The absence of participation in planning by local communities and the proposed beneficiaries is very striking, and the lack of local commitment to the project for more than a decade may be attributed to this.

3.2.3 Land Use Policy Planning Division

In 1978, the pressure of escalating and competing demands on the land and the palpable neglect of the now unprofitable plantation sector prompted the new administration to combine several agencies responsible for the management of land into a new Ministry of Lands and Land Development.

A conference on Land and Water Resources Development convened by the Ministry in 1979, adopted the rationale for land use planning laid down by West (1979) (Box 3) and recommended an institutional structure comprising:

- An Inter-Ministerial Coordinating Committee for Land Use and Development at Secretary level, served by a technical secretariat, the Land Use Policy Planning Division (LUPPD), within the Ministry of Lands and Land Development;

- District Land Use Planning Committees to undertake mapping out of land for specific purposes.

In the same vein, the Thirteenth Amendment to the Constitution, Appendix II (1987), provides for the establishment of a National Land Commission (Box 4).

The terms of reference of LUPPD were to act as a bridge in the flow of information between land resources specialists and policy-makers and administrators; to develop a computerized land information system; to coordinate land use planning at district level; and to provide training in land use planning.

The LUPPD was formally established in 1979 and provision for mapping out re-introduced into the Land Development Ordinance in 1981. However, the nearly 50-year-old statute did not provide a realistic basis for natural resources management in the new situation and no trained staff were available for the work. Assistance was sought from FAO and an agreement signed in December 1983.

At the outset, staff were seconded from other departments that continued to pay their salaries, but little progress could be made until a cadre of professionals was built up whose sole loyalty was to the Division. Ultimately, the operational professional staff comprised a full-time Director (FAO local consultant), Senior Land Use Planner (FAO expatriate), Deputy Director (Technical), Deputy Director (Administration), Agriculturalist, Agricultural Economist, Training Officer, Computer Programmer, and supporting office and cartographic staff . FAO funding of 4-wheel drive transport was also essential to effective operations.

The absolute paucity of Sri Lankan professionals with the necessary breadth of outlook and technical skills has been a continuing constraint, and few suitable candidates were attracted to an unknown situation with uncertain career prospects. However, as a nucleus of staff was built up, good use was made of inputs from short-term FAO consultants.

Box 3: Principles for Land Use Planning: Statement of the 1979 Conference at the Ministry of lands and Land Development

1 Natural resources belong, ultimately, to the whole nation and must be devoted to the national welfare.

2 An institutional structure is to be maintained by which such resources may be located, evaluated, conserved and distributed so that they may be used on a sustainable basis and to the greatest national benefit.

3 Land is the conceptual and operational contact between the nation and environmental resources so the institutional structure should be in terms of land use policy and land use planning.

4 Land use policy and planning are rooted in knowledge of biophysical processes and an understanding of economic progress and socio-political change. They need quantitative data, and integrated approach to development, and flexibility to facilitate the operation of state, corporate and private sectors in a mixed economy.

5 The nation must learn to live in productive and sustained equilibrium with the natural resources of the land; access to these resources should be equitably distributed and basic needs should be safeguarded for all citizens.

Box 4: National Land Commission

Under the terms of the Thirteenth Amendment to the Constitution of Sri Lanka, Appendix II (1987):

> 'The Government of Sri Lanka shall establish a National Land Commission which would be responsible for the formulation of national policy with regard to the use of state land. This Commission will include representatives of all Provincial Councils in the island.
>
> 'National policy on land use will be based on technical aspects (not on political or communal aspects), and the Commission will lay down general norms in regard to the use of land, having regard to soil, climate, rainfall, soil erosion, forest cover, environmental factors, economic viability and ...
>
> In the exercise of the powers devolved on them, the powers shall be exercised by the Provincial Councils having due regard to the national policy formulated by the National Land Commission.'

Again, a technical secretariat to support land use policy and planning is envisaged. In paragraph 3.2 of Appendix II, it is stated that:

> 'The National Land Commission will have a Technical Secretariat representing all the disciplines required to evaluate the physical as well as the socio-economic factors that are relevant to natural resources management.'

3.2.4 National Level Planning

Starting from scratch, the LUPPD established a national land information system based on a locally-purchased and maintained personal computer. The system used a five kilometre raster and input information already available from several departments (Jayasinghe and Ridgway 1985). Through an active and interested Additional Secretary, this and other information and advice has contributed to more-informed national policy making and productive linkages with many line ministries and agencies.

In 1990, the original land information system was replaced by an IBM-compatible PC Arc/Info geographic information system.

In the face of the limited success of regulatory and prescriptive approaches to land use planning, in Sri Lanka and elsewhere, and conscious of the very limited staff and resources available to the Division, a new approach to land use planning was developed. Guidelines were devised to assist those responsible for making decisions about land use - an advisory rather than a regulatory approach. The Division has sought to support decision-makers with information and training rather than to produce blueprints that it has no power to implement. This approach first appeared in a Land Use Planning Handbook for Sri Lanka (Dent and Ridgway 1986) and has now been adopted as FAO Guidelines for Land Use Planning (FAO 1993) (Box 5 and Figure 3). Two key questions in following the 'Ten Steps' of land use planning outlined in the Guidelines are 'whose goals are to be established at Step 1 ?' and 'who shall be responsible for each step ?'

LUPPD has stumbled in its transition from a small nucleus operation at national level to a network of District Land Use Planning Committees. The transition coincided with the end of the FAO project in 1989, succeeded by a much bigger project funded and directed by the Asian Development Bank; changeover of senior staff; and the intensification of civil war; and a major overhaul of the administrative structure of the country.

The new administrative structure, that devolves many responsibilities to Provinces and Districts, came into *de facto* operation only in September 1992. Within the 5 separate levels of government, a hierarchy of bureaucratically-headed land use planning committees has been outlined by Berugoda
(1991). This is administratively tidy but there is no evidence of demand for all these committees, nor any prospect of staffing them with trained professionals or of providing them with adequate facilities. The precedent of District Land Use Planning Committees is not propitious.

Bliek and Schaap (1988) explore mechanisms of participation involving the Integrated Rural Development Projects (established by external development aid in several districts), local officers of line departments, and NGOs co-ordinated from the local government (AGA) office. There have been examples of successful developments being pushed by interested and committed AGAs and, also, at village level. All such schemes hinge upon locally-based land use planners who are expected to facilitate, coordinate and provide a fair degree of specialist technical input. The whole approach may
founder for the lack of 'supermen' available for the job. Investment in further local land use planning staff and their training would be money well spent.

In succession to FAO support for the LUPPD, the aims of the Asian Development Bank (ADB) project are:

- to produce new 1: 50 000 and 1: 20 000 air photography of the whole country;

Box 5: Steps in Land Use Planning

(Adapted from Dent and Ridgway 1986)

Step 1 *Establish goals and ground rules.* Establish the present situation; find out the needs of the people; agree goals to be worked for and specify the terms of reference of the planning team.

Step 2 *Plan to plan.* Organise the work needed; select team and methods; work for widest participation in planning.

Step 3 *Identify and structure the problems and opportunities* of the planning area.

Step 4 *Select promising land uses.* Identify or design a range of land use types that may achieve the goals. Present these options during public consultation and select for further work those that command wide support.

Step 5 *Evaluate land suitability.* For each promising land use type, establish its land requirements and match these with what the land has to offer. This establishes physical suitability.

Step 6 *Appraise alternatives.* For each physically suitable combination of land use and land, assess its environmental, economic and social impact.

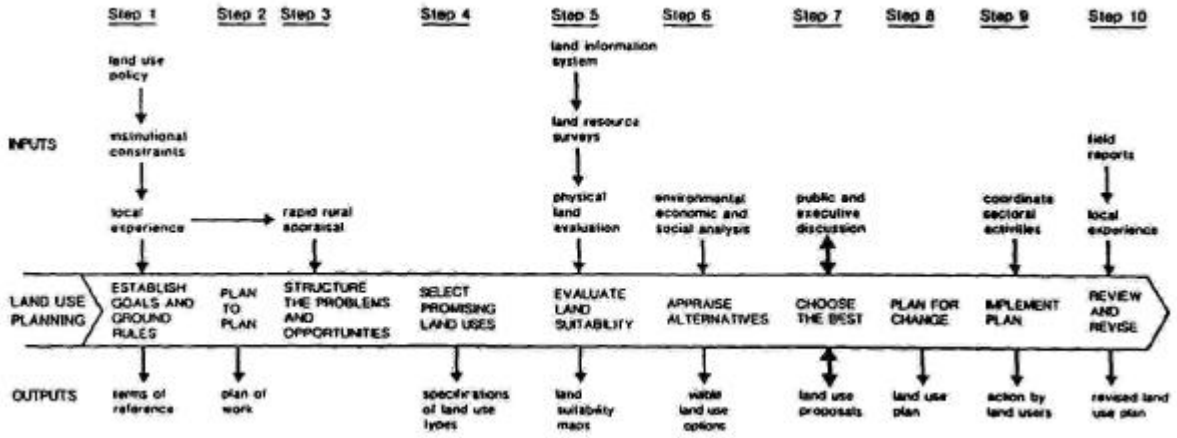
Step 7 *Choose the best* achievable land use. Public and executive discussion of the viable options and their consequences. Make decisions according to the best information available.

Step 8 *Draw up a land use plan,* allocating land use to land and making provision for appropriate management. In policy-making, draw up policy guidelines, budgets and legislation.

Step 9 *Put the plan into action.* Action by decision-maker, sectoral agencies and land users.

Step 10 *Learn from the plan.* Monitor progress toward the goals; revise the plan in the light of experience and to accommodate new goals.

Figure 3: Steps in Land Use Planning
(Source: Dent 1988)



- to establish geographic information systems (GIS) in the Survey Department and the Land Use Division of Irrigation Department;

- to complete semi-detailed soil survey and land evaluation of the whole country by Land Use Division;

- to develop the land information system of LUPPD;

- to provide a new headquarters building for the LUPPD and the Land Use Division;

- to provide technical assistance to the Survey Department, Land Use Division of the Irrigation Department and the LUPPD;

- to establish a cadastral database.

It is planned to provide personal computers for each District Land Use Planning Office as a base for a district land information system. It is also planned to establish a powerful geographic information system jointly with the Land Commissioner's Department to hold both administrative/cadastral data and land resources data. The question of staffing and maintenance of these computer-based systems has still to be effectively addressed. To put it bluntly, big investment in computer technology at local level is misplaced given the cost of equipment, the problems of power supply and maintenance, and the lack of trained staff. Local budgets often cannot meet the costs of tracing paper or fuel for fieldwork and, once trained, computer staff will move to the private sector where they earn several times their civil service salary.

At the time of writing, there is no further equipment in place than there was in November 1990. In the meantime, the simple GIS set up by the FAO project has been allowed to atrophy and a similar system, installed with Dutch technical assistance at Nuwara Eliya IRDP, did not survive the departure of the Dutch specialist who set it up.

3.2.5 National Conservation Strategy and Environmental Action Plan

National policy on the conservation and development of natural resources is set out in the National Conservation Strategy (Central Environmental Authority 1988). An Environmental Action Plan has been

developed in concert by the relevant line ministries, government agencies and non-governmental organisations, co-ordinated by the Central Environmental Authority (1990). This tabulates specific management issues, actions to address these issues, and the institutions responsible for these actions. The issues and proposed responses are familiar, having been considered with gravity by successive Land Commissions. Box 6 presents four examples of issues and proposed actions:

Two unsettling aspects of these proposals are: first, continuing reliance on the tried-and-tested and failed policy of restrictive legislation, with fruitless calls for the enforcement of this legislation; and second, calls for more national co-ordinating organisations - including one with identical terms of reference to the existing LUPPD. Implementation of proposed actions is not in evidence.

3.2.6 Land Use Planning in the Accelerated Mahaweli Project

From 1979, the huge hydro-power and irrigation developments of the Mahaweli basin have been coordinated centrally by the Mahaweli Authority of Sri Lanka within an independent Ministry of Mahaweli Development. A case study is presented in Chapter Four.

Box 6: Extracts from the National Environmental Action Plan

Issue **Degradation of watersheds** that supply the rivers, irrigation water, electric power and urban water supplies; the multiplicity of legislative enactments concerned with catchment protection; and the lack of enforcement of this legislation.

Proposed action
1) More comprehensive, unified legislation to prohibit activities that cause land degradation and to establish a new Water Resources and Watershed Management Council.
2) Identification of degraded watersheds and monitoring of activity by the Council.
3) Enforcement of the legislation, relocation of offending people, and afforestation of the watersheds by the Ministry of Lands, Irrigation and Mahaweli Development.

Issue **The coastal zone** is fragile and subject to heavy development pressure. Valuable habitats such as coral reefs, mangrove stands and estuaries are being degraded and destroyed by misuse.

Proposed action The Coast Conservation Department is to take the lead to:
1) Build up a database on the present status and potential for sustainable use of coastal areas as a basis for a list of priority actions:
2) Establish a co-ordinating mechanism for action;
3) Augment and implement the Coast Conservation Act and Coastal Zone Management Plan, and enforce the requirements for environmental impact assessment of developments that may affect the coastal zone.

Issue **Upland subsistence farming and tobacco cultivation** is causing soil erosion and water pollution and land degradation by excessive use of agrochemicals.

Proposed action The Agriculture Dept. is to take the lead in actions to:
1) Prohibit cultivation on slopes greater than 40° (*sic*) and above the 1500 m contour;
2) Enforce soil conservation requirements in respect of tobacco farming;
3) Introduce an integrated training and extension package for upland farmers which will include measures for soil conservation, proper use of water, proper use of fertilizers and pesticides;
4) Introduce a subsidy scheme to help farmers practise conservation measures.

Issue **Imprudent use of land** is causing environmental degradation and economic losses. Many legislative enactments cover different areas of land use. Individual agencies adopt policies on land use that are relevant to their tasks only, disregarding the need for working within an overall plan.

Proposed action The Ministry of Land, Irrigation and Mahaweli Development is to:
1) Set up an inter-ministerial committee to decide on policy regarding land use;
2) Set up a national organisation for land use planning staffed by competent and experienced technical persons to evaluate and inventorise the land base, monitor and regulate land use;
3) Consolidate the fragmental legislations into a single, comprehensive act.

(Source: Central Environment Authority 1990)

The scale and urgency of the Accelerated Mahaweli Project precluded sophisticated land use planning. Downstream developments were largely in pioneer areas for which detailed soil data were not available and the settlers' experience was only with paddy or chena cultivation. Various consultants' reports since the 1950s had identified the potential for a wide range of crops but, at the time of project initiation, significant markets for this production, agro-industries to handle it, and a large scale extension and training capability had not been developed.

The imposition of a uniform, irrigated land use type on a varied landscape has met with mixed success. However, the development of the irrigated land almost entirely as paddy smallholdings did satisfy two national planning goals: providing employment on the land and promoting a greater degree of self-sufficiency in food. The project management is now focussing on commercial farming on larger farms than in the initial settlements.

As the first phase of development draws to a close, the project management must turn its attention to 1) intensification and diversification by matching land use more closely with land qualities and improving irrigation efficiency, and 2) soil and water conservation on the watershed to safeguard the water supply and the life of the reservoirs. Both tasks will need better and more-detailed information on land use, soils and land suitability; research and development of effective and acceptable means of soil conservation; and a greatly increased land use planning capability to make good use of such information. The present Forest/Land Use Mapping project funded by the UK Overseas Development Administration within the Mahaweli Authority fits well into these recommendations.

3.2.7 Incremental Use of Land Resource Data

Development of the private sector sugar industry also offers pointers for more effective land use planning by an incremental upgrading of the information base. Two almost simultaneous surveys were carried out in Monaragela District: a general purpose, integrated development study(Hunting Technical Services 1980) and the Pelwatte Sugar Project Feasibility Study (Booker Agriculture 1980). Huntings undertook a ¼" to one mile reconnaissance soil survey, and a sample 1:25 000 soil survey, mapping soil complexes with mapping units differentiated by soil depth and drainage class. This information was used in the Booker feasibility study for establishment of the Pelwatte estate. The estate was laid out on the basis of an interpretation of the general purpose survey (Radcliffe 1982). Even then, there was concern over inadequate rainfall and hydrological data. Further specific hydrological and rainfall analyses were undertaken but shortages of water have been a continual limitation to the industry.

Following the establishment of the nucleus estate and a network of outgrowers, the project management has been able to establish, in detail, the natural resource limitations to production; specify its further information needs; and build up its capability to use the information. Given the natural variability of rainfall, root zone water supply is critical and depends on topographic position (upper slope, lower slope, bottomland), position in relation to water-shedding rock outcrops, soil texture, and depth to gravel horizons. This specific information, mapped as land management categories at a scale of 1:10 000 on an air photo base, was commissioned for use in realignment of field boundaries and management blocks, to support outgrower extension, and in day-to-day crop management (Murdoch 1987).

Following on from the Monaragela Study, a second semi-detailed soil survey at Sryambalanduwa led to another sugar industry development.

3.3 CONTINUING CONSTRAINTS ON SUSTAINABLE DEVELOPMENT IN SRI LANKA

The importance of sustainable management of finite natural resources is well recognised; it is part of the Constitution of Sri Lanka. Some kind of land use planning appears to be the rational response to the need for integrated management of land resources and it has been embarked upon several times. Each time, however, it has been constrained by inadequate information, institutional failures to make use of the information that is available, and clouded land title in the densely-populated Wet Zone; and it has been dogged by attempts to impose change from above rather than through broadly-based participation in planning and decision-making.

3.3.1 Availability and Accessibility of Information

Organisations able to supply natural resources information are well established (see Appendix 1). For example: topographic maps and air photos of high quality are supplied by the Survey Department; the Meteorology Department maintains a network of recording stations and a climatic database; soil surveys are undertaken by the Land Use Division of the Irrigation Department. Within the limits imposed by the resources allocated to them (and in some cases these are slender), the established scientific organisations provide a professional service in collection of data and maintenance of their databases.

When the existing database and institutional capacity has been inadequate for specific development projects, external assistance has sometimes been provided in the form of finance, equipment and short-term expatriate expertise. The immediate technical objectives of these assistance projects have been achieved - i.e. production of data to a high technical standard, using state-of-the-art technology supported by expatriate specialists.

Typically, the nature of the data acquired and the methods to be used have been specified by the donors. Counterpart staff of the host agency have been trained in new methods. At the end of the project, expatriate specialists have been withdrawn and there has been an abrupt loss of funding. When the data collection was part of the established work of a host department, a well-found department may have been in a position to retain its trained staff and maintain the database - keeping it intact, accessible and providing necessary interpreting services. A case in point is the Canada-Colombo Plan assistance to the Survey Department for the national air photography project 1948-53.

In other cases, external assistance has been used to set up new and quasi-independent units. This is inevitably the case where land use planning is involved since this activity is, by definition, cross-sectoral. Examples include the UNDP/FAO Agricultural Diversification Project, loosely attached to the Ministry of Plantation Industries; the FAO-assisted Land Use Policy Planning Division within the Ministry of Lands and Land Development, and the present ODA-sponsored Forest Land Use Mapping Project (FORLUMP) attached to the Mahaweli Development Agency.

While external support continued, technical objectives have been achieved. At the end of the project, trained counterpart staff are more likely to be reabsorbed in line departments, and the data and skills lost for the want of capacity or interest in maintaining it by the line departments. The present FORLUMP project might be criticised for spending too much time on detailed mapping (hundreds of map sheets at 1:5 000) and too little on basic training of Sri Lankan professional staff to make use of this information. This is no criticism of the scientific staff involved but a question of their terms of reference.

Work by international consultant companies is a third category. Such work has been commissioned to meet urgent needs of specific projects. It has usually been carried out to budget, to schedule and to a good technical standard. Typically, it has been used for the specific purpose for which it was commissioned (and this might have been principally to secure funding), but there is then a risk that the information will be lost since it is no part of the institutional memory. Happily, this worst-case scenario has been avoided in Sri Lanka by long-term linkages between national institutions and consultants (for example between the Mahaweli Authority and Hunting Technical Services), by personal relationships and, not least, because of the heavy-duty standard of publication of many of the consultants' reports and the consultants' own archival services.

3.3.2 Capability to Use Natural Resources Information

There is a lot of information of good technical standard in Sri Lanka. However, only limited use has been made of the information in national policy-making, or in decision-making at any level of land management. Several related reasons for this may be adduced:

First, the very fragmented, strictly sectoral and, even, jealous nature of the institutions responsible for land use and land information. To some extent, the providers of information rather than users are driving the supply, so the information is not always as relevant to the needs of decision-makers as it might be. A related problem is that poorly-paid staff are unwilling to provide their data to well-paid consultants and foreign-funded projects. Often, the foreign-funded project does not have money allocated for the purchase of data. Contracts often state 'soils, climatic and air photographic data will be provided free of charge by the Government' - so access to essential data may be denied.

Secondly, the limited ability of policy-makers and decision-makers to make use of technical data. Although the generalist secretariat is of the highest quality, the technical support for decision-makers is weak, even at central government level. Few people are able to master the technical details and summarise them for the generalist secretariat or project managers. Typically, technical staff are at sea between the rock of the secretariat and the hard place of technical data that they are unable to test or challenge. Hence, poor support is often given to the secretariat and, so, they give poor support on technical matters to their ministers.

Thirdly, the absence of any established place for natural resources information, other than topographic maps, in the public decision-making process. There is no mechanism for specifying the relevant information or interpreting natural resource and social information. This contrasts with the situation in the international private sector. Following from this is the lack of or uncertain career structure in the fields of natural resources and land use planning, and lack of training within the national curriculum.

