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SOIL & LAND USE

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1. INTRODUCTION

The Mahaweli Project is the largest development project undertaken in Sri Lanka. The project consists of several spatially distributed sub-projects such as System H,B.C. etc. System B involves the development of about 40,000 hectares of irrigated land.

USAID has been assisting the Sri Lanka Government in developing system B. The earlier aid program was to design and construct main and branch canals of system B Left Bank. Presently two linked projects MARD (Mahaweli Agricultural and Rural Development and MDS (Mahaweli Downstream Support projects are being implemented. It has been proposed to extend the MARD Project, more specifically to develop Block 503 of system B.

This study will examine the impacts on the environment (land and vegetation) as a consequence of the proposed development activity.

1.1 Development Proposals for Block 503

Originally the Mahaweli Authority had included the development of about 1000 hectares of irrigable land in Block 503 as part of the construction program of system B. Due to recurrent flooding thought to be due to blocked drainage, the development plans had been abandoned.

MARD project has proposed the improvement of drainage and construction of irrigation canals and structures for development of 503 area. They hoped to continue their experiences in especially zones 1,4, & 5 in to this area. It has been anticipated to give preference to non-rice crops with export potential e.g., Melons, Gherkins, Asparagus, Zuchini, Potato, Vegetables, etc.

2. METHODOLOGY

The present investigation was carried out in the following manner.

2.1 Soils Investigation

Available literature on soils especially the Maduru Oya Feasibility Study (Acres, 1980) were studied as a prelude to field investigations. Subsequently traverses were undertaken in Block 503 and soils were studied up to a depth of 2.2 meters at 10 sites (figure 1). pH, Electrical Conductivity, Cation Exchange Capacity, Exchangeable Cations, Soluble cations and Anions and Organic Matter were determined on 40 samples in the laboratory. An extract of the Soil Map of the Land Use Division is presented in Figure 1.

The Security situation at the site was not conductive for extensive field work. There was a fear that anti-personnel mines are present in the area bordering the Maduru Oya. Therefore investigations were limited by this constraint.

2.2 Land Use/Vegetation

The first record on Land Use and vegetation is that by the Hunting Survey Corporation (1962). This survey was carried out interpretation of 1:40,000 scale aerial photographs of 1956. An extract of the land use/ vegetation map is presented in Figure 2.

Aerial photographs of 1:20,000 scale of 1979 were interpreted during the present exercise to ascertain trends in land use and obtain an approximation of the present situation. This data is presented in Figure 3.

2.3 Environment Impact Assessment

The data on soils and land use/vegetation collected as outlined above were analyzed with respect to suitability of the land for projected development activities and assessment of impacts.

3. ENVIRONMENT

Block 503 in the Northern half is bounded by the Maduru Oya on the East and Kuda Oya on the West. In the Southern half it is bounded by the Kuda Oya on the East and Naran Oya on the West (Figure 1). Thus Kuda Oya forms a continuous boundary on the West.

3.1 Land

A description of the land and soil resources is given below.

3.1.1. Physiography

Block 503 lies entirely in the flood plains of Maduru Oya and Kuda Oya.

A levee or high river bank is formed mainly on the Maduru Oya. The levees gradually grade down via the flood plain proper or back slope to the depressions or back swamps. Some remnants of older levees occur in the middle of the Block.

The land being situated in the flood plain, they were subject to regular floods during the rainy season, October to January before the construction of the Maduru Oya Reservoir Dam. It is estimated that there would be flood of 1 to 1.5 meter height after dam construction for the 10 year return period (Acres, 1980). This is approximately the flood level for the 5 year return period before dam construction.

3.1.2 Soils

The Land Use Division of the Irrigation Department has done a low intensity soil survey covering Mahaweli System B for the purpose of conducting a feasibility study (Acres. 1980). Subsequently medium intensity surveys were carried out in part of zones 1,4,5 and entire zones 2 and 3 for designing of the project. Only low intensity soils data is available for Block 503 (Figure 1).