<u>What are policy-makers and decision-makers looking for</u> ?

- If he wants to serve his country, a politician seeks a dream: a vision that he might turn into a reality. And a politician needs a single, clear argument. If he is not seen to be decisive, he is not credible.

- The secretariat, to serve its minister, needs a cogent argument and a succinct presentation of the relevant facts: not details, rarely basic data but, usually, an interpretation of these data to support decision-making. Decision-makers need options from which to choose, otherwise they are redundant, and the weights of argument and counter-argument must be known.

- Time to make decisions is very short. The higher the level of decision-making, the more frantic is the process and the less time is available to study and absorb information. Minutes or hours, not weeks, are available for high-level decision-makers to get to the heart of the matter. Therefore, only direct, graphic presentation of information or a conversational style of argument by analogy is likely to be effective. In other words, the main argument in broad outline.

- Interpretation should be rigorous, quantitative if possible, and the basic data should have the strength of being accurate.

- Plain English is wanted, not jargon. Neither policy-makers nor managers are natural resources specialists.

The above paragraphs summarise just what is not being provided by natural resources specialists in Sri Lanka. Of course, there are some shining exceptions. Nevertheless, it is difficult to escape the conclusion that the great mass of data produced is not useful to the people who make decisions about land use policy and management. Certainly, it is not used.

What do natural resources specialists need to do ?

Natural resources information will remain superfluous until a place is established for natural resources information in the decision-making process. This place has to be made by natural resources specialists and land use planners themselves. First, they must be masters of the basic data. Also, if they are to provide data that are relevant and usable, they must also know the purpose for which the data are being used, how they will be used (what interpretation will be placed on them and by whom), and the capability of the users of their information.

On this last question depends the amount of interpretation that the specialist must undertake, and the level of detail required of the basic data. It is becoming more and more obvious that the specialist must carry the data through the interpretation of the data to the point of decision. Synthesis and generalisation from factual detail to identify opportunities and problems, and options from which the decision-maker can choose, must be done by the master of the information. No one else has the necessary technical expertise to do this.

The quality of the data is always variable. The generalist has no rational way of dealing with this problem. If this problem is not dealt with by a specialist, others will assume an equal level of reliability, accuracy and precision, or they will read into the data whatever interpretation they want.
Options for action need to be backed up with information on costs, benefits and the social and environmental consequences.

3.3.3 Clouded Land Titles

This is a particular problem in privately-owned land in the low country, urban periphery and Kandyan villages in the Wet Zone. These areas comprise some 15 per cent of the country, supporting 45 per cent of the whole population. Complexity, uncertainty and insecurity of tenure is a constraint to long-term investment and development. West (1987) has outlined a program of rural renewal that includes summary adjudication and conciliation of claims, and registration of titles. This would facilitate consolidation of fragmented holdings, access to credit and improvement of infrastructure to enable the rural community itself to invest in more productive, sustainable land use. At present, there is little appetite for this work within the Government of Sri Lanka.

3.3.4 Insufficient Participation in the Planning Process

This topic brings together two themes of land use planning: natural resources information and institutional development.

The failure to achieve a significant transfer of population from the crowded Wet Zone may be taken as a test case of centralised land use planning. Despite the high level of public literacy, good communications, energetic and powerful Ministers and able staff willing to redistribute access to land, a very small proportion of land and population has been transferred and the situation on ground has departed increasingly from the situation on file. It is hard to escape the conclusion that the administrative load imposed on itself by the Government is not supportable.

The case study presented in Chapter Four (the Sri Lanka Tree Crop Diversification Project) underscores the greatest deficiency in central planning - the failure of implementation of plans and policies because there is no basis for negotiation between the different, often conflicting interests of people in the area. No consensus has been arrived at; planners and people and, also, different groups in the local community are pulling in

different directions. It has proved to be easier to build high dams and their canal systems than to match the land use with the land and water available; concrete is easier to manipulate than people. And it has not been possible to make dry streams run again by the exercise of political will.

It has not proved possible to decide and provide everything centrally. An alternative should be developed which gives more people a stake in the planning process and enables them to contribute to its success.

3.4 POSSIBLE RESPONSES TO POLICY INITIATIVES

The Government of Sri Lanka has now embarked upon two policy initiatives that are likely to have profound consequences for land use.

3.4.1 Decentralized Government

From 1992, authority for most land use matters has been devolved to nine Provincial Councils. Within these provinces are 257 new administrative units - *Pradeshiya Sabhas* - which are nearly synonymous with the old AGA Divisions - each the responsibility of a Divisional Government Agent appointed by the Provincial Councils. The old 25 Districts in the country seem destined to remain as formal development areas. Planning and development within their unchanged boundaries will be monitored by a committee chaired by the Chief Secretary of the Province.

This new structure will likely lead to a change of priorities for development at the local level. Now is the time to abandon the tried and tested and failed top-down approach to planning that has attempted to impose on the land and its local communities plans made by 'experts'. Local communities should be more involved in the planning and implementation of rural development programs.

We have already highlighted the yawning gap between existing information about natural resources and policy-makers who should, in principle, make use of this information. A bridge is needed and this was the original purpose of the Land Use Policy Planning Division (see section 3.2.3). Co-ordination of information from the specialist institutions and line ministries is still needed and still not provided. Specialists in land resource development have to be available to interpret their data with the policy-makers in an iterative way.

To date, it has not proved possible to provide competent, adequately-resourced, land use planning staff at District level. With only nine Provincial Councils compared with 25 District Land Use Planning Committees to serve, the task is reduced by about a third but it remains a major exercise in institution-building, demanding adequate resources, a career structure that will attract staff of high calibre, and training for **both** policy-makers and land use planners.

At the other end of the spectrum, where land use policy becomes land use, the Government thinks it is time for citizens to take more control of their own affairs. It will take a leap of imagination from officialdom to move from a regulatory system to an advisory system. People's participation in planning is a new concept for the bureaucracy of Sri Lanka (Goonewardene 1991), yet it is well developed in rudimentary form in the preparation of cropping or cultivation calendars in small irrigation schemes. Abeywickrema (personal communication) has suggested empowering existing, effective local water management groups or cultivation committees. These might be an effective starting point for local land use planning that could come to grips with local issues of land tenure, water rights and management, and sustainable land use. Hatten (personal communication) has pointed to the success of involvement of local water management groups in the Inginimitya Irrigation Project, both in pilot trials on drainage and reclamation of saline land and in the shutting down of left bank and right bank canals in alternate seasons to save water.

But this immediately raises another question to which there is no obvious answer. If access to natural resources information has held back a relatively small number of central planners and decision-makers, how are the many thousands of local community planners and decision-makers to get the information they need? The only possible answer is 'step-by-step'. Just as there is a need for institutional development at government

level, so there is a need for local institutional support if communities are to be able to take more responsibility on themselves. If technical support and training were provided to local organisations, step-by-step as they develop their own capability and only on request, the operation may be feasible.
A case can be made for cheap, quick local survey and registration of title and local survey of essential land quality data. An urgent research task is to ascertain what are the most useful natural resources data for 'grassroots' planners - data that they can gather and use themselves. Simple survey and decision-support kits can then be developed and tested in the field so that local communities can be independent of scarce technical expertise for day-to-day management decisions. This would need a leap of imagination from natural resources specialists and a switch attention from ever-more-sophisticated technology to information and methods that are of immediate use.

3.4.2 Privatization of the Estate Sector

Tea and rubber estates are now being sold back to the private sector. The new commercial management faces a very competitive world market and will have to concentrate its
investment on the most suitable land, renew the planting stock and infrastructure, and conserve the land and water resources on which production depends. Again, this is most likely to be achieved by a step-by-step development of its land resources data base and its ability to make use of these data. Lessons can be learnt from the sugar industry that has been in commercial hands since its inception.

Consultants will provide a commercial service and the basic survey and land use planning kits proposed for grassroots planners (Section 3.4.1) should be in demand equally by the private sector.

CHAPTER FOUR

LOCAL CASE STUDIES

4.1 SRI LANKA TREE CROP DIVERSIFICATION PROJECT

Project: The Sri Lanka Tree Crop Diversification Project was part of the Sri Lanka Land Rehabilitation and Settlement Development in the Mid-Country: it was undertaken as a pilot project in the Nilambe-Atabage, Gurugoda-Ritigaha and Maha Oya - Kuda Oya catchments.

Executed: By the National Agricultural Diversification and Settlement Authority, now *Hadabima Adikariya* (Heartland Authority)

Dates: 1978 - present

Place: Kandy and Kegelle Districts, Sri Lanka. Headquarters at Gatambe, Peradeniya

4.1.1 Project Initiation

In 1958, the Land Commission censored trial-and-error ways of developing land resources, urging that 'the planning of land use should be on an island-wide basis, and in conformity with modern ideas on development in terms of catchment areas' (Sessional Paper X, para 163).

In 1968, the Land Utilization Committee noted the extent of neglected and abandoned tea smallholdings, rubber and coconut plantations (Sessional Paper XI). It recommended a detailed land classification and agronomic survey of uneconomic plantation land as a first step towards its rehabilitation and diversification of land use.

Also in 1968, the Tea Commission examined the alternative uses of uneconomic tea land (Sessional Paper XVIII). They recommended a detailed assessment of the unsuitability of present tea lands and the physical and economic feasibility of specific alternative crops. One direct outcome was the Report of the Committee on Crop Diversification for Uneconomic Tea and Rubber Lands (Min. Agriculture 1969) that included a map of 'agro-ecological regions' of the Wet Zone together with an account of their potential for tea, rubber and alternative crops on a district-wide basis. A provisional land capability classification was made using available data for steepness of slope, rockiness, soil depth, drainage status, soil erosion, soil nutrient status, rainfall and temperature.

Assistance was obtained from UNDP/FAO in 1970 to set up the Agricultural Diversification Project (ADP) in the Department of Minor Export Crops within the Ministry of Plantation Industries. Its terms of reference were to:

- conduct studies into the long-term prospects for tea and rubber;
- identify a range of suitable alternative crops;
- develop criteria balancing economic, social and technical considerations that could define 'uneconomic' lands;

- establish the technical and economic feasibility of growing alternative crops under field conditions and outline the extension services that would be needed; and

- prepare development plans for a pilot project in agricultural diversification.

Initially, the project was to operate in two catchments: Nilambe-Atabage, comprising 18 400 ha with a large area of degraded tea estates; and Gurugoda-Ritigaha, comprising 12 690 ha, mostly low-yielding rubber plantations.

The ADP project, from 1970-1975, undertook natural resources and socio-economic studies and some market research.

To implement the project as required by the funding agency, the International Development Association, the National Agricultural Diversification and Settlement Authority (NADSA) was established under the State Agricultural Corporation Act No. 11 of 1972 and was placed under the Ministry of Agricultural Development and Research. For this, a special notification was published in the Government Gazette Extraordinary No. 302/12 of 1 February 1978. The main goal of NADSA was to find an alternative use for the neglected Mid-Country plantation lands which was technically, ecologically and economically viable. It envisaged the small, mixed-crop family farm as the basic unit of development and attempted to realise three objectives: watershed management, settlement development, and agricultural diversification.

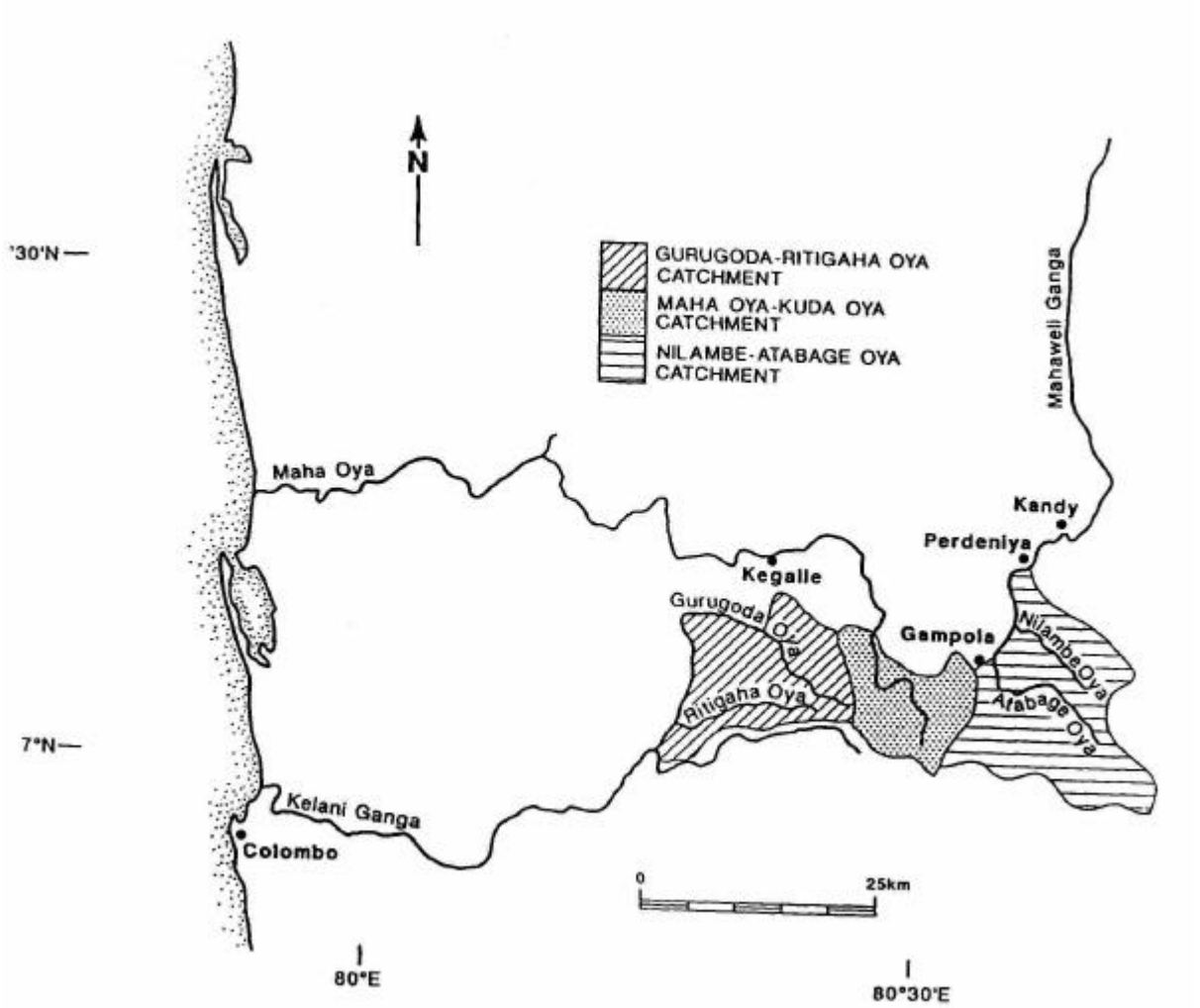
As a major component of the NADSA, the Sri Lanka Tree Crop Diversification Project was initiated in three river catchments, Nilambe/Atabage, Gurugoda/Ritigaha and Maha Oya/Kuda Oya located in the administrative districts of Kandy and Kegalle (Figure 4).

4.1.2 Initial Justification for the Project

It had become increasingly evident to the Government of Sri Lanka that some of the tea and rubber lands in the Wet Zone had become unprofitable, especially tea lands at elevations below 1480 metres. This was partly due to bad management and partly because the land planted was not suitable for these crops in the first place, both leading to serious land degradation. At the same time, the human population in the area was growing rapidly, bringing pressure on available land resources for the cultivation of food and cash crops.

Following the UNDP/FAO Agricultural Diversification Project, the Government of Sri Lanka prepared a project for the rehabilitation of the two catchment areas which had been studied in detail - the Nilambe/Atabage and Gurugoda-Ritigaha. These areas are located near to the towns of Kandy, Gampola and Kegalle and have relatively well developed infrastructure. The average density of the rural population (4.0 to 4.7 per hectare) is higher than for the rest of the Wet Zone. The acquisition of most of these estate lands under the Land Reform Act of 1972 and 1975 had given the Government a unique opportunity to transform tea and rubber estate lands to the best economic and social advantage. The two areas selected, having a wide variety of terrain, soils, crops and the social problems of low employment levels were considered to be ideal locations to carry out a program of crop diversification, rehabilitation and land settlement.

Figure 4: Location of Sri Lanka Tree Crop Diversification Project



4.1.3 The Main Objectives of the Project

The main objectives are:

- Reduction of the area under tea and rubber by 64 and 20 per cent, respectively (i.e. tea from about 14 000 to 5 200 ha, and rubber from about 4 000 to 3 200 ha);

- Establishment of 'mixed forest garden smallholdings' on the land taken out of tea and rubber and, also, on other unused land suitable for such purposes;

- Establishment of pasture for dairy development, which envisaged importing 5000 dairy cows;

- Use of 2 800 ha of abandoned land for production of timber, pulp and fuelwood;

- Rehabilitation of about 2 000 ha of seedling tea and replanting of about 1000 ha with vegetatively propogated (VP) tea and 200 ha with clonal rubber;

- Minor additions to existing roads and educational, health, transport and marketing facilities.

4.1.4 Response to the Proposal

The Agricultural Diversification Project (ADP) was started first in 1970 in the Department of Minor Export Crops under the Ministry of Plantation Industries. The report of the Tea Commission (1970) suggested that current production targets for tea could be met from a much smaller acreage if existing seedling tea was replaced with high-yielding, VP (vegetatively propagated) clones. It was assumed that this would release large areas of land suitable for the production of more profitable crops, especially cloves, nutmeg, pepper and cardamom. The same assumption was made in the case of rubber: that unthrifty stands could be replaced with more profitable crops.

The background studies undertaken during the first stage of the ADP, during the 1970-75 period, were useful in formulating the present project.

The International Development Association was to provide US $ 4.5 million as credit - as a major portion of the total financial allocation of the project of US $ 6.5 million. Consequently, the Sri Lankan Government was keen to get the project underway, although there was also a substantial amount to be contributed by the Government itself.

4.1.5 Opposition to the Project

Opposition to the project came from the staff of the estates identified for the project, who were concerned about the uncertainty of their employment. They had been informed that, after the takeover, they could be assured of employment only for a further period of one year. Therefore, many of the staff did not like their estates being taken over by the NADSA project and preferred to stay with the existing management of the State Plantation Corporation (SPC) or the Janatha Estate Development Board (JEDB). They were prepared to justify their reluctance by claiming that tea yields of these estates were increasing during the preceding two year period and that they were becoming profitable to run as tea estates, though in fact the yield figures proved the opposite.

The previous owners of some of these estates also protested. During the ADP project period, the Government of Sri Lanka implemented the 1972 Land Reform Act under which private holdings over fifty acres were nationalised and, in 1975, company-owned estates were also taken over by the government. With the accession to power of a new government in 1977, the former owners hoped to get back the lands which had been expropriated by the previous government.

The Tamil labourers of these estates opposed the NADSA project for several reasons: they did not wish to own separate lands for themselves, although entitled, but wished to remain and work as paid estate labourers as this was seen as an assured means of income. Some of the Sinhalese labourers held similar views.

4.1.6 Levels of Decision-Making Involved

Several levels of decision-making were involved. At national level, decision-making on the agricultural activities of the major organisations was co-ordinated through the Cabinet Sectoral Committee on Agriculture, Minor Irrigation and Fisheries. This committee was chaired by the Minister of Agriculture and Lands and its members were the Ministers of Plantation Industries, Fisheries, Irrigation, and Trade, with the Director of National Planning acting as Secretary.

At District level, the District Agricultural Committee had responsibility to advise the Government Agent on all matters relating to agriculture within the District. This committee comprised the:

Government Agent (Chairman)
District Agricultural Extension Officer
Government Veterinary Surgeon
Assistant Conservator of Forests
Assistant Commissioner of Rural Institutions
District Land Officer
Regional Manager, Paddy Marketing Board
Assistant Director of Regional Development
Assistant Commissioner of Co-operative Development
Divisional Marketing Officer
Assistant Commissioner of Local Government
Assistant Government Agents
Members of the National State Assembly for the District.

Other official or non-official members could be co-opted at the discretion of the Government Agent.

In districts where large areas of land were acquired under the Land Reform Act of 1972, District Land Authorities were set up to supervise the acquisition, alienation and payment for land on behalf of the Land Reform Commission. This Authority had the following composition:

Government Agent (Chairman)
District Director of Land Reform (Secretary)
District Agricultural Extension Officer
Assistant Commissioner of Rural Institutions
Assistant Commissioner of Co-operative Development
Superintendent of Surveys
Assistant Government Agent
Members of the National State Assembly.

At Divisional level, a committee chaired by the Assistant Government Agent mirrored the District Organisation. At the village level, there were many committees dealing with agricultural and development activities: Village Councils, Agricultural Productivity Committees, Cultivation Committees, Agricultural Co-operative Societies, Rural Development Societies and Janatha Committees.

In Kandy and Kegalle Districts, where the integrated development was to be undertaken, District Catchment Development Committees had been formed as sub-committees of the District Agricultural Committees. At the national level, the hierarchy of the Catchment Development Committees began with the Cabinet Sectoral Committee on Agriculture, Minor Irrigation and Fisheries. Then, there was a National Committee on Catchment Development. Down the line, there were District and Village level committees. Linking the

District Catchment Committees with the village level organisations were Field Project Units manned by the Project officers. Under the Field Project Officer, at the local level, were farmer groups (Figure 5).

It is not clear which amongst this imbroglio of committees, other than the District Land Authorities, has had any input into project planning or management.

4.1.7 Perceived Need for Land Use Planning

Prior to the project, there had not been any spectacular development activities since the original tea and rubber plantations. Two serious problems demanded attention:

Declining productivity and accelerating erosion of the uneconomic tea and rubber estates;

Growing landlessness and unemployment resulting from population growth.

It was obvious that, without remedial action, the decline in productivity and increasing erosion of estate lands would accelerate. Also, if well-planned settlements were not started, spontaneous and unplanned settlements or encroachments would be likely to occur in derelict estates and forests, further degrading land resources. As a result, there would be little increase in the capacity of the non-estate areas to feed the growing population. At the same time, foreign exchange earnings from the estate sector would decline. Land use planning was seen as a rational response to the situation.

4.1.8 Availability of Natural Resources Information

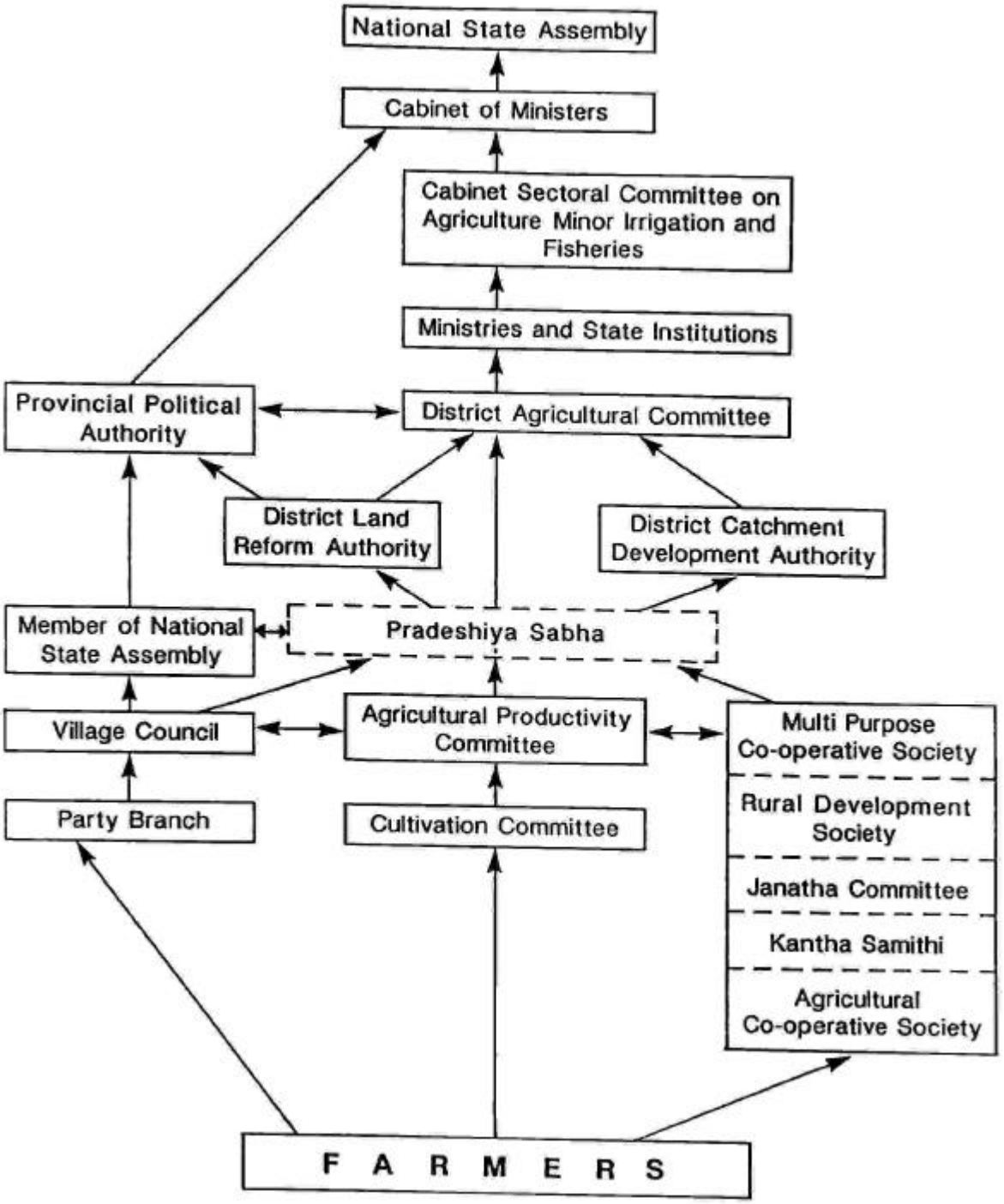
The Survey Department flew 1:25 000 aerial photography and produced base maps for the two pilot catchments.

The UNDP/FAO Agricultural Diversification Project produced over 80 publications covering:

- Land capability and land evaluation, identifying the optimal land use pattern;
- Marketing studies, identifying the present limitations and marketing of potential crops;
- Farm management and production economics, identifying management implications;
- Land use plans;
- Guidelines for planning and establishment of settlements;
- Maps of the existing land use pattern and land capability (based on soil and topography) for the selected project areas in the Nilambe-Atabage and Gurugoda-Ritigaha Catchments;
- Social and economic studies on village lands in the project areas. Systems of rehabilitation and improvement of existing mixed gardens were developed.

Some of these reports are listed in Box 7.

Figure 5. Political and Administrative Institutions concerned with Agricultural Development



Box 7: Some Publications of the UNDP/FAO Agricultural Diversification Project
(References are given in the Bibliography, pp 91 - 122)

In 1970, a FAO Commodity Specialist drew up **A Preliminary List of Agricultural Commodities**, which considered alternative crops for the uneconomic tea and rubber lands (Wolf 1970). In 1971, an FAO consultant reviewed the available soil, land capability and crop suitability information, and suggested a system of **Land Capability Classification.** This subsequently formed the basis for planning in the Wet Zone, including the Catchment Area under consideration (Smith 1971).

In 1971, a Land Capability Survey delineated lands according to the slope, rockiness and soil depth. Since this type of survey gave only a broad idea of the possible types of cultivation, it was later recommended that a more detailed survey be carried out to determine the choice of crops and the costs of development for the different lands.

In 1972, a Land Evaluation Survey was undertaken in sample areas during whichts were mapped on the basis of soil characteristics and present land use. It was considered impossible to cover the entire 1.5 million ha of the Wet Zone before the end of the project and, also, the data were required urgently for land development. Therefore, the Wet Zone was divided into 47 morpho-ecological regions, each of which showed a similar pattern of climate, landscape, soils and land-use. The **Guidelines for Land Development of the Districts of the Wet Zone of Sri Lanka,** include a discussion on land development recommendations for these morpho-ecological regions (Desaunettes 1974). Several detailed land evaluation surveys were completed (Desaunettes *et.al*. 1973, 1974).

In 1972, the Commodities and Trade Divis ion of the FAO contributed **A Summary of Findings of Commodity Studies**, on behalf of the ADP. These studies consisted of 26 Reports covering most of the products regarded as alternative crops for diversification (UNDP/FAO 1972). The aim of the FAO studies was to investigate the market possibilities and to determine the long-term prospects for these commodities. A series of studies analyzing the marketing system of minor export crops such as pepper, cloves, nutmeg were carried out (Embrich, Ponnusamy and Bandara, 1972-1974).

Reports were produced on production economics and farm management for pepper, cinnamon, cardamom, cloves, nutmeg and mace (McConnell et al 1972). Another report on the **Economic Structure of Kandyan Forest Garden Farm** presented the results of a survey of a small mixed farm in the Kandy District (McConell and Dharmapala 1973). **Production economics reports on cocoa, coffee, pineapple and passion fruit**, gave basic input-output data including labour and material requirements, cost of farm enterprise, yields, processing and distribution. Relative profitability of these crops as an alternative to tea and rubber was demonstrated (Kuhonate 1973).

A report on **The Economics of Rubber Production in Sri Lanka** presented data relating to costs, labour and production (McConnel et al 1974). Similarly, in the report on the **Actual and Conditional Economics of Replanting Tea in the Mid-Country of Sri Lanka**, the inputs and cost of uprooting old-seedling tea and replanting with higher-yielding, vegetatively-propagated tea on mid-country estates were given (Ariyaratnam and McConnell 1974). A further report on **Power and Fuel in the Manufacture of Mid-country Tea** analysed inputs and their costs in relation to total costs of tea production, and the demand and supply situation in the mid-country estates (McConnell & Ariyaratnam 1974).

The profitability of forestry on uneconomic tea and rubber land was indicated in **The comparative economic analysis of pulpwood and timber production on Pinus caribaea on different sites** (Redhead *et.al*. 1975). Information on the nature of the present land use, income and the employment situation was provided in **Socio-Economic Studies of the Established Settlements in the Gurugoda-Ritigaha Catchment** (Ahmed et al 1975)

Planting trials were carried out for alternative crops, including pasture grasses for dairy development on less stony lands, and forestry plantations.

General land use plans for the catchments under consideration were prepared. This was followed by preparation of maps for each estate separately and recommendations for future land use (de Silva et al 1974). In a study of the **Settlement Farming in the Wet Zone Highlands of Sri Lanka**, a system of land-use was proposed based on the 'mixed garden' which is a traditional form of land use adopted by smallholders in the Kandy District (Jayanetti et al 1974).

In establishing new settlements as a part of catchment development, **Settlement Planning Procedures and Guidelines** were laid down for the benefit of the officials and the prospective settlers concerned (Wimaladharma et al 1975).

These achievements of the ADP project are remarkable. It might have been expected that all these data would have been used to good effect during the formulation of the subsequent project. However, they were not and the objectives of the Tree Crop Diversification Project have not yet been achieved.

4.1.9 Preparation of the Initial Project Document

The initial project document had been prepared by the local Crop Diversification Project Unit of the Agricultural Diversification Division of the Ministry of Agriculture and Lands, with assistance from local and expatriate consultants. Although a lot of studies had been undertaken beforehand, neither the beneficiary group who constituted the bulk of estate labour, not the people who had to manage the project were consulted. For the success of a project of this nature, the beneficiary group should have felt a strong need for it. If such need was not perceived at the time the project was conceived, efforts to explain the project's aim and to foster beneficiary support could have been made during project formulation. This did not happen.

There was not much flexibility because the project formulation was designed explicitly to seek a tranche of foreign funds for its implementation. The project proposals formulated by local staff with the assistance of expatriate staff were rejected, in the first instance, by the International Development Association. If the project was to qualify for assistance, it had to conform to the proposals made by the donor's own team of consultants sent to evaluate it. In fact, the primary concern of the evaluation mission was to ascertain the financial viability of the project, so that the capital lent could be recovered over a specified period of time. Within the short period of time spent in the area by such an evaluation mission, it would not have been possible to have dialogue about the political, social and administrative aspects with the parties involved.

4.1.10 Agreed Terms of Reference of the Land Use Component of the Development Project

Tea - The area under tea was to be reduced from over 14 500 ha to approximately 5000 ha, because much of the area was degraded and incapable of producing high yields, even if planted with VP clones.

Rubber - Approximately 800 ha of rubber was of poor quality due to neglect, over-maturity or high elevation. This rubber was to be converted to mixed forest gardens and would be gradually replaced by other tree crops.

Cardamom - This was to be grown in areas above 1000 m and the extent to be increased from 400 to 1200 ha. Since cardamom could be grown only in shaded conditions under forest cover, the existing forest was to be preserved or shade trees grown to establish this crop. The protective cover requirement would also tend to reduce runoff and soil erosion.

Mixed forest gardens - This traditional form of land use resembles a forest type of cover and is ecologically sustainable. Mixed forest gardens were to be established to provide a good protective cover to the land.

Sericulture - Mulberry was to be encouraged as smallholding crop.

Pulpwood and Timber - Over 20 000 ha of pine plantation were to be established on unproductive patana grassland and degraded forest land.

Fuelwood - To supply fuelwood for the manufacture of tea, about 650 ha of Eucalyptus were to be planted on tea lands unsuitable for replanting with VP tea or other more demanding crops.

Conservation forestry - Around 1 100 ha of jungle and patana grassland on slopes of more than 75% were to be retained and protected from fire.

4.1.11 Use of Natural Resources Data

Land capability maps of the area had been prepared following Smith (1971) on the basis of the slope, soil depth and rockiness. In the land capability classification, four categories were used:

Class A1: Land suited to a wide range of crops: slopes not exceeding 20%, soil deeper than 1.2 m, stone and gravel content of the topsoil less than 25%, large boulders and rock outcrops occupy less than 25% of the land surface, water table deep enough, and no serious erosion problems such as earth slumps or gullying.

Class A2: Land with more limitations to use, not suitable for annual arable crops but may be used for plantation crops or forests and, on the gentler slopes, pastures.

Class A3: Land with severe limitations, marginal for plantation crops. Wherever possible, it should be used for forage or timber production.

Class A4: Land with such severe restrictions on its use that it should be allowed to revert to jungle or patana. Such land includes:

- slopes greater than 75%;

- slopes less than 75% on which the soil depth is less than 1.2 m or on which there is serious erosion, such as soil slips and gullies;

- slopes between 50-75% on which the stone/gravel content of the topsoil exceeds 25% or on which boulders and rock outcrops occupy more than 25% of the land surface; and

- slopes less than 50% on which gravel content of the topsoil exceeds 50%, or rock outcrops/boulders cover more than 50% of the surface.

Rainfall: Data were analysed for a period of 29 years (1931-60). Galaha and Sogama Estates provided rainfall data for Nilambe-Atabage catchment. Yatideriya and Kellie estate records were selected for Gurugoda-Ritigaha catchment.

Soils: Analysis of some 90 soil samples showed that the soils in the project area were reddish brown to yellowish brown sandy clay loams overlying sandy clay loams and clay loams, with the deeper soils (more than 1.5 m) on the less steep slopes. The pH varied from 4.5 to 5.5; the eroded, shallower and gravelly soils being more acid. The exchange complex was low in bases (4% to 14%). The 'average soil' in the Nilambe-Atabage catchment contained about 25% gravel and could hold about 60 mm available water m^{-1} soil, while the 'average' soil in the Gurugoda-Ritigaha catchment contained 10% gravel and could store 110 mm water m^{-1} soil depth.

There is no evidence of use of these natural resources data in the day-to-day planning and management of the project. Most probably, they might have been used by the team of officers and consultants who initially drew

up land use plans recommending the alternative land uses. Only the simplest initial physical plans produced for each estate (McConnel et al 1974) are still available for project management.

Seminars were held locally to explain the various aspects of the development proposals, but these did not consider natural resources. However, the local officers who participated in the soil and land classification surveys were given good training by the expatriate consultants.

4.1.12 Local Participation in Planning

Since 1970, the Government has made continual efforts to promote the participation of farmers in planning and community development. Several institutions have been set up as channels of communication between farmers and the administration (see Figure 4) including:

Village Councils: elected at village level, established under the Village Councils Act of 1968. They were responsible for maintenance of minor roads and civic amenities, and for organisation of rural markets.

Agricultural Productivity Committees: established under the Agricultural Productivity Law of 1972 to liaise between the District and Divisional Administration and the Cultivation Committees. They were entrusted with promotion, coordination and development of agriculture, and assisting in the formulation of programs and targets for the production of crops and livestock.

Cultivation Committees: responsible for maintaining and developing irrigation works, dealing with water issues.

Agricultural cooperative societies: responsible for supplying farmers' needs and initiating collective systems of production.

Rural Development Societies: voluntary organisations at village level, elected by farmers. They were concerned with improving roads, water supplies, social welfare and cultural projects, agricultural development and cottage industries etc.

4.1.13 Government Agencies

Many ministries, Government departments, corporations and boards have been involved in rural development activities, but some might not have had any direct involvement in the project. The various organisations described below were operating at the time in question but do not necessarily operate now.

The **Ministry of Agriculture and Lands** contained the following departments or divisions:

Agriculture Department: extension, training, research, agricultural development division, agricultural engineering division, and animal production and health;

Agricultural Development Division, Agricultural Project Planning Unit;

Forest Department;

Survey Department, responsible for blocking out and mapping state and private lands;

Land Commissioner's Department, responsible for alienation of state lands, and for their development under Colonisation Schemes;

Rural Institutions Division, responsible for guiding the farmers' institutions set up under the Agricultural Productivity and Agricultural Land Acts:

Land Reform Commission;

Up-country Co-operative Estate Development Board (Uswasama) and People's Estate Development Board (Janawasama), responsible for management of certain acquired mid-country estates and company estates respectively;

Agricultural Insurance Board, responsible for insuring paddy crops in the field;

Paddy Marketing Board;

Fertilizer Corporation;

Agrarian Research and Training Institute;

National Livestock Board, Milk Board, Sugar Corporation etc.

Ministry of Plantation Industries, included the following divisions and boards:

Planning Division;

Agricultural Diversification Division, responsible for planning for integrated development of areas which included uneconomic plantation crops;

Tea Board, Rubber Control Department and Coconut Development Authority. Each of these ran a Research Institute with concomitant extension services for its respective crop, serving both large-scale and smallholder producers;

State Plantation Corporation and Janatha Estates Development Board, which managed several tea, rubber, cocoa and cashew plantations;

Cashew Board.

Other ministries and institutions concerned:

Regional Development Division of the Ministry of Planning and Employment operated Divisional Development Councils;

Ministry of Food, Co-operative and Small Industries, responsible for distribution of food rations through Multi-Purpose Co-operative Societies;

Ministry of Public Administration and Home Affairs which, through its Rural Development Department, provided advice, training and financial support to Rural Development Societies;

Territorial Civil Engineering Organisation (T.C.E.O) of the Ministry of Power and Highways, which was responsible for construction and maintenance of public roads and minor irrigation works.

4.1.14 Conclusions

To date, the results of the project are disappointing. There are no thriving villages, no new society of smallholders drawing their sustinence mainly from Kandyan forest gardens. Few people have been resettled and most of the money poured into the early years of the project was diverted into the upkeep of the existing tea estates. Large areas of *Pinus caribaea* have been planted but these have not had a beneficial effect on soil and water conservation.

It would be unproductive to try to single out agencies that have been effective or ineffective in terms of the failure of the project as a whole. Factors contributing to the failure raised by informants include:

'poor inherent fertility of the land'
'poor calibre of settlers'
'estate labour'
'poor project management'
'political interference'.

All succinctly expressed as 'Everything here is eroded. The land is eroded. The management is eroded. The people are eroded'.

Management shortcomings are not disputed. At the outset, staff at all levels were, in some degree, political appointees and line management only had experience of working in tea estates. If the lion's share of resources was diverted to the tea estates, then management did not believe in the new project. Following the radical change in government in 1977, the government's attention was elsewhere, in the Accelerated Mahaweli Project. The diversification project has been reorganised now, with stronger management, but still operates under severe constraints, as follow:

- *The lines of communication are long and indirect.*

- *Lack of participation = lack of commitment.* The plans drawn up by outside and local consultants, working closely with the Sri Lankan government agencies, were rejected by the external funding organisation which imposed its own criteria of profitable returns on investment.

  There was no contribution to the project formulation by the project managers or the people to be resettled. Initial suspicion and resistance are evident. Even now, there is no enthusiasm for the project goals or the land use promoted by the project, and for good reasons: tea and rubber give a stable, regular income once the crops and infrastructure are established (which they were and still are); the prices now fetched by the alternative perennial crops are not attractive (the market studies carried out in the early 1970s are out of date); and the management of Kandyan forest gardens demands great skill and experience that are not easily acquired. The project provides planting materials and, now, a guaranteed price, but this is costly and complicated to administer.

- *Mismatch between land, people and land use.* The best land has been kept under tea plantations. Settlers have been given poorer land. But the target settlers are poor and landless people, the people with the least expertise, capital, or technical support to overcome the limitations of poor land.

- *Little use made of natural resources information.* Land resource information does not have a recognised place in project decision-making: hilltops have been settled and the slopes below planted with pines; fruit-trees have been doggedly planted beyond their ecological range. The natural resources information and the evaluation skills built up by the FAO project have been, effectively, lost. Planning appears to be a mechanical process of allocating to each estate numbers of trees, by species, responsibility and budget allocations.

Some 5000 ha of *Pinus caribaea* have been planted but, unless skillfully thinned, the exotic forests allow little ground cover so are less effective in arresting runoff and soil loss than patana grassland and, probably, not a lot better than degraded tea. The present view of the Forest Department is that nothing else that is useful will grow on degraded land.

Information wanted by the present project management (Y.G. Wijeratne, personal communication) but not available to them includes:

- large-scale contoured topographic maps for planning roads, terraces and irrigation works;

- maps showing viable land use options for each parcel of land, linked with specific management prescriptions answering the questions:

  'what can be grown ?'
  'what are its particular management needs ?'
  'what will the production be ?'

  Since the unit of management is still the 'estate', the maps are needed estate-by-estate, and should not be too big or too complex to handle. A new land use plan for the Nilambe-Atabage catchment has been requested from LUPPD.

- a basic land resource map showing steepland, rocky land, deep soils and shallow soils and contours (because of the big range in elevation);
- water supply;

- up-to-date market information and projections so that an informed choice can be made between the options that are physically suitable;

- information about the motivation of the people!