Three major soil series namely Bulatiabbe, Timbiri Aru and Odigar Villu series occur in the area. The extent of the soils are given in Table 1. Brief descriptions are given below. Soil analytical data carried out for this study are presented in Table 2.

Table 1. **Extent of Soils in Block 503**

Soil Series	Extent hectares	%
Bulatiebbe	220	12
Timbiri Aru	1400	78
Odigar Villu	180	10

Table 2. Soil Analytical Data of Block 503 (Mahaweli System B)

BORE NO & SOIL SERIES	DEPTH mm	PH SAT PASTE	EC SAT PASTE mmhos/cm	PH SAT EXT:	EC SAT EXT mmhos/cm	CEC	EXCHANGEABLE Na	EXCHANGEABLE K	SOLUBLE CATIONS Ca	SOLUBLE CATIONS Mg	SOLUBLE CATIONS Na	SOLUBLE CATIONS K	O.M. %	ESP %
						Meq/100g			Meq/100g					
1	0-10	5.7	0.56	6.8	0.21	19.8	0.0	0.2	0.1	0.1	0.1	0.0	7.8	0.0
	20-40	6.9	0.01	8.3	0.16	19.6	0.6	0.1	0.1	0.1	0.1	0.0	5.5	3.1
Timbiri	40-60	6.8	0.05	7.2	0.49	21.9	1.7	0.0	0.1	0.1	0.2	0.0	5.2	7.8
Aru	60-100	7.4	0.86	7.0	0.28	23.8	2.0	0.0	0.3	1.2	1.1	0.0	5.3	8.4
Series	100-150	7.5	4.40	6.9	8.60	18.3	2.7	0.0	1.5	0.3	3.0	0.0	5.0	14.8
	150-180	7.1	2.20	7.6	5.60	20.0	4.7	0.1	0.4	0.3	1.2	0.0	4.4	23.5
	180-210	7.6	3.20	7.5	3.80	24.0	5.1	0.1	0.3	0.1	1.5	0.0	4.7	21.3
	210 +	7.8	1.30	8.6	3.80	27.4	7.4	0.0	0.1	0.0	0.6	0.0	5.3	27.0
2	0-45	5.2	0.21	6.9	0.49	6.7	0.0	0.5	0.1	0.0	0.0	0.0	5.2	0.2
Bulatlebbe	120-150	6.8	0.10	8.1	0.19	3.4	0.1	0.0	0.0	0.1	0.0	0.0	0.8	2.9
Series	210+	6.1	0.10	6.3	0.16	7.8	0.1	0.0	0.0	0.0	0.0	0.0	0.9	0.9
3	0-15	5.9	0.14	7.2	0.16	0.6	0.2	0.2	0.0	0.0	0.0	0.0	7.6	41.8
Odigar	150-180	6.2	0.56	8.3	0.75	9.8	2.4	0.0	0.1	0.0	0.2	0.0	1.0	24.8
Villu	180-210	7.6	0.64	7.7	0.72	9.0	1.3	0.0	0.0	0.0	0.1	0.0	0.9	14.5
Series														
4	0-15	5.6	0.15	6.2	0.12	8.8	0.1	0.1	0.1	0.0	0.0	0.0	5.4	1.1