4.2 THE ACCELERATED MAHAWELI PROJECT

Dates: 1979 - present

Place: Central, North Central, North Western and Eastern Provinces, Sri Lanka

Area: Catchment area 40 448 km^2

4.2.1 Project Initiation

Following studies of the natural resources of the Mahaweli Basin by the Canada-Colombo Plan project (Hunting Survey Corp. 1962) and the United States Operations Mission which outlined a multi-purpose development including trans-basin diversion of water from the Mahaweli, FAO was requested to prepare a masterplan for development. The 'Masterplan', which was completed in 1969, envisaged 14 dams feeding 365 000 ha of irrigated land in several systems, of which 100 000 was already developed by tanks (traditionally-constructed reservoirs held by earth dams) recommended for upgrading, and 11 hydroelectric power stations with a total capacity of 600 MW. The proposals envisaged that developments would be phased over 30 years.

The project was initiated in 1970 with the Mahaweli Development Board Act (No 14, ch 587). The first component to be completed was the Polgolla Diversion, in 1976, irrigating 12 000 ha of new land in system H (SOGREAH 1972) and augmenting several existing tanks.

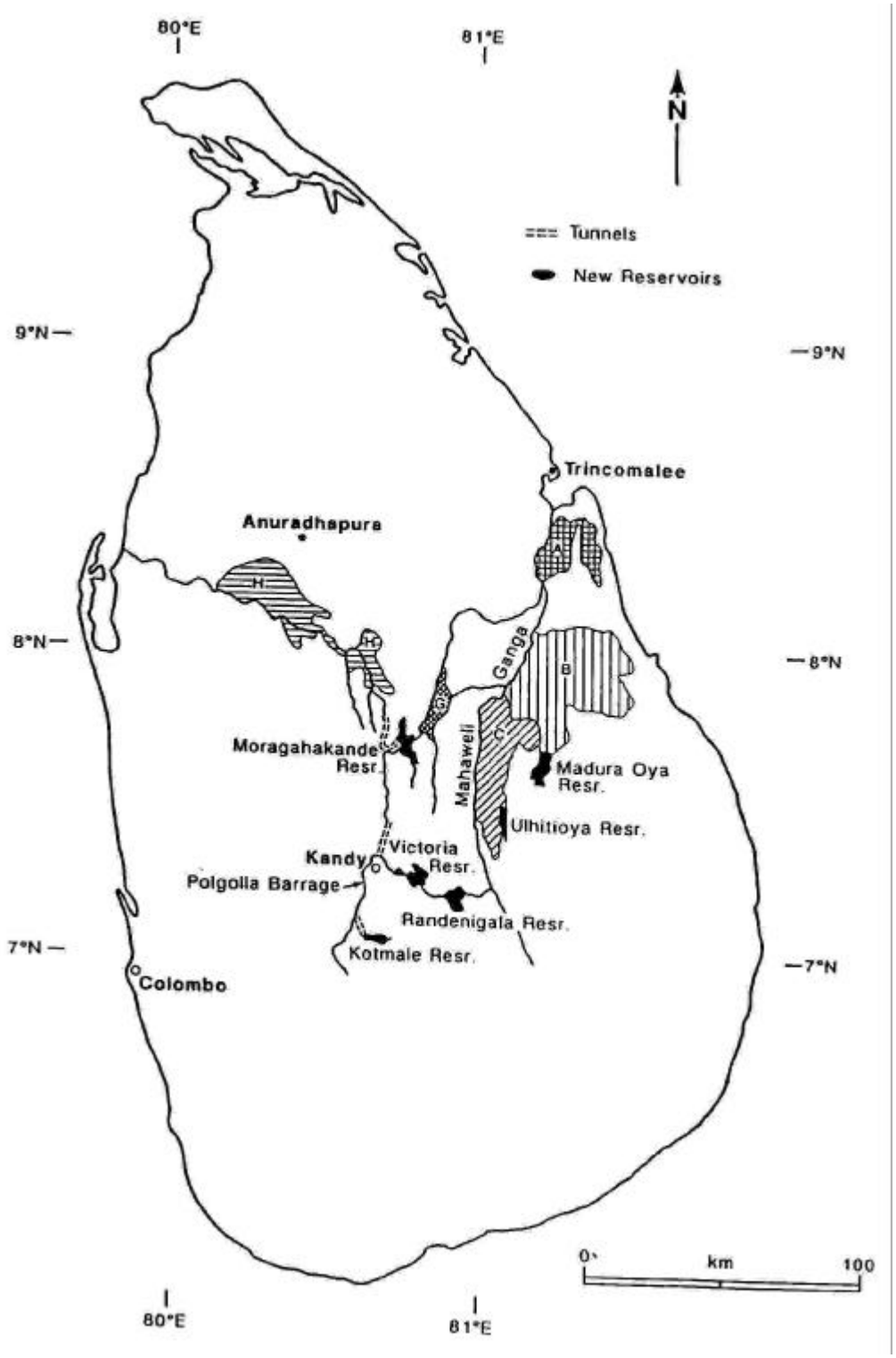
Table 3: Irrigation Systems of the Accelerated Mahaweli Project

System	Pre-existing irrigation upgraded (ha)	New irrigated paddy (ha)	Other new cropland (ha)	Total area (ha)	Population pre-project	Population now
A	3 500	14 000	-	17 500	30 000	300 000
B	8 500	25 000	5 500	40 150	25 500	93 500
C	-	19 550	-	19 550	29 700	133 400
D	2 000	10 950	5 000	17 950	83 000	100 000
H				37 600		
				95 150*	168 200*	626 900*

* Systems A-D only

In November 1977, the prime minister of the newly elected government, Hon. J.R. Jayawardene, proposed telescoping the main parts of the Masterplan into a 5 year period (Table 3 and Figure 6). This was unanimously approved by the cabinet and a separate Ministry of Mahaweli Development set

Figure 6: Location of Accelerated Mahaweli Developments



up in September 1978, under Mr. Gamini Dissanayake. The Mahaweli Authority of Sri Lanka was established by Act of Parliament (No.23 of 1979, ch 272) to undertake the work.

4.2.2 Initial Justification of the Project

The new government saw the Accelerated Mahaweli Project as a political imperative. The economy of the country was in crisis. One third of the budget was being spent on food imports; official unemployment was 1.2 millions with an annual addition to the work force of 125 000. It was estimated that each hectare of farmland would provide full time employment for an average family unit as well as an additional unit of labour in the service sector. National demand for electricity was rising at about 10 per cent annually and the cost of importing fuel would be unsupportable: power considerations alone justified the project and could support a growing industrial and commercial sector. Spiralling inflation would have put development of the Masterplan over 30 years out of reach - but the goodwill of a raft of potential donors offered an opportunity, perhaps the only opportunity, to turn around the economy.

4.2.3 Baseline Natural Resources Information

The decision was bold. Although it was, essentially, a political decision, the scheme could not have been conceived on such a scale without the existence of natural resources surveys dating from the Colombo Plan (which was co-authored by the Hon J R Jayawardene). The key document was the 'Masterplan' (FAO 1969) which assembled data from several departments and agencies and was accepted by the new government as evidence of the feasibility of the project.

However, in 1977, the only rigorous feasibility studies were the SOGREAH study for System H, the Polgolla - Bowatenna complex, and the Kotmale Power Project. The Dutch consultants NEDECO were financed by the Netherlands government to prepare a plan for implementation of an Accelerated Mahaweli Project for submission to the International Bank for Reconstruction and Development (IBRD) and potential donors, and the whole project was divided into units for funding by different international donors. The NEDECO report was submitted in November 1978, by which time feasibility studies for the various systems were already under way.

The feasibility studies included: soils and land classification; hydrology and waterbalance; engineering works; agronomy and cropping systems; forestry; livestock; settlement planning; economic analyses; implementation, organisation and management strategies; and environmental aspects. Most basic data were provided by the government departments concerned, including the Geological Survey Department, the Irrigation Department and its Land Use Division, the Meteorology Department, the Survey Department and the Forestry Department.

Coordination of all this work was undertaken by the Mahaweli Authority, with the Mahaweli Development Board and the Central Engineering Consultancy Bureau maintaining close liaison with overseas consultants and line ministries.

The immediate and urgent task was to secure international finance, which demanded that the project be credible both technically and economically and that the Government of Sri Lanka demonstrate its ability to carry through the work. In this the government was successful, and finance was provided by a group of donors which 'adopted' the various sub-projects. Thereafter, the pace of development outran the provision of detailed natural resources information for planning, and the feasibility studies became implementation plans.

There is no indication of participation of local communities in the initial stages of planning.

4.2.4 Initial Opposition to the Project

Opposition was voiced within Parliament (25 Nov 1978) and outside (Iriyagolle 1978) to implementation of the Accelerated Project without more rigorous feasibility studies. The consultants charged with producing a plan for implementation recognised that the 'Masterplan' was only an outline in which neither the lands to be

irrigated nor distribution systems were even roughly located (NEDECO 1978). IBRD found that many data in the 17 volumes of technical reports in the FAO study were inconsistent and information about water balance, water use, topography and soils inadequate for even a feasibility study.

4.2.5 Natural Resources Information Demanded and Provided to Potential Funding Agencies

Although IBRD found the FAO study an inadequate basis for funding, it nevertheless agreed to fund the first phase - the Polgolla Diversion Project - with the proviso that international consultants carried out a rigorous feasibility study (the SOGREAH 1972 study for system H).

No further substantial studies had been completed when the new Government of Sri Lanka matched up the various parts of the Accelerated Mahaweli Project with bilateral donors. The latter supported the project without rigorous technical assessment but, also, insisted that such feasibility studies were undertaken (Hunting Technical Services 1979 for System C; Joint Venture Randenigala 1979 for System A; Acres International 1989 for Madura Oya project in System B; Japan International Cooperation Agency 1979 for System D, and a further report on System H by Weatherly and Arnold 1977 - references in main bibliography, p 103 - 138). In the bibliography, abstracts are provided of the SOGREAH 1972 and Huntings 1979 reports to illustrate the kind of data provided - p140 *et seq*.

In-country professional staff were heavily involved in providing basic data for all the consultants, liaison being maintained by the Mahaweli Development Board and Central Engineering Consultancy Bureau.

Most of the early investment and site investigations were for the major engineering construction of reservoirs, hydro-power plants and trans-basin canals and tunnels. Land development, irrigation and settlement has had to find their own way without the benefit of detailed soil survey, land evaluation or more than the most basic land use planning. Information eventually available to the consultants at this stage included good topographic sheets at 1:3 168 or 1:5 000 with 1 m contours and 1:20 000 air photographs flown in 1979.

4.2.6 The Perceived Need for and Role of Land Use Planning

The scale of the project demanded planning. The need for a sound farming system, scientific land use and efficient water management was accepted from the outset. The consultants' feasibility studies drew up schematic settlement models and land use plans to relate land use to the variety of topography and soils within the area, but on a provisional basis since no detailed natural resource data were available at the scale needed for implementation. The various sectoral agencies responsible for providing the basic data have struggled to meet the demands of the Mahaweli Authority for these data (see, for example, Dimantha 1986, Jayawardene 1983, and Land Use Division 1981).

Land use planning has been done in two stages, first by the consultants in the feasibility studies. Then, in detail, by the Mahaweli Authority at the implementation stage.

4.2.7 Use of Natural Resources Data in Land Use Planning

Once it was established that there was enough water and enough land that could be irrigated, very limited use has been made of natural resources data. Topographic and land suitability maps have been used to identify areas not suitable for irrigation and to locate settlement and irrigated holdings. Within the Mahaweli Engineering and Construction Agency, responsible for infrastructure, all key managerial staff are engineers. Apart from the hydro power development, the main design and implementation effort has gone into water distribution and other infrastructure which is the concern of engineers. The other wing of implementation is the Mahaweli Economic Agency with a broader mandate of water management, agricultural planning, settlement, marketing and community development. We have not established what use is made of spatial information on land resources. The feasibility studies carried out by international consultants envisaged

tailoring land use to topography and soils, with a range of cropping systems to meet the government policy of import substitution and export growth. In the event, virtually all irrigated land was laid out in paddy smallholdings although, in many areas now, irrigated yala crops other than rice are being grown.

Topography. Engineering concepts were based almost entirely on topographic information. Initially, in feasibility studies, the national 1" to one mile topographic sheets were used, supplemented by a variety of larger-scale survey work by the Survey Department based on 1: 40 000 air photos and field surveys. The Structure Plan produced by the Mahaweli Authority for project implementation is based on 1:5 000 topographic sheets with a 1m contour interval, and individual irrigation blocks are surveyed at 1:2 000 for layout of tertiary canals, water inlets and drainage outlets of individual 1ha irrigated farms.

Geological Survey. The 1" to one mile geological survey sheets are not used in project implementation, being too small scale. For the bigger engineering structures, the Mahaweli Authority has its own geology unit which undertakes deep borings along the lines of canals and deep excavations to collect essential data on strength, permeability and Atterberg limits.

Hydrology. Flood predictions are provided through cooperation between the Meteorology Department and the Hydrology Section of the Irrigation Department, and a network of meteorological stations is maintained within the scheme area. A number of informants mentioned that better stream gauging data would be valuable.

Agroclimate. Evaporation and rainfall probability (75% exceedance) data were used to estimate crop water requirements at the engineering design stage. Assumptions were made for irrigation efficiency, which was assumed to be uniformly high! Some of the more sophisticated models used by the consultants (e.g. Hunting Technical Services) have not been persevered with due to lack of soil data.

Soils. The Land Use Division of the Irrigation Department provided basic soil survey data for the original feasibility studies. Survey data were plotted on 1:5 000 topographic sheets, but surveys were carried out along grid traces at 1km intervals where metric base maps used used (½ mile where Imperial scale base maps were used) with 3-6 auger borings km^{-2}, usually to a depth of 1.5m. This intensity of survey is only appropriate to mapping at a scale of 1:50 000. The units mapped are 'non calcic brown soils', 'reddish brown earths', 'low humic gleys', and rock outcrops and erosional remnants. These are groups of the Sri Lanka genetic soil classification (Moormann and Panabokke 1961, de Alwis and Panabokke 1972). Significantly, there is no specification of depth, texture and permeability although, in 1980, HTS and LUD did carry out soil physical measurements, including permeability and available water capacity, and depth phases were mapped in the System C study.

The soil maps are not used directly by the land use planners but through a land suitability interpretation (Table 4) that is, essentially:

- *Suitable for irrigation*, whether for rice or 'upland' crops. Suitable land is gently sloping with deep soils. Low humic gleys, being poorly drained, are considered suitable for rice;
- *Suitable for homesteads*. 'Upland' with deep soils suitable for gardens;
- *Unsuitable land*, earmarked for forest plantations and not alienated;
- *Rock and erosional remnants.*

Table 4: Land Classifications for Irrigation, Mahaweli Development

(Source: Hunting Technical Services, 1980 Victoria Scheme, Mahaweli Development, System C Feasibility Study Main Report pp 35-37)

I - LAND CLASSIFICATION: DRYFOOT CROPS: SURFACE IRRIGATION

Soil type, Drainage	Soil depth phase	Gravel depth	Slope phase (t)				
			0-1.5%	1.5-3%	3-4%	4-6%	>6%
RBEs, Well drained	d;vd>120cm md90-120 ms60-90 s < 60	>90cm 60-90 30-60 < 30	1 1 3p 6p	1 2pt 3pt 6pt	2t 3tp pt' 6pt	3t 6tp' 6pt 6pt	6t 6tp 6tp 6tp
RBE, Imperfectly drained	d;vd>120cm md90-120 ms60-90	>90cm 60-90 30-60	3d 3dp 6dp	3d 3dp 6dp	3dt 6dtp' 6dtp	6dt 6dtp 6dtp	- - -
LHG, Poorly drained	d;vd>120cm	>90cm	5d	5d	5dt	6dt	-

II - LAND CLASSIFICATION : WETLAND RICE

Soil type, Drainage	Soil depth phase	Slope phase (t)			
		0-1.5%	1.5-3%	3-4%	4-6%
RBEs, Well-drained	All depth phases but shallow Shallow depth phase	R2s R2p	R3st R3pt	R6st R6pt	R6st R6pt
RBE, Imperfectly drained	All depth phases but shallow	R1	R2t	R3t	R6t
LHG, Poorly drained	Shallow depth phase	R2p	R3pt	R6pt	R6pt

Note: p, d, and t refer to depth, drainage, and topography (slope) subclasses respectively

Subclasses 6tp', 6pt', etc. are marginally dow ngraded

Classes 1 and 2 are 'suitable'; class 3 'marginally suitable'; class 5 'unknown suitability'; class 6 'unsuitable'

The Land Use Division does have more information on the general characteristics of the mapping units but no use seems to be made of this. Paddy farms have been laid out according to the practicability of water supply and distribution, not the capability of land to make good use of the water. Recommendations by several consultants for a more varied pattern of land use to make efficient use of water on the more permeable soils have not been taken up.

The big question of land use: paddy versus diversified cropping

Hunting Technical Services showed that all paddy, paddy/sugarcane, or diversifieid cropping options were economically viable with comparable returns at 1979/80 costs and prices. The arguments for the paddy-plus-sugarcane options were:

i) Scope for greater savings of irrigation water;

ii) The country was 80 per cent self-sufficient in rice with rapidly increasing production, but only 10 per cent sufficient in sugar with stagnating production;

iii) The Commonwealth Development Corporation (CDC) and other investors were very interested in expanding sugarcane operations in the country, and aid finance for the expensive sugarmill would probably be available;

iv) Planning for rice/sugarcane allowed for greater flexibility. If (say in 30 years) sugarcane was no longer viable, other dry-foot crops could be substituted, using the existing irrigation infrastructure;

v) The rice/sugarcane option had a slightly higher internal rate of return than the all-rice option;

However, the World Bank wanted to finance the all-rice option. They justified this by arguing that:

i) Smallholder double cropping of rice had been very successful in the adjacent Mahaweli left bank areas, and this could be extended into System C;

ii) After construction of the Victoria reservoir, there would be ample water for 100 per cent rice irrigation;

iii) If the Rotalawala and System A offtakes were constructed, re-use of drainage water from System C would further increase efficiency in water use;

iv) Drainage problems existed for sugarcane over half of the catena. Hydraulic conductivities for the subsoil horizons were rather low so drain spacings would have to be close and, therefore, expensive. Drainage problems and low sugarcane yields were very evident at the two big sugarcane operations at Kantalai and Hingurana on land rather similar to System C;

v) The all-rice option was viable as a smallholder scheme alone. The rice/sugarcane option would, ideally, require a foreign company to run the mill and up to 40 per cent of the sugarcane land. Politically, this would be less popular and would take some explaining!

The Government followed the all-rice option, which matched the goal of settling as many farmers as possible.

Over-use of water has been every bit as bad as predicted and some drainage problems have arisen because irrigation works have been designed to supply water, not to take it away. It was assumed that natural drainage would be adequate except in flat bottomlands. Only in System B, where the American funding agency insisted, are canals lined to avoid seepage into permeable soils. The Mahaweli Authority has no information on water use, field efficiency and permeability for different kinds of soils. The Sri Lanka genetic soil classification is ill-suited to provide this and a great deal of potentially useful information on soil texture gathered by the field surveyors has been lost by the classification.

The Structure Plan produced centrally by the Mahaweli Authority at 1:5 000 shows, for each irrigation block:

- Irrigation units, with areas;
- Water distribution systems, roads and bridges;
- Irrigated paddy, upland crops;
- Settlements and gardens;
- Village tanks and wells;
- Areas outside the command area.

The plan follows the model produced by Hunting Technical Services for the System C feasibility study.

4.2.8 Monitoring and Evaluation

An independent process control and monitoring unit was set up, supported by external finance. Its initial task was to mediate between the engineers and settlement agencies. A planning and monitoring role developed gradually to ensure that development targets were met on schedule. This became a major operation with a library of 5 000 volumes; specialist sections for transport, photography, statistics, cartography, audio-visual, and special studies; and a computer network to record all phased activities so that the consequences for each operation of any change in plan could be assessed quickly.

Field officers filed monthly reports based on a modular questionnaire and project officers made spot checks and spoke regularly with field officers, contractors, labourers and farmers. A photographic record was maintained of work in progress, deficiencies like collapsed bunds, pests and diseases in crops, goods and equipment in storage. Data were collated for monthly review meetings of heads of divisions and contractors. These review meetings were not popular! Field officers were threatened from time to time and the monitor could function only while retaining the absolute confidence and support of the highest level of government and all levels below, and by being seen to be above board, impartial and strict.

Adherance to the plan was closely monitored, not the success of the plan in achieving its goals.

4.2.9 Lessons to be Learned

Power development has been a success. In the downstream areas, land and water resources have been developed, new farming systems instituted and communities housed with basic infrastructure and services. The political gamble can now be seen to have been justified - land, water and human resources were sufficient and the information base was sufficient - just.

Looking at some of the details, the kinds of problems arising from paucity of initial data and speed of development without data may be illustrated by the difficulties encountered with the Victoria Reservoir that were revealed by an environmental impact appraisal after the event (Owen et al 1987). A pre-feasibility study in 1979 by V.C. Robertson examined engineering, economic, managerial, agricultural and settlement issues. It was estimated that the reservoir would flood 1 800 ha of farmland, of which 215 were paddy, and would displace 1 300 families that would be relocated on irrigated land downstream. No problem of reservoir sedimentation was imagined on the basis of estimated (not measured) rates of erosion in the catchment, but it was recommended that land use in the catchment be properly managed. In fact, the Mahaweli Development Board engineers decided to increase the height of the dams by 8 m, without undertaking a further environmental study. 2 700 ha of farmland was flooded, 530 of which was paddy. 6 000 families (30 000 people) were displaced of which 2 000 relocated upstream and 4 000 downstream.

Downstream problems arose because of the number of people to be handled. The pace of irrigation development could not match the need for resettlement; water, even potable water, was insufficient; there was a resurgence of dengue and malaria vectors breeding in the unflushed gorge and canal seepage, and community services were not up to the job. Debt, food shortage and despair drove some 200 families back

upstream. Upstream settlement was scarcely planned at all. Settlements along the shore brought contamination of water by sewage and other refuse. Some settlements occupied the best farmland, some agricultural developments occurred on unsuitable land. Inadequate acquisition of land around the shore led to flooding and collapse of dwellings and the need for further resettlement. Erosion along the shoreline and road construction in the catchment caused sedimentation in the reservoir. Extensive soil erosion in the upper catchment has not caused problems for the Victoria reservoir because the Polgolla Barrage is immediately upstream. Further environmental problems included lake stratification, and algal blooms obstructing fishing, navigation and the operation of sluices.

It is significant that, even today, the capacity for rigorous environmental impact assessment of development projects does not exist (see CECB report abstracts).

Land use planning in the first phase of development has been very basic for several reasons that are inter-related: the speed of development; the lack of more than a bare minimum of data on land resources, especially land quality; and the sheer size of the planning task in relation to the resources of the country, in particular its planning and management capability. Land use planning has turned out to be more complex and difficult than planning dams, hydro-power stations and canals, not least because many more people are directly involved in its implementation.

The next cycle of development will be more difficult still. The next generation cannot be given more land. Income must be increased from the same area and this will demand higher yields, more efficient water use, intensification and diversification of land use, and added value through agro-industries and services. Attention must also be given to conservation of the watershed to ensure sustainable supply of water and the lifespan of the reservoirs.

All this will require another cycle of massive investment, not least in more-detailed and better information about soils, hydrology, weather, cropping systems, markets and opportunities for investment, so that land use is more closely matched to land suitability. And this information is needed by a much broader spectrum of people than has been able to make use of the first generation of information, because the task is now beyond the capability of a central planning organisation.

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APPENDIX 1

LEGISLATION RELATING TO MANAGEMENT OF NATURAL RESOURCES AND LAND USE PLANNING

The information presented here is summarised primarily from Legislative Enactments of the Democratic Republic of Sri Lanka (Deherogoda 1980). It is organised in five sections:

A. Land Use
B. Water Quality
C. Coastal Environment
D. Environmental Impact, Forest Conservation, Parks and Wildlife
E. Mineral Development

SECTION A: LAND USE

Agrarian Services Act No. 58 of 1979 (Ch 261 - 1980 Revised)

Provides security of tenure to tenant cultivators of paddy lands, specifies the rent payable to landlords, and provides for maximum productivity of paddy and other agricultural land through the proper use and management of agricultural crops and livestock. Provides for the establishment of Agrarian Services Committees, and determination of tenurial and other disputes relating to agricultural land by the Commissioner of Agrarian Services. Imposes duty on the Commissioner to provide for the appointment of cultivation officers. Repeals the Agricultural Productivity Law No. 2 of 1972; and related matters.

Section 4	Maximum extent to be cultivated by a tenant to be five acres.
Section 33,34	Owner or occupier to cultivate agricultural land with such crops and rear such breeds of livestock as are best suited for the land.
Section 43	Appointment of Agrarian Services Committees.
Section 45	Register of agricultural lands.
Section 62	Paddy land to be used only for cultivation of paddy or as authorized by the Commissioner.

Implementing agency: Agrarian Services Department

Coconut Development Act No. 46 of 1971 (Ch 260 - 1980 Revised)

Provides for the development and regulation of the coconut industry, and the use of land in and for coconut plantations. Establishes boards and a public authority, known as the Coconut Development Authority, and regulates their growers. Provides for a levy on coconut products to provide for the management and related matters.

Section 2	Appointment of Boards
Section 20	Function of Boards: a. Development and assistance in the development of the productivity of land in coconut plantations. d. Animal husbandry in coconut plantations.

Section 24	Establishment of the Coconut Development Authority.
Section 30	Functions of the Authority: a. Assists in the formulation of policy and in the determination of development priorities.

Implementing agency: Coconut Cultivation Board

Forest Ordinance No. 16 of 1907 etc. (Ch 283 - 1980 Revised)

Consolidates and amends the law relating to forest and the felling and transport of timber.

Section 3	State land to be declared reserved forest.
Section 12	Constitution of village forest.

Implementing agency: Forest Conservation Department

Greater Colombo Economic Commission Law No. 4 of 1978 etc. (Ch 300 - 1985 Revised)

Establishes the Greater Colombo Economic Commission, and vests it with powers necessary for the development and resurgence of the economy of the Republic, and provides for related matters.

Section 16	Powers of the Commission: c. To lay out industrial estates.

Implementing agency: The Greater Colombo Economic Commission.

Irrigation Ordinance No. 32 of 1946 etc. (Ch 285 - 1980 Revised)

Amends and consolidates the law relating to irrigation.

Section 3	District agricultural committees.
Section 4	Duties of District Agricultural Committees - advise Government Agent on: Irrigation, paddy cultivation, agriculture.
Section 6	Advisory committees on major irrigation works.
Section 23	Cultivation committees.
Section 46	Irrigation rates.

Implementing agency: Irrigation Department

Janawasa Law No. 25 of 1976 (Ch 265)

Provides for the registration of certain societies (for example registered Co-operative Societies) as JANAWASA (human settlement) enabling them to hold property as co-operative bodies, for establishment the Janawasa Commission to register, regulate and supervise JANAWASA, for the formation of a JANAWASA Federation.

Section 2	Societies to be registered as Janawasas
Section 9	Objectives of Janawasa: a.i) Collective management and development of agricultural land. a.ii) Ensure maximum productivity and maximum utilization of agricultural land.

Implementing agency: Janawasa Commission

Land Development (Amendment) Act No. 40 of 1978 etc. (Ch 300 - 1983 Revised)

Provides for the systematic development and alienation of state land in Sri Lanka.

Section 8	Mapping out of state land for different purposes.

Implementing agency: Land Commissioner's Department

Land Grants (Special Provision) Act No. 43 of 1979 (Ch 287 - 1980 Revised)

Provides for the vesting in the state of agricultural or estate land under the Land Reform Commission to enable the transfer, free of charge, to the landless of the such lands.

Section 2	L.R.C. agricultural land to be vested in the State.
Section 3	Lands vested in the State to be transferred.
Section 5	Transfers to be subject to conditions: a. Transfer to carry out soil conservation measures. g. To be prescribed for the proper utilization and management of such land.

Implementing agency: Land Commissioner's Department

Land Reform Law No. 1 of 1972 etc. (Ch 297 - 1980 Revised)

Establishes a Land Reform Commission to fix a ceiling on the extent of agricultural land that may be owned by persons, and to provide for the vesting of lands owned in excess of such ceiling in the Land Reform Commission, and for such land to be held by the former owners on a statutory lease from the Commission. Prescribes the purposes and the manner of disposition by the Commission of agricultural lands vested in the Commission so as to increase productivity and employment. Provides for the payment of compensation to persons deprived of their lands under this law, and related matters.

Section 2	To take over agricultural land owned by a person in excess of the ceiling, and to utilize such land for increasing productivity etc.
Section 42	Purposes for which lands vested may be used.

Implementing agency: Land Commissioner's Department

Land Settlement Ordinance No. 20 of 1931 etc. (Ch 299 - 1980 Revised)

Amends and consolidates the law relating to land settlement.

Section 4	Settlement order: For forests, waste or unoccupied lands.

Implementing agency: Land Commissioner's Department

Mahaweli Authority of Sri Lanka Act No 23 of 1979 (Ch 272 - 1980 Revised)

Establishes the Mahaweli Authority of Sri Lanka to be the Authority responsible for the implementation of the Mahaweli Ganga Development Scheme. Provides for the establishment of corporations to assist in such implementation and to provide for related matters.

Section 3	Declaration of special areas that can be developed with the water resources of Mahaweli Ganga or of any major river.
Section 12	Functions of the Authority: a. Plan and implement the Mahaweli Ganga Development Scheme. b. Foster and secure full and integrated development of any special area. c. Optimize agricultural productivity and employment potential. d. Conserve and maintain the physical environment.

Implementing agency: Mahaweli Ministry

Mahaweli Development Board Act No. 14 of 1970 etc. (Ch 587 - 1980)

Provides for the establishment and regulation of the Mahaweli Development.

Section 4	Development work.
Section 6	Special areas.

Implementing agency: Mahaweli Ministry

National Environmental Act No 47 of 1980 (Ch 554 - 1980 Revised). Amended 1988

Establishes a Central Environmental Authority and makes provision for its powers, functions and duties.

Section 10	Powers, functions and duties of the Central Environmental Aurhority: b. To recommend National environmental policy to the Minister. e. To specify standards, norms and criteria for the protection of the environment l. To promote, encourage, co-ordinate and carry out long range planning in environmental protection management.
Section 16	Formulation of land use schemes.
Section 17	Policy as to the management and conservation of the country's natural resources.
Section 20	System of rational exploitation and conservation of wildlife resources.
Section 21	Policy for forestry.
Section 22	Policy on soil conservation.

Implementing agency: Central Environmental Authority

National Planning Council Act No 40 of 1956 etc. (Ch 315 - 1980 Revised)

Provides for the establishment of a National Planning Council and a Planning Secretariat, and for related matters.

Section 5	Functions: advise the Cabinet on planning of agriculture, industry, education, housing, health and social services, public utilities and all other matters pertaining to the national economy.
Section 8	Planning secretariat.

Implementing agency: Ministry of Finance, Ministry of Policy Planning and Implementation

Pasture Lands (Reservation and Development) Act No. 4 of 1983

Section 2	Declaration for land to be reserved as pasture land.

Implementing agency: Land Commissioner's Department

Rubber Control Act No 11 of 1956 etc. (Ch 255 - 1980 Revised)

Provides for the registration of rubber plantations and proprietors, for the control of the planting and replanting of rubber, the possession, sale and purchase of rubber and the exportation of rubber seed and such parts of rubber plants that are capable of being used for propagation. Imposes an export duty on rubber for the establishment of a Rubber Advisory Board.

Section 2	Register of estates and small holdings.
Section 7	Planting and replanting of rubber only on permit.

Implementing agency: Rubber Controller's Department

Soil Conservation Act No. 25 of 1951 etc. (Ch 279 - 1980 Revised)

Makes provision for the conservation of soil resources, for the prevention or mitigation of soil erosion, and for the protection of land against damage by floods and drought.

Section 3	Declaration of erodible area.
Section 4	Regulations to be made: a. For owners to make suitable measures. b. Prohibiting clear weeding. c. Restricting uses.
Section 6	Regulations: a. Promotion of soil fertility.
Section 7	Director to grant loans to take suitable measures.

Implementing agency: Agriculture Department

Sri Lanka Land Reclamation and Development Corporation Act No 15 of 1968 etc. (Ch 606 - 1980 Revised)

Provides for the establishment of the Colombo District (low-lying areas) Reclamation and Development Board for the reclamation and development of such areas as may be declared by order of the Minister so that they may be rendered suitable for building.

Section 2	Declaration of Reclamation and Development areas.
Section 3	Vesting of land in the Board.

Implementing agency: Sri Lanka Land Reclamation and Development Board

Sri Lanka Tea Board Law No 14 of 1975 (Ch 253 - 1980 Revised)

Provides for the establishment of the Sri Lanka Tea Board.

Section 4	Power: a. Regulate production and cultivation of new areas in tea, replanting etc.
Section 9	Tea Commissioner to exercise power of the Tea Controller.

Implementing agency: Sri Lanka Tea Board

State Lands (Recovery of Possession) Act No. 7 of 1979 (Ch 289 - 1980 Revised)

Provides for the recovery of possession of State lands from persons in unauthorized possession or occupation thereof, and for related matters.

Implementing agency: Land Commissioner's Department.

State Lands Encroachment Ordinance No 12 of 1840 etc. (Ch 288 - 1980 Revised)

Provides for the prevention of encroachments upon State lands.

Implementing agency: Land Commissioner's Department

State Lands Ordinance No 8 of 1947 etc. (Ch 286 - 1980 Revised)

Provides for the grant and disposition of State land for the management and control of such land and the foreshore for the regulation of the use of the water.

Section 2	Grants by the President.
Section 27	Vesting by the President.
Section 49	Reservation for water courses.
Section 55	Road reservation - wasteland which is within 33 feet of the middle of the public carriage way or cartway.
Section 57	Leasing of road reservations by the Government Agent
Section 58	Foreshore vested in the State.
Section 61	Leasing and occupation of foreshore.
Section 70	Use of water in lakes and public streams.
Section 96	Regulations for: a. Disposition of land over 5000 feet in elevation.

Implementing agency: Land Commissioner's Department

Tea and Rubber Estates (Control of Fragmentation) Act No. 2 of 1958 (Ch 257 - 1980 Revised)

An act to control the fragmentation of tea and rubber estates and provide for related matters.

Section 3	Transfer of ownership only after consent from the Board.
Section 4	Partition by deed by agreement of co-owners not valid unless done with the consent from the Board.
Section 6	Institution of the partition action after obtaining consent from the Board.
Section 8	Instances where the Board may grant consent.
Section 10	Tea and Rubber Estates (control of fragmentation) Board.

Implementing agency: Tea and Rubber Estates Fragmentation Board

Tea Control Act No. 51 of 1957 etc. (Ch 251 - 1980 Revised)

Provides for the registration of tea plantations and proprietors, tea manufacturers and their factories, for the development and maintenance of tea plantations and tea factories, and consequences for non-compliance with orders issued by the Controller for the control of the planting and replanting of tea; the possession, sale and purchase of tea and the exportation of tea, and tea seed and such parts of the plant as are capable of being used for propagation. Imposes an export duty on tea for the establishment of a Tea Advisory Board.

Section 2	Register of estates and smallholdings.
Section 11	Duty of proprietor to develop the estate or smallholding up to the "required standard" of production and management as the Controller deems satisfactory.
Section 11C	Criteria to be taken into account in the determination of "required standard".
Section 11D	Special Advisory Committee.
Section 11F	Diversification to approved crops
Section 11G	In the event of failure to comply with directions of the Controller, the estate or the smallholding may be vested with the Government.
Section 11L	Compensation on vested property.
Section 12	Planting and replanting tea only under permit (note: estates are of 10 acres or more, smallholdings are less than 10 acres).

Implementing agency: Tea Controller's Department

Tea Small Holding Development Law No 35 of 1975 (Ch 252 - 1980 Revised)

Establishes a public authority known as the Tea Small Holdings Development Authority to provide for the development management and regulation of tea smallholdings. Provides for the compulsory acquisition of movable and immovable property and makes provision for related matters.

Section 14	Functions of the authority: a. To promote of develop tea smallholdings

Implementing Agency: Tea Small Holdings Development Authority

Town and Country Planning Ordinance No. 13 of 1946 etc. (Ch 605 - 1980 Revised)

Authorizes the making of schemes with respect to the planning and development of land in Sri Lanka. Provides for the protection of natural amenities and preservation of buildings and objects of interest or beauty. Facilitates the acquisition of land for such schemes, and related matters

Section 2	Scope of planning schemes.
Section 3	Central Planning Commission.
Section 6	Urban development areas.
Section 7	Trunk road development areas.
Section 8	Regional development areas.
Section 9	Planning authorities.
Section 38	Contents of planning schemes.

Implementing agency: Urban Development Authority

Urban Development Authority Law No 41 of 1978 etc. (Ch 602 - 1980 Revised)

Provides for the establishment of an Urban Development Authority. Promotes integrated planning and implementation of economic, social and physical development of certain areas as may be declared by the Minister to be Urban Development Areas.

Section 3	Declaration of Urban Development areas.
Section 8	Functions of the Authority: a. Integrated planning. b. Implement development work. i. Formulate and implement urban land use policy in such areas. j. To develop environmental standards and prepare schemes for environmental improvement in such areas.

Implementing agency: Department of Town and Country Planning, Ministry of Housing and Construction

SECTION B: WATER QUALITY

Flood Protection Ordinance No 4 of 1924 (Ch 278 - 1980 Rev)

Ordinance for the protection of areas subject to damage from floods.

Section 3	Declaration of flood areas.
Section 4	Director of Irrigation to prepare scheme for flood protection.
Section 7	Government Agent or MC to be nominated a flood authority.
Section 13	Recovery of "flood rates".

Implementing agency: Irrigation Department

Greater Colombo Economic Commission Law

See above under Land Use

Irrigation Ordinance

See above under Land Use

National Aquatic Resources Research and Development Act No. 54 of 1981

Section 4	Objectives and functions of the Authority: s. The development management and conservation of aquatic resources in inland waters, coastal wetlands and offshore areas.
Section 13	National Aquatic Resources Management Council, provision for establishment.

Implementing agency: National Aquatic Resources Research and Development Authority

National Water Supply and Drainage Board Law No. 2 of 1974 (Ch 541 - 180 Revised)

Provides for the establishment of a public authority known as the National Water Supply and Drainage Board and for related matters.

Section 17	Power of the Board: b. To carry out investigations and to collect data concerning the provision, development and maintenance of water supply and sewage services.

Implementing agency: National Water Supply and Drainage Board

Water Resources Board Act No. 29 of 1964 (Ch 280)

Provides for the establishment of a Water Resources Board and makes provisions for related matters.

Section 12	Duties of the Board - to advise the Minister on: a. Control, regulation, development (including conservation and use) of the water resources of the country; c. Promotion of afforestation; d. National policies on use of water resources; f. National policies on use of water resources; j. Preparation of integrated plan for the conservation, utilization, control and the development of water resources of the country.
Section 14	Interdepartmental Advisory Committee to the Water Resources Board.

Implementing agency: Water Resources Board

SECTION C: COASTAL ENVIRONMENT

Coast Conservation Act No. 57 of 1981

Section 12	Coastal Zone Management Plan b. Proposals to deal with: Land use; Transport facilities; Preservation and management of the scenic and other natural resources; Human settlement; Agriculture; Industry.
Section 16	Environmental impact assessment.

Implementing agency: Coast Conservation Department

Marine Pollution Prevention Law

Maritime Zones Law No. 22 of 1976

Provides for declarartion of territorial waters and exclusive economic zones and related matters.

Section 5-2	All natural resources within the exclusive economic zone vested in the Republic.
6-2	All Natural resources of the continental shelf vested in the Republic
Section 7	Pollution prevention zones may be declared by Presidential proclamation. Relevant minister to take steps required to prevent pollution and maintain ecological balance within such zones.

National Aquatic Resources Research and Development Act

See above under Water Quality

Seashore Protection Ordinance No. 12 of 1911

Provides for prevention of damage to the shoreline by removal of sand, coral, etc. from the seashore.

Section 2	Provides for the proclamation of protected areas, the removal from which of sand, stone, coral or other substances is permitted only under licence from the Government Agent.

State Lands Ordinance No 8 of 1947 (Ch 286 - 1980 Revised)

See Section A: Land Use

SECTION D: ENVIRONMENTAL IMPACT, FOREST CONSERVATION, PARKS AND WILDLIFE

Coast Conservation Act

See Section C: Coastal Environment

Fauna and Flora Protection Ordinance No. 2 of 1937 etc. (Ch 567 - 1980 Revised)

Provides for the protection of fauna and flora of Sri Lanka.

Section 2	Reclamation of State land to form: Strict Natural Reserves; National Parks; Nature Reserves; Jungle Corridors or Intermediate Zones; Land other than National Reserve to be declared a sanctuary (sanctuary to contain State and other land).
Section 3	Essential features of reserves or sanctuary.

Implementing agency: Forest Conservation Department and Wildlife Department

Forest Ordinance

See Section A: Land Use

National Environmental Act

See Section A: Land Use

Soil Conservation Act

See Section A: Land Use

State Lands Ordinance

See Section C: Coastal Environment

SECTION E: MINERAL DEVELOPMENT

Mines and Minerals Law No 4 of 1973 (Ch 340 - 1980 Revised)

Provides for the vesting of absolute ownership of certain minerals in the Republic to regulate the mining or prospecting for collection, processing, sale and export of minerals; to provide for the health, safety and welfare of workers in mines; to enable the compulsory acquisition or requisition of immovable or movable property for any corporation established to develop the mineral industry; and to make provision for related matters.

Section 2	Ownership of minerals vested in the Republic.
Section 4	License for mining, prospecting, etc.
Section 13	License not to be issued in certain specified lands.
Section 22	No prospecting for minerals to be undertaken by the Director within unalienated lands belonging to the Republic.

Implementing agencies: State Gem Corporation
Geological Survey
Graphite Corporation
Mineral Sands Corporation

State Gem Corporation Act No 13 of 1971 (Ch 341 - 1980 Revised)

Provides for the establishment of a corporation for the development, regulation and control of the gem industry and for related matters.

Section 13	Functions of the Corporation: j. Sole authority for the alienation of the right to mine gems in State land.

Implementing agency: State Gem Corporation

APPENDIX 2

INSTITUTIONS SUPPLYING AND USING NATURAL RESOURCES INFORMATION

A2.1 INTRODUCTION

Government agencies responsible for the supply of primary data are listed first by kind of data, then alphabetically. Principal users of this information and agencies responsible for land use planning are also listed. At this stage, information is not included about institutions that are responsible primarily for training, such as universities, nor for non-governmental organisations such as the International Irrigation Management Institute, Kotte and the Institute for Fundamental Studies, Peradeniya, although they have important libraries and research capabilities.