Timbiri	150-180	6.3	0.20	6.9	0.19	8.1	0.2	0.0	0.1	0.0	0.0	0.0	1.2	2.2
Aru	180-210	6.6	0.03	6.9	0.24	N.D	N.D.	N.D.	0.0	0.0	0.0	0.0	0.8	N.D.
Series														
5	0-10	5.9	0.24	7.5	0.32	6.7	0.0	0.1	0.1	0.1	0.1	0.0	5.4	0.0
Timbiri	10-30	5.3	0.14	7.0	0.14	5.4	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.2
	100-150	6.2	0.10	6.6	0.14	5.6	0.1	0.0	0.0	0.0	0.0	0.0	0.5	1.6
Series														
6	0-20	6.2	0.52	7.2	0.40	12.2	0.4	0.1	0.0	0.1	0.1	0.0	1.7	3.2
Timbiri	20-45	7.0	0.42	7.3	0.21	15.1	0.8	0.1	0.0	0.1	0.1	0.0	1.1	5.2
Aru	120-150	7.7	2.40	7.5	6.00	23.5	6.1	0.1	0.3	0.4	2.0	0.0	1.0	26.1
Series	150-180	7.9	1.60	7.6	4.90	22.8	4.5	0.1	0.2	0.3	1.6	0.0	1.1	19.6
7	0-20	5.7	0.12	7.0	0.25	7.4	0.1	0.1	0.1	0.0	0.0	0.0	2.1	1.2
Timbiri	20-50	6.1	0.14	6.7	0.14	6.6	0.1	0.1	0.0	0.0	0.0	0.0	0.6	1.4
Aru	90-140	6.4	0.11	6.9	0.18	5.4	0.1	0.1	0.0	0.0	0.0	0.0	0.2	2.6
Series														
8	0-20	5.9	0.32	8.1	1.00	4.9	0.0	0.2	0.1	0.1	0.1	0.0	6.7	0.8
Bulatlebbe	90-110	6.2	0.20	6.5	0.43	2.6	0.0	0.1	0.1	0.1	0.0	0.0	1.1	0.8
Series	160-210	5.1	0.12	6.3	0.06	9.1	0.0	0.1	0.0	0.0	0.0	0.0	5.0	0.2
9	0-15	5.3	0.44	7.3	0.58	13.8	0.3	0.1	0.1	0.1	0.0	0.0	7.5	2.2
Odigar	15-40	5.8	1.80	6.8	3.00	10.9	0.9	0.0	0.3	0.3	0.7	0.0	6.0	7.8
Villu	150-180	7.3	2.50	6.9	4.60	13.7	4.0	0.0	0.2	0.1	1.1	0.0	0.6	28.9
Series	180-210	7.4	3.00	7.9	5.20	12.3	4.2	0.0	0.1	0.2	1.3	0.0	1.2	34.4
10	0-20	5.7	0.22	7.4	0.29	8.8	0.1	0.5	0.1	0.1	0.0	0.0	8.5	1.0
Bulatlebbe	20-60	6.2	0.06	7.2	0.12	5.4	0.1	0.1	0.0	0.0	0.0	0.0	1.6	1.3
Series	20-110	6.3	0.07	7.1	0.30	3.6	0.1	0.1	0.0	0.0	0.0	0.0	1.4	1.9
	110-140	6.5	0.05	7.0	0.09	3.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.9
	200-230	6.2	0.06	6.7	0.08	4.2	0.0	0.0	0.1	0.0	0.0	0.0	1.2	0.7