Sources of Primary Data:

Agroclimatic data	Meteorology Dept.
Air photos	Survey Dept.
Biodiversity	Wildlife Conservation Dept., Forest Dept.
Cadastral data	Land Commissioner's Dept., Agrarian Services Dept.
Coastal erosion and sedimentation	Coast Conservation Dept.
Forest inventory	Forest Dept.
Geological maps	Geological Survey Dept.
Hydrology	(surface waters) Hydrology Division, Irrigation Dept. (groundwater) Water Resources Board
Land evaluation	Land Use Division, Irrigation Dept.; Land and Water Management Research Centre, Agriculture Dept.
Land use	Survey Dept., Forest Dept., Forest Land Use Mapping Project, Mahaweli Authority
Market information	Agrarian Research and Training Institute
Meteorological data	Meteorology Dept.
Satellite imagery	Survey Dept.
Soil maps	Land Use Division, Irrigation Dept.; Land and Water Management Research Centre, Agriculture Dept.
Requirements of specific crops	Coconut Research Institute Export Agriculture Dept. Rubber Research Institute Sugar Research Complex Tea Research Institute

Suppliers of Natural Resources Information

Agrarian Research and Training Institute
Coast Conservation Department
Coconut Research Institute
Export Agriculture Department
Forest Department
Geological Survey Department
Hydrology Division, Irrigation Department
Land and Water Management Research Centre,
Agriculture Department
Land Use Division, Irrigation Department
Meteorology Department
Sugar Research Complex
Survey Department
Tea Research Institute
Water Resources Board

Users of Natural Resources Information

Agrarian Services Department
Agricultural Development Authority
Central Engineering Consultancy Bureau
Coast Conservation Department
Coconut Research Institute
Export Agriculture Department
Forest Department
Hadabima Adikariya (NADSA)
Hydrology Division, Irrigation Department
Land and Water Management Research Centre
Land Use Division, Irrigation Department
Land Use Policy Planning Division, Ministry of Lands
Mahaweli Authority
Ministry of Environment and Parliamentary Affairs
Natural Resources, Energy and Scientific Authority
Regional Development Unit, Ministry of Policy Planning and Implementation
Rubber Research Institute
Sri Lanka Council for Agricultural Research Policy
Sri Lanka Land Reclamation and Development Corporation
Sugar Research Complex
Tea Research Institute
Water Resources Board
Wildlife Conservation Department

Land Use Planning

Central Engineering Consultancy Bureau
Coast Conservation Department

Forest Department
Hadabima Adikariya (NADSA)
Land Use Policy Planning Division, Min. Lands
Mahaweli Authority
Regional Development Unit, Ministry of Policy Planning and Implementation
Wildlife Conservation Department

A2.2 INSTITUTIONS RESPONSIBLE FOR NATURAL RESOURCES MANAGEMENT

Agrarian Research and Training Institute, Ministry of Agricultural Development and Research

Address: 114 Wijerma Mawatha, Colombo 7

Objectives and Main Activities:

- To foster and coordinate research into agrarian structure;
- To examine economic, social and institutional factors responsible to the development of agriculture;
- To offer training at various levels to those concerned with programs in the agricultural sector;
- To serve as the centre for agricultural development and agrarian reforms;
- To conduct irrigation and environmental impact assessment studies in irrigation schemes;
- To provide market information on daily consumer products.

Availability of Information:

Raw data are collected at field level, analysed and presented as reports. Important library and publications series.

Customers:

Donor agencies such as World Bank, Asian Development Bank, USAID, government ministries and agencies like Lands and Irrigation, Agriculture, and Forestry.

Staff: Professionals 40
Supporting staff 100

Category: Supplier of socio-economic information and environmental impact assessment

Agrarian Services Department, Ministry of Agricultural Development and Research

Address: 42 Sir Marcus Fernando Mawatha, Colombo 7

Objectives and Main Activities:

- Main objective is agrarian management through:
  - Servicing the agrarian community through agrarian centres and Divisional Officers;
  - Supply of agricultural inputs and assistance for paddy production;
  - Repair and maintenance of minor irrigation schemes;
  - Introduction of water management systems.
- Responsible for implementing the Paddy Lands Act and safeguarding the interests of paddy farmers; settling disputes between owners and tenant cultivators of paddy lands
- Maintains records of paddy land owners and tenants

Availability of Information:

- Records are maintained in files by the Divisional Officers attached to Divisional Secretaries' Offices.

Staff: Professionals 30
Support staff 540

Category: User of natural resources and socio-economic information

Agricultural Development Authority, Ministry of Agricultural Development and Research

Address: 38 D.R. Wijeyawardene Mawatha, Colombo 10

Objectives and Main Activities:

- To coordinate agricultural development activities in private lands with the cooperation of the owners;

- To supervise agricultural development activities in private lands, in consultation with the Department of Agriculture and other state agencies;

- To ensure the availability of agricultural inputs;

- To supervise and coordinate existing agricultural storage and marketing facilities.

Availability of Information:

Information is available with the district managers and at the head office in conventional paper files.

Staff: Professionals 160
Supporting staff 400

Categories: User of natural resources and socio-economic information

Central Engineering Consultancy Bureau, Ministry of Forestry, Irrigation and Mahaweli Development

Address: 415 Baudhaloka Mawatha, Colombo 7

Objectives and Main Activities:

- Preparation of feasibility reports, designs and estimates of single and multi-purpose irrigation projects; flood control and power projects; highway projects; water supply, drainage facilities and sewerage projects, coastal and maritime projects; hydro-power schemes and similar engineering projects;

- Investigations for the preparation of feasibility reports and plans, designs and estimates of such projects;

- Supervision of construction of civil engineering projects;

- Training of engineering and technical personnel.

Availability of Information:

Most of the information is available in the form of reports with accompanying maps. A computerised database is also maintained and is used for modelling and designing.

Staff: Professionals 50
Supporting staff 150

Categories: User of natural resource and socio-economic information
Land use planning at feasibility level

Coast Conservation Department, Ministry of Fisheries

Address: 4th Floor New Secretariat Building, Maligawatte, Colombo 10

Objectives and Main Activities:

- Preservation, restoration, management and development of coastal resources by:
  - Preparation and implementation of National Coastal Zone Management Plan;
  - Preparation and implementation of Coastal Erosion Management Plan;
  - Enforcement of the Coast Conservation Law.
- Erosion rate studies and coast conservation research
- Planning, designing and construction of coast conservation and reclamation of land from the sea

Availability of Information:

Reports and maps. Computerised database is being maintained under a foreign-funded project.

Staff: Professionals 12
Support staff 130

Categories: User of natural resources information
Supplier of natural resources information
Land Use Planning

Coconut Research Institute, Ministry of Coconut Industries

Address: Coconut Research Institute, Ministry of Coconut Industries, Lunuwila

Objectives and Main Activities:

- Research into all aspects of cultivation and processing of coconut:
  - Research on mixed cropping of coconut lands with other crops, and animal husbandry;
  - Research on prevention and cure of diseases and pests.
- Establishment and maintenance of experimental stations and nurseries.
- Training of advisory and extension workers.
- Advising the coconut industry in technical matters.

Availability of Information:

Mainly as publications in the form of reports, research papers, magazine articles and leaflets.

Staff: Professionals 30
Support staff 40

Categories: User of natural resources information
Supplier of natural resources information

Export Agriculture Department, Ministry of Agricultural Development and Research

Address: 1095 Gatambe, Peradeniya

Objectives and Main Activities:

- Promotion, development, organisation of cultivation and processing of perennial plantation-scale export crops except tea, rubber and coconut;
- Promotion of new practices and new crops with export potential;
- Field surveys to obtain statistical, agricultural, and economic data on these crops;
- Identification of land suitable for these crops;
- Organising and providing planting materials and fertilizer;
- Training of growers;
- Dissemination of information to growers, demonstrations in growers' fields, extension and education services;
- Organisation and co-ordination of research into new crops with export potential.

Availability of Information:

Reports and leaflets.

Staff: Professionals 22
Support staff 30

Categories: Supplier of agronomic and economic data resources
User of natural resource and socio-economic information

Forest Department, Ministry of Forestry, Irrigation and Mahaweli Development

Address: Rajamalwatte Road, Battaramulla

Objectives and Main Activities:

- To reserve and maintain adequate and suitable forest reserves for the amelioration of local climatic conditions, the conservation of soil and water resources, and for aesthetic purposes;
- To manage the forest resources so as to meet part of the timber requirements of the country and to progressively build up the plantations to meet the future requirement both for internal consumption as well as for export and, also, to contribute towards conservation of soil and water.

  Main activities are:

  - Survey of forest resources and maintaining inventories, including bio-diversity surveys of both flora and fauna in forest reserves;
  - Reforestation and afforestation;

- Forest protection and administration of the Forest Ordinance;
- Management of forests;
- Silvicultural research;
- Forestry training, education, public relations and extension;
- Development of minor forest and non-wood forest produce;
- Community forestry and forestry education;
- Regulation of felling by the State Timber Corporation.

Availability of Information:

As reports and accompanying maps. Different types of forest maps are produced, such as those covering the entire country at 1:500 000; those covering districts at 1:50 000 and plantation maps at 1:20 000. Computerised database.

Staff: Professionals 30
Technical staff 150

Categories: Land use planning
Survey of resources
Use of natural resources and socio-economic information

Geological Survey Department, Ministry of Industries, Science and Technology

Address: 48 Sri Jinarathana Road, Colombo 2

Objectives and Main Activities:

- Systematic geological mapping;
- Prospecting, exploration and appraisal of mineral resources;
- Hydrological investigations and studies on engineering geology;
- Administration of mining enactments, supervision of mining and collection of mineral statistics;
- Research in earth sciences and applied research on mineral raw materials for industry.

Availability of Information:

Geological maps at a scale of one inch to one mile have been prepared in manuscript for the whole country but of the 72 sheets, only 3 sheets (Polonnaruwa, Elahara and Rangala) have been published. Manuscripts can be consulted in the Geological Survey Dept.; reports; representative display of mineral specimens.

Staff: Professionals 30
Support staff 200

Category: Supplier of land resources information

Hadabima Adikariya (Heartland Authority), formerly National Agricultural Diversification and Settlement Authority (NADSA), Ministry of Agricultural Development and Research

Address: Ganoruwa, Peradeniya

Objectives and Main Activities:

- Diversification of activities in uneconomic tea and rubber lands in the Central Mid-Country by:
  - Acquisition of uneconomic and degraded land and developing it on sustainable basis;
  - Establishing new settlers on the land and providing inputs and assistance for development, in particular Minor Export Crops and horticulture and establishment of fuelwood plantations.

Availability of Information:

Natural resources and socio-economic information generated by previous Agricultural Diversification Project is available in the library as reports and accompanying maps. Some data are available in conventional paper files.

Staff: Professionals 10
Supporting staff 70

Categories: User of natural resource information
Land use planning

Hydrology Division, Irrigation Department, Ministry of Forestry, Irrigation and Mahaweli Development

Address: Baudhaloka Mawatha, Colombo 7

Objectives and Main Activities:

- The design, construction, operation and maintenance of the island-wide hydrometric network;
- Primary processing and storage of hydrological data;
- Conversion of river stage to estimates of flow, synthesis of flood flows and flood routing;
- Computation of precipitation on catchments, rainfall: runoff relationships and replenishment of reservoirs;
- Estimates or schedules of reservoir operation;
- Studies on evaporation, consumptive use and re-use of water;
- Processing rainfall data and studies of intensity and frequency of intense rainfall;
- Measurement of rainfall, water levels in reservoirs and wind velocities;
- Current metering of waterways, suspended sediment and bed load sampling;
- Water management studies, consumptive use and seepage tests.

Availability of Information:

Hydrological data are stored either as paper copy or on magnetic tapes/discs or both, and published on an annual basis in a user-available format by March of the following year.

Staff: Professionals 6
Support staff 60

Categories: Survey of hydrological data
User of natural resources information

Land and Water Management Research Centre: Agricultural Dept. (Former Land & Water Use Division), Ministry of Agricultural Development and Research

Address: Department of Agriculture, Peradeniya

Objectives and Main Activities:

- Development of cropping patterns and economic farming systems for different agro-climatic areas with reference to soil conservation and fertilizer practices, and irrigation and water management;
- Soil survey and land evaluation studies under irrigation rehabilitation projects;
- Water balance studies for irrigation tanks;
- Assistance to land development and soil conservation in the Dry Zone Agricultural Development Project;
- Watershed management studies under existing land use in the Wet Zone;
- Soil conservation work in Ratnapura and N'Eliya districts under Integrated Rural Development Projects.

Availability of Information:

Information is available as reports and maps. The agro-ecological map produced by the Division is widely used. Recently, arrangements have been made to establish a computerised data base.

Staff: Professionals 10
Supporting staff 20

Categories: User of natural resources and socio-economic information
Supplier of natural resources information

Land Use Division, Irrigation Department, Ministry of Forestry, Irrigation and Mahaweli Development

Address: Baudhaloka Mawatha, Colombo 7

Objectives and Main Activities:

- Systematic national soil survey;
- Soil and land classification surveys for irrigation and settlement projects;
- Suitability evaluation and land use studies under Integrated Rural Development Programs;
- Chemical and physical characterisation of soils;
- Studies of crop water requirements and cultivation practices.

Availability of Information:

Soil/land classification maps, and land suitability evaluation reports accompanying the maps are held by the Division. Action is being taken to digitise the maps and establish a computerised database.

Staff: Professionals 15
Support staff 50

Categories: Supplier of natural resources information
User of natural resources information

The whole country is covered by reconnaisance soil survey plotted at 1 inch to one mile.

Systematic survey of Jaffna, Kalutara, Gampola and Galle Districts has been completed at semi-detailed scale but not yet published. Under the IRDP program, semi-detailed surveys have been published (at 1:50 000 or 1:63 360) of Hambantota, Matara, Monaragela, Nuwara Eliya and Ratnapura Districts.

Also, there are many surveys carried out in support of irrigation developments, mostly in the Mahaweli catchment.

Land Use Policy Planning Division, Ministry of Forestry, Irrigation & Mahaweli Development

Address: Survey Department Building, Kirula Road, Colombo 5

Objectives and Main Activities:

- Formulate land use policies and prepare plans to rationally allocate the land resources for optimal and sustainable use;

- Establish and support Land Use Units and Committees at national, provincial, divisional and village level;

- Conduct training at all the levels envisaged;

- Conduct land use planning studies;

- Establish and maintain a computerised land information system.

Availability of Information:

Indicative land use plans at a scale of one inch to a mile or 1:50 000 are available for most districts. Maps and reports of special case studies. Useful library on land use planning and natural resources.

Staff: Professionals 20
Support staff 30

Categories: User of natural resources information
Land use planning

Mahaweli Authority of Sri Lanka, Ministry of Forestry, Irrigation and Mahaweli Development

Address: 500 T.B.Jaya Mawatha, Colombo 10.

Objectives and Main Activities:

- Implementation and management of river basin development projects that were included under the Accelerated Mahaweli Project of 1979;

- Implementation and management of other Mahaweli Ganga development projects and any other projects that were declared as Mahaweli Special Areas;

- Implementation of work to increase the hydro-electric power generation capacity;

- Initiatives to support enterprise development and increasing of farm employment opportunities to the second generation of farmers in the Mahaweli Project.

Availability of Information:

Reports and maps. Computerised database is also available for modelling and progress monitoring.

Staff: Professionals 30
Supporting staff 50

Categories: Land use planning
User of natural resources and socio-economic information

Meteorology Department, Ministry of Industries, Science and Technology

Address: 383 Baudhaloka Mawatha, Colombo 7

Objectives and Main Activities:

- Responsible for the provision of a weather service to national and international aviation and shipping, to irrigation, agricultural and fisheries departments, and other interested agencies, and for forecasting weather to the nation, including forecasting hazardous situations;

- Research in meteorology and allied subjects and making climatological data available to interested parties;

- Provision of a time service;

- Recording seismic disturbances and providing limited astronomical and geomagnetic information.

Availability of Information:

Climatic data are collected by 22 synoptic stations controlled by the Meteorology Dept. Data from agro-meteorology stations and rain guages belonging to other organisations are also collated.

Data from synoptic stations include: rainfall, max. and min. temperature, relative humidity, sunshine hours, evaporation, wind speed, direction and run of wind, cloud, radiation (actinograph), solar radiation (diffuse and direct), and soil temperature.

Monthly rainfall maps and offsets are available.

Until recently, the information was available in manually-prepared data sheets and in (nominally) annual bulletins. At present, data are stored in a computerised database and the information is available as computer printouts.

Staff: Professionals 30
Supporting staff 350

Category: Supply of meteorological and climatic data

Ministry of Environment and Parliamentary Affairs

Address: 6th floor, Unity Plaza Building, Colombo 4

Objectives and Main Activities:

- Formulation, direction and implementation of programs and projects based on national environmental policy;
- Environmental protection and management.

Staff: Professionals 6
Supporting staff 10

Categories: User of natural resources information
Land use planning

Natural Resources, Energy and Scientific Authority of Sri Lanka, Ministry of Industries, Science and Technology

Address: Maitland Place, Colombo 7

Objectives and Main Activities:

- Advice to the government on:
  - The promotion of national self-reliance in the application of science and technology;
  - Management and development of natural resources;
  - National energy and science policies.
- Direction of program pertaining to the exploitation and development of natural resources and energy; Collection and dissemination of information on the above matters.
- Liaison with those involved in these fields and, inter alia, support for scientific and technological research. Financial assistance has been provided to undertake research in the following areas:
  - Felling of forests in the upper montane regions;
  - Fuelwood;
  - Inland fisheries;
  - Mangrove ecosystem;
  - Climatic and crop data for agricultural purposes;
  - Multi-storied cropping in the Dry-Zone.

Availability of Information:

Reports, documents and research papers.

Staff: Professionals 15

Support staff 75

Category: User of natural resources information

Regional Development Unit, Ministry of Policy Planning and Implementation

Address: "Sethsiripaya", Sri Jayawardanapura, Kotte, Battaramulla

Objectives and Main Activities:

- Widen economic opportunities and to enhance living standards in rural areas;
- Focus development efforts on local needs and local initiatives;
- Channel resources into those districts which derive little or no benefits from the Mahaweli project or from the other major projects but which have a high potential and relatively low development status, hence to promote more balanced regional development nationally;
- Allocate resources to productive but low-cost, short-gestation, labour-intensive investments, planned and implemented at the local level;
- Release the potential of district resources through the removal of constraints, especially in plan implementation;
- Implement programs to maintain an ecologically-balanced environment such as "Green Sector Develolpment", SALT Projects, reforestation and watershed protection projects.

Availability of Information:

Most of the information is in the form of conventional paper files, reports and maps. Computerised databases have been installed in most of the district offices.

Staff: (dealing with natural resource-related work)
Professionals 30
Supporting staff 70

Categories: Land use planning
User of natural resource information

Rubber Research Institute

Address: Dartarfield, Agalawatte

Objectives and Main Activities:

- Include studies on crop requirements and recommendations for soil conservation

Sri Lanka Council for Agricultural Research Policy, Ministry of Agricultural Development and Research

Address: 4th Floor State Mortgage and Investment Bank Building, 269 Galle Road, Colombo 3

Objectives and Main Activities:

- To advise the government on the organisation, co-ordination, planning and execution of agricultural research;
- To formulate national agricultural research policy and priorities;
- To define the overall aims and scope of agricultural research with a view to furthering national development objectives;
- To review institutional and departmental agricultural research programs and make recommendations with regard to their priorities and funding;
- To promote agricultural research;
- To act as a channel of communication between agricultural research institutions and the government;
- To arrange for and fund inter-institutional agricultural research projects at national and international level;
- To organise conferences on international, national and inter-institutional issues relating to agricultural research;
- To arrange for the postgraduate training of agricultural research staff and for interchange of scientists with institutions abroad;

- To review the performance of agricultural research projects, institutions and divisions.

Availability of Information:

Reports and documents. Information is also stored in a computerised database.

Staff: Professionals 5
Support staff 10

Category: User of natural resources and socio-economic information

Sri Lanka Land Reclamation and Development Corporation, Ministry of Industries, Science and Technology

Address: 351 Kotte Road, Welikada, Rajagiriya

Objectives and Main Activities:

- Reclamation and development of areas for building, industrial, commercial or agricultural purposes;
- Management and control of reclamation and development of lands in areas pending development;
- Execution of reclamation projects, maintenance of the canal systems in and around Colombo ensuring proper drainage of storm water to the sea;
- Consultancy in the field of engineering, provision of infrastructure in reclamation areas, construction of harbours and anchorages, construction of irrigation works, sea reclamation and coastal development and manufacture of any material required for such building, engineering or construction work.

Availability of Information:

Most of the information generated is presented in the form of reports and maps, some in a computerised database.

Staff: Professionals 50
Support staff 100

Category: User of natural resources information

Sugar Research Complex

Address: Uda Walawe

Objectives and Main Activities:

- Include studies on crop requirements and management recommendations.

Survey Department, Ministry of Forestry, Irrigation and Mahaweli Development

Address: Kirula Road, Narahenpita

Objectives and Main Activities:

- The main objective is land surveying and mapping of the country for the following purposes:
  - Alienation of State land for landless and rural population under village expansion and middle class colonisation schemes;
  - Identification and demarcation of lands under land settlement schemes;
  - Carrying out all the land surveys required by the government, viz. Revenue Offices and other government departments, local bodies, state corporations, etc., and issuing the necessary plans to them;
  - Contour surveys for irrigation and other purposes; block and topographical preliminary plan surveys, settlement demarcation surveys; town surveys; forest surveys;
  - Carrying out programs of aerial photography and photo interpretation for development and planning;
  - Publishing of up-to-date maps, including topographic maps of different scales for sale;
  - Maintenance of a geodetic framework of survey points throughout the country;
  - Examinining and issuing licences for practising land surveyors and authorised draughtsmen;
  - Training.

Availability of Information:

The 1" to one mile (1:63 360) topographic sheets (72 covering the whole country) are being replaced by 1:50 000 sheets with a 100 foot contour interval (92 sheets, 85 printed so far). Under the Agricultural Base Mapping Project, 1:10 000 topographic sheets with 5 or 10m contour interval are being produced (130 printed so far out of 1 834).

Close contour surveys are made for irrigation schemes range from 4 and 8 chains to 1" with a 2 foot contour interval to 1:2 000/1:5 000 with 1m or 2m contour interval.

Cadastral surveys at 4 chains to 1" (1:3 168) have been made for land alienation and land settlement.

Thematic maps include: climate (1:506 880 and 1:1 million); soils (1:506 880 and 1:1 million); land use (1:1 million and a few sheets at larger scales); irrigation development potential (1:1m); Water Resources Development Plan (1:253 440); River Basins (1:253 440); Agro-ecology (1:1m).

Facilities are available for the provision of satellite imagery.

Staff: Professionals 20 (2 dealing with natural resources)
Support staff 300

Category: Supplier of topographic and land use information

Tea Research Institute

Address: St Coombs, Talawakelle

Objectives and Main Activities:

- Include soil analysis, studies on crop requirements, fertilizer trials, land evaluation, erosion and conservation studies, management recommendations.

Water Resources Board, Ministry of Forestry, Irrigation and Mahaweli Development

Address: 2A Gregory's Avenue, Colombo 7

Objectives and Main Activities:

- Identification, investigation, research and development of groundwater by:
  - Research through the Geo-Scientific Unit in order to achieve qualitative groundwater survey data island-wide;
  - Establishment of a comprehensive groundwater data bank;
  - Advice on water resources in general, and groundwater resources in particular, for all purposes and publication of groundwater maps on an administrative unit basis;
  - Survey and development of groundwater for small-scale water supply systems serving domestic, industrial and agricultural demands;
  - Harnessing wind energy for groundwater exploitation;
  - Propagation of agricultural and ornamental planting material for sale, and development of environmentally-compatible landscaping projects.
- Main activities:
  - Investigation, research and development of groundwater with management responsibilities in major coastal aquifers;
  - Investigation, research and development of small-scale groundwater resources in Dry Zone rural areas;
  - Evaluation of scientific data and preparation of hydrogeological maps depicting regional groundwater potential and distribution;
  - Research and development of low-cost, water-lifting devices;
  - Nursery for propagation of agricultural and ornamental planting materials.

Availability of Information:

Hydrological, hydrogeological and hydrogeochemical survey data available in the form of maps and reports. Action is being taken to establish a computerised geo-hydrological database.

Staff: Professionals 30
Support staff 500

Categories: Supplier of water resources information
User of natural resources information

Wildlife Conservation Department, Ministry of Forestry, Irrigation and Mahaweli Development

Address: Rajamalwatte Road, Battaramulla

Objectives and Main Activities:

- To demarcate ecologically important areas in the Wet Zone as Protected Areas and formulate a manifesto of different objectives applicable to each declared reserve;

- To reassess scientifically all existing Protected Areas and new areas identified for protection, and examine ways and means of meeting the objectives of such areas, their ecological stability and needs of the people, in particular to accept and introduce the concept of scientific management of Protected Areas to ensure ecological stability and sustainability;

- To identify the potential human uses in Protected Areas which are compatible with the objective applicable to each such area, and regulate and control the activities on a sustainable basis, permitting multiple use on a sustainable basis;

- To demarcate zones of activities to achieve the specific objectives of each Protected Area along with other sustainable uses;

- To establish local administration to facilitate disbursement of benefits from Protected Areas among the people living in adjacent areas;

- To formulate and implement a National Conservation Act incorporating the foregoing guidelines and also the fundamental concepts of conservation as practised today;

- To recognise and promote the concept of ex-situ conservation, particularly in conjunction with the National Zoological and Botanical Gardens;

- To promote research and education in the efforts of conservation;

- To bring about a close link between the institutions concerned with promoting conservation and those concerned with development, to ensure a more practical approach for natural resource conservation.

- The main activities are:

- Study of the wild flora and fauna;

- Protection, management and development of National Reserves and Sanctuaries;

- Prevention of the capture of wild animals or collection of wild flora, except under licence;

- Regulation of the trade in live specimens, flesh skins, tusks, horns, plumage and eggs;

- Control and destruction of dangerous animals;

- Control of the export of indigenous species and import of exotic species;
- Prevention and detection of offences under the Fauna and Flora Protection Ordinance;
- Enforcement of international conservation conventions to which Sri Lanka is a signatory;
- Liaison with international conservation organisations;
- Formulation and implementation of educational programs to create awareness of the conservation of wildlife and to solicit the support of the community at large.

Availability of Information:

Information is available in the form of reports, maps and educational materials. A computerised database has been established recently.

Staff:	Professionals	20
	Technical Officers	50
	Support staff	650
Categories:	Land use planning	
	User of natural resource information	

BIBLIOGRAPHY

PART 1: Title Listing

PART 2: Extended Abstracts of Representative Publications

PART 1: TITLE LISTING

I Legislation. An abstract of relevant legislation is given in Appendix 1. Commentary on legislation is included in this bibliography under the same headings as Appendix 1.

Land use
Water quality and use
Environmental impact, forest conservation, parks and wildlife

II Strategy and policy

Departmental policy and consultative documents
Commentary

III Renewable natural resources

Reports and surveys
Texts and research papers
Geographic information systems

IV Socio-economic studies

General
Farm management and production economics
Forestry studies
Marketing studies

V Land use planning

Plans and reports
Handbooks and research papers

VI Bibliographies

Locations of References

For most listed titles, the library where seen in Sri Lanka is given in parentheses. Some key references located outside Sri Lanka are also listed. References given without locations have been abstracted from other reports but not seen.

ARTI lib.	Agrarian Research and Training Institute Library, 114 Wijerama Mawatha, Colombo 7
CEA lib.	Central Environmental Authority Library, New Secretariat, Maligwatte, Colombo 10
FAO lib.	AGLS Documentation Centre, Food and Agriculture Organisation of the United Nations, Viale delle Terme di Caracalla, 00100 Rome
Forestry lib.	Forest Departmental Library, Rajamalwatte Road, Battaramulla
Geological lib.	Geological Survey Department Library, 48 Sri Jinarathana Road, Colombo 2
Huntings' lib.	Hunting Technical Services, Thamesfield House, Boundary Way, Hemel Hempstead, England
IIED lib.	International Institute for Environment and Development, Interaise Documentation Centre, 3 Endsleigh Street, London
IIMI lib.	International Irrigation Management Institute Library, 127 Sunil Mawatha, Pelawatte, Battaramulla
Irrigation lib.	Irrigation Department Library, Bauddhaloka Mawatha, Colombo 7
LUD lib.	Land Use Division, Irrigation Dept., Colombo
LUPPD lib.	Land Use Policy Planning Division Library, Survey Department Building, Kirula Road, Nurahenpita, Colombo 7
MDB lib.	Mahaweli Development Ministry Library, 500 T.B. Jayah Mawatha, Colombo 10
NADSA lib.	National Agricultural Diversification and Settlement Authority (now Hadabima Adikariya), Gannoruwa, Peradeniya
National lib.	National Library Services Board, (National Library of Sri Lanka), Independence Avenue, Colombo
NRI lib.	Natural Resources Institute Library, Central Avenue, Chatham Maritime, UK
Postgraduate Inst. lib.	Postgraduate Institute of Agriculture Library, Old Galaha Road, Peradeniya
Univ.Perad.lib.	University of Peradeniya Library, Peradeniya
TRI lib.	Tea Research Institute Library, Talawakele
Univ.Jpura	University of Sri Jayawardenapura Library, Gangodawila, Nugegoda

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PART 2: EXTENDED ABSTRACTS OF REPRESENTATIVE PUBLICATIONS

Renewable Natural Resources Surveys

Title: *Land Evaluation Survey, Wikiliya, Sample Area no. 6*

Authors: Desaunettes J.R., Sompala H., Hettige P.M.C., Amarasinghe L.

Publishers: UNDP/FAO Agricultural Diversification Project, Ministry of Plantation Industries

Date: 1974

Place of Publication: Peradeniya

Pages: 53

Maps: 1:12 672 land evaluation map (folded) covering 6 600 acres (2 640 ha)

Where seen: NADSA library and AGLS Documentation Centre, FAO, Rome

Keywords: Sri Lanka, land evaluation, soil survey

Abstract:

To assist diversification of land use in uneconomic tea and rubber lands, a land capability survey was initiated (Smith 1971) delineating land units according to slope angle, rockiness and soil depth. In 1972, a more sophisticated survey was begun to provide information to determine optimum cropping pattern and costs of development.

To provide information quickly, the Wet Zone was divided into 49 'morpho-ecological regions' (Desaunettes 1974), equivalent to land systems. Sample surveys for each region were carried out at 1:12 672, distinguishing mapping units by landform (37 in this example), soil class (10 classes in this example) according to the FAO/Unesco legend), present land use, and slope/rockiness subclasses (98).

Landform delineations were made by air photo interpretation of 1: 25 000 photos flown in 1972/73. Field checking included 42 observation sites chosen to give representation of the range of landform/land use units.

In addition to standard soil profile descriptions, there are laboratory determinations of particle size, pH, water content at -100, -330 and -1500 kPa, cation exchange capacity and exchangeable Na, Ca, K and Mg, extractable P, %C and %N. These data are provided for each land unit along with an estimation of available water capacity and statement of land potential (suitable crops).

Finally, summary land suitability tables state, for each land mapping unit - soil series percentage of land classes in the unit according to slope, depth of soil and rockiness, area, optimum land use without land improvements, potential land use with specified land improvements (e.g. drainage, stone picking, uprooting of former plantations), and recommended land use.

Judgement of Quality A state-of-the-art survey for its time. In the event, almost unused by management and decision-makers because it could only be used by a natural resources specialist.

The scale of the base map is too large for the scale of initial air photo interpretation or density of field samples - and has encouraged spurious detail in the final map. The only base map information on the dieline map is the river system, main roads and railway. Hence, location of sites on the ground or on the map is not possible without transferring boundaries to a topographic sheet. This would have to be done individually for each effective management unit - that is estate-by-estate.

Most of the laboriously-determined laboratory data are superfluous. There is no clue as to how they contributed to the judgement of land suitability. Nor is any other basis given for land suitability judgements.

Title: *Monaragala Land Use Study*

Author: C. Hatten (Hunting Technical Services in association with Resources Development Consultants Ltd, Colombo)

Other Details: Report for Ministry of Agricultural Development and Research, Sri Lanka

Publishers: Hunting Technical Services Ltd, Borehamwood, UK

Date: 1980

Pages: 130 + appendices, glossary and bibliography

Maps: 9: geology, soils and land suitability for whole study area of 330 000 ha and for 3 areas of semi-detailed surveys (scale 1:25 000), each 15 000 ha. (Maps not with report in Booker Tate library).

Where seen: Booker Tate, Thame

Filed under: Sri Lanka

Keywords: Sri Lanka, soil survey and land evaluation, land use planning

Abstract:

Target Audience: National and District government integrated rainfed farming project for planned settlement in the Dry Zone. Terms of reference were to produce maps of land suitability for rainfed farming, identifying land suitable for agricultural development.

Data Presented: Brief analyses are provided of climatic data: rainfall, pan evaporation (including variability) and effectiveness of rainfall to estimate effective rainy seasons.

Substantial soil survey results are presented, drawing on the very generalised reconnaissance of the 1950s that used 1:40 000 air photos, plotted at 1" to one mile, and using the same mapping units (associations and complexes) and soil classification (de Alwis and Panabokke 1972). Three promising areas, each of c. 15 000 ha, were mapped on 1:25 000 air photos. Soil relationships are represented by catena diagrams. Soils are distinguished according to the slope angle, catenary position, texture of A and B horizon, depth to gravel/rock, and drainage class. Soils were finally mapped as groups of soil phases of similar agricultural potential. Final map units were: 1) very deep to moderately deep, well drained and moderately well drained red brown earths (deep upland soils); 2) shallow and moderately shallow soils (shallow upland soils); 3)

gleys, imperfectly drained red brown earths and solodised solonetz (lowland soils); 4) rock knob plains; and 5) erosional remnants.

Land suitability follows the FAO Framework for Land Evaluation (1974) for dryfoot crops, fodder, wetland rice, homestead plots, grazing, forest plantations and wildlife refuge. Judgement is based on rootable depth, slope gradient, drainage, rock outcrops, salinity/alkalinity, water and nutrient retention.

Water resources are considered very briefly, especially possibilities of groundwater development.

Crop selection is based on length of growing season which is limited primarily by the duration of the wet seasons but also modified by soil water reserves (estimated from texture and depth).

Gross margin analysis of physically suitable crops is presented, taking account of draught animal and labour availability, and suggested crop combinations including sugar cane as main cash crop.

The impact of development on wildlife is considered briefly.

Finally, long-term land use zoning for development areas includes mapping out for different land use types, settlement plans, and elephant corridors. The justification for the Uda Walawe Park is questioned while justifying the increase in conservation areas around the Yala National Park.

Assessment of Quality: The terms of reference required a report within 15 weeks! Soil observations at a density of 3-5 km^{-2} were combined with air photo interpretation. Time was saved by using experience of Mahaweli development surveys to confine data collection to key parameters.

The report is comprehensible in full only to specialists in natural resources and tropical agriculture. There is a lot of superfluous information, but the summary and conclusions do identify and quantify areas suitable for agricultural settlement, marginal areas, and unsuitable areas. It is a good standard consultant's job with no innovation and no risks.

Natural resources information was focussed by the terms of reference but, in the event, was used for a quite different development - the Pelwatte Sugar Company, the soil data being relevant and detailed enough to establish the estate. A second sugarcane development was also begun in the second of the selected areas but the security situation has halted implementation. Cane successfully grown by smallholders is now processed at Pelwatte or Hingurana.

Title: *A Report on a Survey of Resources of Mahaweli Ganga Basin, Ceylon - Parts 1 and 2*

Author: Hunting Survey Corporation Ltd - Toronto

Other Details: Canadian Ceylon Colombo Plan Project

Publishers: Government Press, Colombo

Date: 1962

Pages: Part 1 - 252; Part 2 (Appendix) - 213

Maps: 1 Map - Mahaweli Ganga Basin - Mahaweli Scale 4 miles : 1 inch,
Part 2 - Maps (tabular data: figs, small folded maps, tables diagrams and representative soil profiles)

Where seen: Forest Department Library, Colombo

Filed under: F116 (5A8.7) SRD

Keywords: Natural resources, soils, geology, landforms, land use, hydrology, irrigation and power development, Sri Lanka

Abstract:

Topographic maps with scale 16 chains to one inch (1:12 000) with 10 or 20 foot contours were produced, based on 1:40 000 air photos. Maps of forest inventory, structure and geology, geophysical survey, landform, soil and land units were produced using air photo interpretation and ground checks. Climatic data were collected for hydrological surveys. A technical program for land resource development was identified. The individual sections appear to have been produced independently and are not completely correlated.

Structural geology is dealt with under physiographic regions. Lithology is grouped according to rock types as distinguished on air photos. The results of previous mapping have also been incorporated. Specimen areas are illustrated by annotated air photos.

13 landform maps identify and describe mountain, escarpment, hill and ridge, mantle plain and rock knob plains. Examples are illustrated by air photos and snapshots. Brief notes are given on soils and land use, and irrigation potential.

No *soil map was* produced. On the basis of the 650 soil profile descriptions along the traverses, 5 widespread soil catenas are described, each catena having well drained, imperfectly drained and poorly drained members. It is not easy to correlate the soil units with landform units although it is obvious that they are closely related. Soils are described in terms of profile morphology, texture, parent material and base exchange capacity. Brief comments are given on suitability for irrigation.

Land use and forest cover is shown on 20 maps at a scale of one inch to a mile (not present in the volume seen). The units distinguished are settlement, horticulture, perennial crops and annual crops, improved pasture, grassland and scrub, woodland, swamp and marsh, and unused. Brief descriptions are illustrated by annotated air photos and snapshots.

Hydrology. Rainfall: runoff relationship is used to estimate monthly flows. A good network of rainfall data for 15 year was available, but the runoff relationship appears arbitrary and weakly supported by data that may be unreliable and of short duration.

Areas with potential for irrigation, reservoir and hydro-electric power sites have been identified. Comparison of estimated and potential water storage and supply shows enough water to be available for development and trans-basin diversion. Areas of land available for irrigation are estimated from (1) command area of potential reservoirs and (2) judgement of percentage irrigable land in landform mapping units (eg. mantled plain has 80% suitable landform). The water requirement of irrigated land is estimated by using Blaney and Criddle (1950). Note: It appears that the FAO 'Masterplan' (1969) for the Accelerated Mahaweli Development Project was based on this estimate although it is not suitable for detailed engineering work. An allowance of 15% was made for field application efficiency and 40% for distribution losses from canals (both estimates are extremely optimistic).

Nine power development sites have been identified. With a suggested generating capacity of 225 MW. **This report appears to be the main source report for many subsequent reports, in particular the FAO/UNDP Mahaweli Masterplan.**

Title: *System C Mahaweli Development Project Feasibility Study - Main Report*

Publishers: Hunting Technical Services Ltd

Date: 1979

Place of Publication: Borehamwood, Herts, UK

Pages: Main report and 6 annexes, see especially 1A environment, B soils and land use, C groundwater, D agronomy, E water management, G forestry, O sociology, M training and extension, K economic and financial appraisal

Where seen: Hunting Technical Services, Hemel Hempstead, UK

Filed under: Sri Lanka

Keywords: Land use planning, irrigation, natural resource survey

Abstract:

Terms of reference were to produce phased and costed proposals for the development of System C, which encompasses 69 000 ha on the right bank of the Mahaweli Ganga commanded by the Victoria Dam; the northern half was then almost unpopulated, the southern half already had basic infrastructure and some 3500 ha of irrigated land. The reports deal with both hydro power development and irrigation development. Only sections concerned with irrigated development are abstracted here.

The goals of irrigation development were to raise farm production, especially of rice; to create employment; and to settle as many farmers as possible on viable holdings. The land use plan, phased over 7 years, aimed at a mosaic of irrigated bottomland amongst forested land on slopes and hills. Initially, a diversified pattern of agriculture was envisaged and a range of crops investigated, including their market prospects, labour needs, cropping patterns, water requirement and water management.

Rice was to be the main irrigated crop but the report also proposed a nucleus irrigated sugar estate and outgrowers growing rainfed cane on upland soils.

Separate plans were produced for settlement, services and infrastructure.

Natural resources data: for engineering

Annex C, vol II, provides a summary of Meteorology Department rainfall records from a dense network in the upper Mahaweli and fewer in E and NE. Inconsistent data were checked. Data were interpolated using Thiessen polygons. Runoff was estimated from river stage gauges calibrated by hourly measurements of flow. Evaporation was estimated using Penman's formula based on 3 climatological stations. Sedimentation was estimated from very limited data and related to river discharge.

1:20 000 air photography was flown during Jan-March 1979. From this, the Survey Department produced topographic maps and mapped present land use. This resulted in the revision of the original canal system design.

Soils and land classification

Semi-detailed soil survey (5-10 inspections km^{-2}) was carried out by the Land Use Division using 1:10 000 and 1:25 000 air photos and compiled on 1:31 680 mosaic. A threefold grouping was used:

- 'Upland soils'. Well drained, mainly reddish brown earths;

- 'Imperfectly drained and poorly-drained soils. 'Lowland soils', including imperfectly drained reddish brown earths and low humic gleys;
- 'Areas unsuitable for cultivation'.

Detailed description of soil series is given in Annex M. Infiltration data (5 replicates) are provided for 12 sites representing the main soil series. Standard particle size and chemical data are also provided, from the LUD and Hunting Technical Services' laboratories.

The land classification criteria used are texture, depth to limiting horizon, nature of limiting horizon, topography and derived soil characteristics (permeability, infiltration and available water capacity), and the ultimate groupings are:

- fine textured, poorly drained
- fine to medium texture, imperfectly drained
- fine to medium textured, well drained
- other

Agrometeorology and agronomy.

Annex N, Vol IV, part 1. Good data on climate, crop water requirements; rice agronomy and irrigation methods.

Compared with the FAO/UNDP Masterplan, costs and benefits were substantially revised. However, these assumed double cropping of rice and overhead irrigation of sugar cane (no cane ever grown). In the event, rice was grown on all irrigated land, regardless of land suitability, and there has not been enough water for double cropping over the whole area.

Assessment of quality:

No more could be expected in the time available. Work was constrained by lack of sufficiently detailed basic data on climate, topography and soils to make plans for irrigation layout, infrastructure and cropping systems, and also by the late arrival (in Oct 1979) of the NEDECO Mahaweli Implementation strategy. The report fulfilled its primary purpose of securing funding for the project although the land use plans were not implemented as envisaged in the report. They were revised in 1980 following the decision of the World Bank to allow funding only for the 'all-rice' option.

The final designs and cost estimates (Hunting Technical Services 1980/81) cover much of the same material but give revised terms of reference asked for costing of three options:

a) development of lowland areas only,
b) development of lowland areas (and upland areas for cane)
c) development of lowland areas and upland areas for crops other than cane.

They include preliminary land use and settlement plans at 1:25 000 and 1:5000 for sample areas -with layout of irrigated area, homestead gardens, woodland, local tanks, wells, power lines, roads, housing, clinics and schools. This format has subsequently been adopted by the Mahaweli Authority for physical planning.

Title: *Sri Lanka Pelwatte Sugar Project Soil Investigations*

Author: D J Radcliffe

Other Details: also, Supplement: Soil Chemical Properties

Publishers: Booker Agriculture International, UK

Date: May 1982, supplement August 1982

Pages: 103, supplement 18

Maps: 1:25 000 land mapping units, land suitability for sugar cane

Where seen: Booker Tate, Thame

Keywords: Sri Lanka, sugar, land suitability

Abstract:

Only 30 days were spent in the field. Effort was concentrated on previously unsurveyed areas, studies of the variation within mapping units and a specific land evaluation for estate and outgrower cane development. The report uses the same complex land mapping units as Huntings (1980) but lowland soil mapping is refined by watertable observations. It also located a semi-detailed soil survey of Pelwatte Farm (Sri Lanka Sugar Corporation 1977 at 1:9 504).

9 soil mapping units were sampled for chemical analysis (reported in supplement), 4 infiltration and hydraulic conductivity tests were carried out.

Land suitability evaluation follows the FAO Framework for Land Evaluation, based on:

- 'moisture availability', using rainfall data, crop water demand and soil available water capacity (depth x 0.1-15 bar water content for 6 topsoil and 6 subsoil samples);
- 'oxygen availability', using drainage class and field watertable observations;
- 'physical rooting conditions', using depth to gravel/weathered rock;
- 'salinity hazard', using limited chemical data from Huntings (1980);
- 'workability', using topsoil consistence, rock outcrops, drainage;
- 'erosion hazard', using SLEMSA model applied mainly to slope.

Cane yield estimates, based on 50% probability rainfall exceedance values and soil available water, suggested 30% of yield variation due to rainfall variability, only 5-12% to soils (deep/shallow). (Subsequently, yields of outgrowers on 'hand-picked' soils have been much better than those of the core estate where only absolutely-not-suitable land was left unplanted).

Recommendations for estate development and ongoing management indicated areas needing full and reduced drainage specifications, soil conservation, and not suitable land. The recommendations were based primarily on the soil mapping units, but recognised factory, distribution and other infrastructure needs.

A supplement of chemical data presents standard information, much of which was not used in the decisions subsequently made. The absence of salinity and high ESP, and adequate CEC to respond to fertilizers are taken account of. The fertilization regime would be determined by trials on site.

Assessment of quality: Both reports are written mainly in technical language. Interpretations of the significance of the data are provided in plain language, however, though they are not clearly flagged, and appear in the summary. The report includes much detail of marginal relevance, all very standard, and much material is copied directly from Hunting Technical Services (1980).

Title: *Mahaweli Ganga Development Project - Project I Feasibility Study for Stage II*

8 volumes:

I	Feasibility Report, 84pp
II	Agriculture, 108pp and appendices
III	Land Classification, 156pp
IV	Land Classification Maps and Tables, outsize
V	Engineering, 186pp
VI	Engineering Drawings, outsize
VII	Settlement and Development, 205pp
VIII	Marketing and Credit, 69pp

Author: SOGREAH Grenoble, France

Publishers: Mahaweli Development Board, Colombo

Date: 1972

Filed under: Sri Lanka, Mahaweli

Located: Volume III Land Use Division, Irrigation Department Library. Full report in AGLS Documentation Centre, FAO, Rome

Key Words Mahaweli, irrigation, land classification, soil survey, payment capacity

Abstract: (VOLS III/IV only)

The soil survey of 91 000 ha within system H was carried out by the Land Use Division with the technical assistance from SOGREAH consultants. Use was also made of an earlier reconnaissance soil survey of 97 000 ha, plotted 1:1 mile, by the Land Use Division (Panabokke and Ponnswamy 1968). The survey involved observations at 1 per 50 acres; 1 sample per 700 acres was analysed for pH, organic matter, nitrogen, available phosphorous, particle size, exchangeable cations; 24 ten foot borings were made for permeability; 36 saturation extracts were taken; and 90 soil water release curves -1 to -1500 kPa, 43 infiltration tests and 23 permeability tests were carried out.

Mapping units plotted at 1:20 000 are called soil series but are very broadly defined and appear to be drainage classes of Great Soil Groups, eg. [1.0] surface water gley-like mottled reddish brown earth; [1.2] intermediate gley reddish brown earth; [1.3] groundwater gleyed reddish brown earths. These units are, essentially, the catenary members distinguished in the Huntings' (1952) survey classified according to Moormann and Panabokke (1961). Chemical and physical data are summarised by Great Soil Group and the variance is large.

Soil mapping units were plotted on 50 sheets (scale 1:20,000) and compiled into high quality coloured ½" to one mile sheets. They are grouped into USBR irrigability classes:

- 'arable' 1,2,3 with subgroups, s (soil limitations), d (drainage limitations), t (topographic limitations), k (stoniness), p (slight risk of flooding);

- a 'limited arable' class with subclasses;
- 'temporarily non arable' (too high for gravity irrigation);
- non arable.

The extent of each class is tabulated and estimates of costs of engineering works and cropping patterns from other volumes are used to calculate the payment capacity of each land class and cropping type.

Judgement of quality: A comprehensive, professional survey. The semi-detailed soil survey is more than adequate for a feasibility study and a full range of laboratory data is presented. For project design, for which the information was later used without additional work, the soil maps lack base information, soil survey would be considered inadequately detailed by most professionals, and the genetic soil groups of the Ceylon Soil Classification (1961) are ill-suited, being defined only by profile morphology and drainage class.

Title: *Erosion Hazard and Land Suitability in the Nuwara Eliya District*

Author: P J Zijlstra

Publisher: Integrated Rural Development Project, Nuwara Eliya

Date: June 1987

Pages/Maps: 85pp + appendices, 45pp tables and 1:225 000 maps of land suitability, erosion hazard, land use, soil and slope. Small scale land suitability maps of 15 crops and 10 individual land qualities

Where seen: Land Use Division, Irrigation Department Library, Jawatha Road, Colombo 7

Filed under: Accession No.1440

Keywords: Erosion hazard, land suitability survey, Nuwara Eliya

Abstract:

The report provides an analysis of the 1981 Land Use Division surveys (de Alwis and Dimantha) plus additional field surveys placed in a common format. Data were plotted at 1" to the mile for erosion hazard; slope; soil (by Sri Lankan genetic classification); and land suitability assessed for irrigated paddy, rainfed terraced paddy, estate tea, smallholder tea, improved smallholder tea, improved pasture, minor export crops, coffee, annual crops, tobacco, fruit trees, commercial vegetable crops, potatoes, home gardens, rubber and mulberry.

Present land use was surveyed. Erosion hazard was assessed qualitatively by combining slope class and land use, to identify the 'suitability of present land use' in respect of erosion hazard. Special attention is given to tea, paddy, chena crops, tobacco, and commercial vegetables and potato.

The analysis is mechanical and the exposition opaque. Data were entered in a PC-MAP geographic information system. The discs are now lost and the published maps in raster format contain little base information: the 1:225 000 maps show main roads, town and (indistinctly) AGA Division boundaries. The small scale maps of crop suitability and individual land qualities have no base data and are, thus, unusable. Much patient work is not easily retrievable.

A short section on land use planning highlights institutional failures and unsatisfactory land tenure as responsible for the parlous condition of the land.

Geographic Information Systems

Title: *Sri Lanka Land Information System*

Authors: G Jayasinghe and R B Ridgway

Publishers: Ministry of Lands and Land Development/FAO

Date: May 1985

Place of Publication: Colombo

Pages: 142

Maps: 26, scale 1:1 million, Land suitability for rainfed and irrigated rice, maize, cassava, soya bean, oil palm, coconut, sugar cane, cotton, tea, rubber, black grain, chillies, cashew

Where seen: AGLS Documentation Centre, FAO, Rome

Filed under: Sri Lanka

Keywords: Sri Lanka, land use planning, geographic information system

Abstract:

A PC-based system to provide generalised data to support national policy and strategic planning decisions. Data were entered for 5 km grid cells (2900) in 20 fields. Crop requirements (13 crops) also entered and the software matched these with the land data to assess land suitability, following the FAO framework for land evaluation. The report gives details of data base, file structures and how to use the system.

The system was devised by the national land use planning team, was simple to use and understand, cheap, and an effective tool to support national land use planning. However, the system had reached the limit of the PC hardware on which it was developed and was not IBM compatible.

Following staff changes at the end of the FAO project, the system was discarded. A similar but more detailed system was developed for Nuwara Eliya District using 1 km raster squares but, again, discarded as soon as the expatriate responsible left (see Zijlstra 1990).

Land Use Plans

Title:	*General Land Use Plans for Nilambe-Atabage Catchment*
Authors:	McConnel D.J., Silva M.de, Jayanette E., Kirinde S.T.W., Antione J., Desaunettes J.R. and Reddy V.B.
Publishers:	UNDP/FAO Agricultural Diversification Project, Ministry of Plantation Industries
Date:	May 1974
Place of Publication	Peradeniya
Pages	171
Maps:	Location, 1" to 1 mile Estate plans, 1:13 333 approx (27 dielines) Land use plans, (2 folded dielines)
Filed under:	Sri Lanka S20
Where seen:	AGLS Documentation Centre, FAO, Rome
Keywords:	Sri Lanka, Land Use Plans

Abstract:

Prescriptive land use plans to guide the Land Reform Commission in its acquisition and development of tea estates in Kandy District. Aims: 1) to redistribute land as viable smallholdings; 2) to maintain well-managed, viable tea estates by consolidation and redistribution of suitable land; 3) arrest land degradation by implementing appropriate land use. In this case, recommended land uses include afforestation with pine and eucalyptus and mixed garden cultivation by smallholders. The authors emphasise that re-allocation of land will not lead to successful settlements without provision of planting materials, finance and technical direction.

Land use plans are presented both as 19 development projects involving groups of estates within the catchment and on an estate-by-estate basis. Summary tabular data presented for each estate are: area, present ownership, area to be acquired by the Land Reform Commission or Government Agent, elevation, present land use, proposed changes over the previous three years, tea production over three year, population by class and nationality, labour use, tea factory details, and water supply. A sketch map of 27 estates scheduled for redevelopment shows land use, contours, roads and streams.

This is a draft document that illustrates the method of land use planning developed in the ADP project. It was preceded by a soil/land capability survey (reported by Desaunettes et al 1973/4) and an estate-by-estate survey of population and land use. A scheme of optimum land use was produced for the whole catchment, then built in 19 development projects for estates to be affected by land reform acquisitions. Because the estate was the unit of management, an estate-by-estate schedule was provided.

This framework of planning is still used by the Hadabima Adikarya (NADSA) project that succeeded the ADP project. Physical land data have not been augmented or updated since this work and the market research /economic data, though no longer valid, have not been updated either.

Cross references:

ADP (1977) *Land classification for settlements and forestry in Nilambe Atabage, Maha Oya-Kunda Oya and Gurugoda-Ritigaha catchments in the Mid-Country of Sri Lanka.* UNDP/FAO Agricultural Diversification Project, Ministry of Plantation Industries, Peradenyia.

Desaunettes J.R., Somapala H., Hettige P.M.L. and Amarasinghe L. (1973/74). *Land evaluation survey (Diddeniya* etc., sample areas representing 49 morpho-ecological regions of the Wet Zone) UNDP/FAO ADP, Peradeniya

Title:	*Land Classification for Settlements and Forestry in Nilambe-Atabage, Maha Oya-Kuda Oya and Gurugoda-Ritigaha Catchments in the Mid-Country of Sri Lanka*
Authors:	ADP project staff
Publishers:	UNDP/FAO Agricultural Diversification Project, Ministry of Plantation Industries
Date:	June 1977
Place of Publication:	Peradeniya
Pages:	61 + 30 maps
Maps:	30 estate sketch maps, scale 1:8 000 to 1: 18 000
Where seen:	NADSA library
Keywords:	Sri Lanka, land use plans

Abstract:

Physical land use plans for proposed settlements of landless people in uneconomic tea and rubber lands and introduction of sustainable land use, namely forestry and multiple-cropping smallholdings.

Field officers visited each estate, checking boundaries and recording access, elevation range (from 1" to one mile topographic map or with an altimeter), average annual rainfall at nearest rain gauge, natural water resources, liability to strong winds, soil pH (nominally topsoil and subsoil), soil organic matter (visual estimate: fair/poor), present land use acreage, and land capability class areas by field. Field data were plotted on 1:8 000/1: 10 000 air photos.

These data are presented in a table along with a map traced from the air photos but re-scaled for easy reference, showing roads, streams, management units (fields), paddy, forest settlements and proposed new settlement sites. Some also show land capability classes.

A simple tabular plan for settlement schedules field numbers, areas proposed for settlement (cultivable) and forestry, number of settlers and clusters, and area for each settlement, typically 2.5 - 3 acres (see Box 2, p17).

Reference also made to different settlement models.

Judgement of Quality: This is the only natural resources information now used by the Heartland Project, successor to the ADP.

The land resources data presented here are minimal, often missing, and difficult to interpret (eg. elevation may range over several thousand feet, recorded soil pH may range between 4.0 and 5.5 with no indication of distribution). Land capability classes are defined by drainage class (well drained - class A; poorly drained - class B), slope/stoniness/rock outcrop (A1 = up to 20% slope with < 25% gravel or rock outcrops; A2 = 20-50% slopes and < 25% stones, gravel and < 50% rock outcrops; A3 = 50-75% slopes; A4 = < 75% slopes).

The land capability approach to land classification was superceded by a more sophisticated land evaluation procedure in order to prescribe specific crops and farming systems, but only the simpler information has survived in use.

It is difficult to determine just how much use is made of the land capability assessments. Obviously land use has changed since 1972; yet these data are referred to whereas the more comprehensive land evaluations and integrated plans are not. Probably, the simplicity of the data presented and their tying in to the effective management units, the estates, are the key factors in ensuring their acceptance by administrators, planner and managers.

Title: *Monaragala District - Pelwatte Sugar Project Feasibility Study*

Author: Booker Agricultural International

Other Details: Report for Ministry of Agriculture Development and Research, Sri Lanka

Publishers: Booker Agricultural International, UK

Date: September 1980

Pages/Maps: Volume I - main report, 24p, location map
Volume II - appendices: national resources, 40p; agricultural development, 41p, 3 maps: 2 pre-reconnaissance land facet maps, 1:63 360; 3 land use surveys 1:25 000 (combined with Huntings' 1980 land units)

Where seen: Booker Tate, Thame

Filed under: Sri Lanka

Keywords: Sri Lanka, sugar, feasibility study

Abstract:

Proposals are presented for a 12 000 ha rainfed sugar project comprising a nucleus estate with mill and more gradual development of outgrowers. The report is intended as a basis of negotiations with the Sri Lanka Government and to attract other investors.

Technical assessment is based on a land resources report at 1:25 000 scale by Hatton (Huntings) 1980 that covered half the area of interest which was re-interpreted for the sugar project, with a market, industrial and financial appraisal.

Key data were rainfall and evaporation analysis, the existing reconnaissance soil survey, a FAO/World Bank (1978) sugar feasibility study, and a 1:63 360 land capability map for rainfed sugar cane by the Land Use Division, Irrigation Dept (1975) (which only mapped topographic units).

Yield prediction based on estimated actual evapo-transpiration (i.e., allowing for soil available water capacity) and management factors (in the event, optimistic ones).

Management planning took account of soil erodability, rainfall-evaporation balance and the need to maximise infiltration and reduce runoff, weak soil structure, and soil nutrient status.

The assessment of project feasibility went on to include settler organisation, training and project management and made a financial projection.

Title: *Yan Oya - Padaviya Agricultural Extension Project, Pre-Feasibility Study*

Authors and Publishers: Central Engineering Consultancy Bureau
413 Bauddhaloka Mawatha, Colombo 7

Date: February 1992

Pages: 108 + 15 figures

Maps:
. Land suitability, 1:125 000
. Engineering layout, 4 at 1:5 000 with 2m contours
. Small scale location and access maps

Keywords: Irrigation, engineering design, land use plan, Sri Lanka

Abstract: The report covers a study for a new tank to supplement irrigation water for 5387 ha in NE Sri Lanka.

• *Terms of reference*: To examine the feasibility for an earth dam, 2.8 km canal and extension of irrigated area, including engineering design; water requirements for existing and new developments and how they can be supplied, design floods and dependable yield of water; suitability of soils for upland crops and paddy; demarcation of promising areas for new development, environmental impact appraisal, and financial appraisal.

• *Natural resources data*:

- Long term rain gauge data for 2 stations within the catchment and 2 others nearby (none operating now).

- Evaporation pan data (stations still operated by Irrigation Dept.).

- River gauging data. Local data was tested and found to be unrealistic compared with station upstream. Runoff factors were calculated between 14 and 47%. Reprocessed Irrigation Dept. Data from NEDECO was used instead. Flood frequency was calculated using both streamflow and raingauge data. In view of differing results, the worst case is assumed plus a safety factor of 1.2.

- A one inch to one mile regional geology map provides a useful background picture but is not adequate for design. On-site data are needed for the nature and depth of alluvial fill, groundwater levels, borrow materials and watertightness of reservoir. For the pre-feasibility study, only a reconnaissance undertaken, indicating distribution of 'residual soil', 'alluvial deposits', 'weathered rock' and 'fresh rock'.

- The available soil maps show only two categories, which have been interpreted as 'well drained' and not suitable for paddy, and 'poorly drained' and suitable for paddy. Land suitability maps at 1:125 000 prepared for the earlier Transbasin Diversion Study (presumably by Huntings) show 'existing paddy land'; areas 'suitable for new paddy' (poorly drained, gently sloping); areas 'suitable for upland

crops' (other soils, gently sloping); 'unsuitable' land (rock outcrops); and land 'above command area'. The CECB does not mention the methods of survey or intensity of observations.

• *Financial appraisal*. There is no consideration of market opportunities. Calculations assume an increase in cropping intensity of irrigated land from the present 0.86 to 2.0 (which has never been achieved). Calculations of the benefits from rice and other field crops are based on figures from previous feasibility studies. Sensitivity analysis is used to test errors up to 10 per cent in capital costs, benefits and date of project completion.

• *Environmental impact appraisal.* A standard list of possible impacts in flooded areas. The report highlights the need for investigation of physical, ecological, microclimate, water quality and human environmental impact.

Judgement of Quality: This is a professional engineering appraisal. Agricultural development prospects are not assessed rigorously in the absence of any market research or data for key soil characteristics like texture, permeability and depth. Assumptions made for runoff and seepage losses might be challenged and consideration given to reservoir sedimentation.

The presentation is very clear and an executive summary is provided.

Title: *Wandura Peenu Ela Reservoir Project, Stage 1 of Updating the Feasibility Study*

Authors and Publishers: Central Engineering Consultancy Bureau

Date: September 1992

Place of Publication: Colombo

Pages: 41 + 12 figures and 30 pages of data in appendices

Maps: 1" to 1 mile geology, land suitability, and project layout

Abstract:

The *terms of reference* are to update the financial evaluation of a preliminary study made in 1990, involving new costings of rehabilitation of tank, headworks and water distribution. The complete double cropping of all new irrigated land (1 000ha) is assumed, including 10% under field crops other than paddy in Yala. For existing irrigated land (3 000ha), it is assumed that supplementary irrigation will permit full double cropping with 100 per cent paddy in Maha and 74 per cent paddy and 26 per cent under other field crops in Yala; the changes in cropping are to be introduced over 4 years.

Natural resources data provided:

- Topographic survey with 2m contour interval of tank site only;
- 1" to one mile unpublished sheet of the Geological Survey Dept. that shows lithology, foliation and joint patterns of outcrops but nothing for areas of colluvial and alluvial cover;
- Land suitability at a scale of 1:125 000 showing land 'suitable for upland crops', 'suitable for paddy', 'undulating to mountainous land requiring lift irrigation', and 'unsuitable'. Criteria are not given;

- Field tests were carried out on the existing earth dam and a geotechnical assessment was made of new construction material: shrink-swell potential, Atterberg limits and dry bulk density;

- A hydrological study used existing river gauge data (1946-62) and rain gauge data, correlating streamflow with rainfall using runoff factors of 0.36 and 0.44. Flood prediction used a synthetic unit hydrograph from rainfall data.

Analyses:

Crop water needs were estimated using monthly Penman E_o data from nearby Kurunagala; assumed deep percolation losses of 2mm day^{-1} for low humic gley soils and 4mm day^{-1} for reddish brown earths. Effective rainfall is estimated using the Land Use Division factor of R effective = 0.67(R -25mm $month^{-1}$). Crop coefficients used were those of FAO (1979). Land preparation requirements were assumed to be 200 mm for low humic gley soils and 230 mm for reddish brown earths + 20 mm for first flood and 50 mm for second flood for rice, and 75 mm for other field crops. Field application efficiency was assumed to be 60% for paddy and 40% for other field crops.

The financial analysis assumes that the land use pattern will be that recommended by the Department of Agriculture, and uses its data for yield and costs. The cost of family labour is not included. 30 year economic life of civil works and 25 year life of other equipment is assumed. Sensitivity analysis is used to test (± 10%) variation in capital, benefit and project completion time.

The environmental impact analysis merely lists possible consequences that need investigation.

Judgement of Quality: This is an excellently presented desk study. The assumption of cropping intensity seems unrealistic; assumptions are made about runoff and percolation losses because of the lack of measured data on critical soil, and hydrologic and geotechnical properties. The environmental impact statement is a charade.