N.D. = Not determined due non-availability of sufficient soil sample for analysis.

Bulatiebbe Series

These are deep, moderately well drained levee alluvial soils.

The top soils are brown to dark brown in colour and the textures are loamy sand to sandy loam. Occasionally there is a thin cover of sandy clay loam to clay loam. The sub soils are yellowish brown to strong brown and the textures are loamy sand to sandy loam. The sub soils are faintly mottled.

The soil reaction is slightly acid and the electrical conductivity is low. The cation exchange capacity is low to medium and the base saturation is high. The organic matter content of the top soil is moderate and low in the sub soil.

Timbiri Aru Series

These are deep, alluvial soils occurring in the back slope of the flood plain. They are imperfectly drained in the natural state. However if additional water is introduced such as for irrigation, water stagnation occurs for longer periods.

The top soils are very dark greyish brown, dark brown to black in colour and the textures are generally clay loam to clay with sandy loams and sandy clay loams occurring in few sites.

The sub soils are grey to greyish brown in colour and textures are generally similar to the top soil. Common to many mottles occur in the profile. However, at depths of 1 1/2 to 2 meters sandy layers occur.

The soil reaction in the top soil is slightly acid while the subsoil is slightly acid to neutral. In some sites carbonates occur in the sub soil and the reaction is slightly alkaline to alkaline. The electrical conductivity is low in the top soil and moderate to high in the sub soil. The cation exchange capacity is medium to high and the base saturation is high. The organic matter content is low to medium in the top and sub soil.

Odigar Villu Series

These are deep, poorly drained alluvial soils occurring in the back swamp or villu type sites of the flood plain.

The soil colour is grey, dark greyish brown to black. Mottling and greying occurs throughout the profile. The soil textures are clay loan to clay.

The soil reaction is slightly acid to slightly alkaline. The electrical conductivity is medium to high.

3.2 Climate

System B including Block 503 lies in the Dry Zone of Sri Lanka. The main climatic zones have been further sub divided into 26 Agro-ecological Regions (Land and Water Use Division, 1976). The Agro-ecological Regions covering System B are Dry Lowland 1 (DL_1), Dry Lowland 2 (DL_2), and Intermediate Lowland 2 (IL_2). Block 503 lies in the DL_2 region.

3.2.1. Rainfall

Monthly weighted average rainfall figures according to the Thiessen Polygon method for System B (Acres, 1980) are presented in Table 3 along with 75% probability figures for DL_2 region.

Table 3. **Monthly rainfall estimates for Mahaweli System B and DL_2 Agro-ecological Region.**

Rainfall Estimate	Monthly Average Rainfall mm.											
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Weighted Rainfall for Sys. B	235	146	70	93	63	21	67	66	77	192	326	440
75% expectancy of rainfall	100	27	15	23	13	00	00	30	30	122	198	225

3.2.2. Temperature

The average monthly temperature of Batticaloa is presented in Table 4. Batticaloa even though it lies in the D1 agro-ecological region is not representative of system B since it is a coastal station. However, since this statio has long term records the data is presented.

Table 4. **Monthly average temperature C of Batticaloa.**

Average Monthly Temperature C											
Jan.	Feb.	Mar.	Ap.	May.	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
25.4	25.7	26.8	28.0	29.0	29.6	29.1	28.7	28.4	27.4	26.3	25.5

3.2.3 Evapotranspiration

Reference evapotranspiration calculated according to the Modified Penman method (FAO, 1977) is presented in Table 5. Again due to the absence of a suitable station with long term data within system B, estimations are carried out on data of Batticaloa.

Table 5. Monthly Average Reference Evapotranspiration (ET_0) data DL_2 Agro-ecological Region.

Average Monthly Reference Evapotranspiration(ET) in mm											
Jan.	Feb.	Mar.	Apr.	May.	Ju.	Jy.	Aug	Sep.	Oct.	Nov.	Dec.
143	151	189	183	198	198	198	205	192	167	135	124

Direct comparison of monthly rainfall and reference evapotranspiration shows that there is acute moisture deficiency for plants from March to October.

3.3 Stream Water

The streams/rivers which run through Block 503 are Maduru Oya, Kuda Oya and Naran Oya. At the down stream end of Block 503 these three join together.

3.3.1 Quality & Quantity of Water

Flow characteristics, estimated using rainfall data, basin features (Bocks 1959, Hunting Survey Corporation 1962) along with measured data of Maduru Oya (Irrigation Dept) at Welikanda are presented in Table 6.

Table 6. Flow characterities of Maduru Oya

Estimation Method	Area km^2	Avg. Annual Rainfall mm	Avg. Annual Flow m.cm	Avg. Annual Flow mm	Flow/ Rainfall Factor %	Specific Yield mcm/km^2
Synthesized	1541	1985	800	519	26	0.52
Measured 1945-1978	1541	1985	926	601	30	0.60

The quality of waters for irrigation purposed as determined on samples collected during the present investigatio is presented in Table 7.

Table 7.

Source	pH	Ec mmho/cm	Ca meq/1	Mg meq/1	Na meq	K meq	SAR	Salinity hazard	Sodium hazard
Irrigation Canal	7.2	0.21	0.82	0.31	0.21	0.02	0.28	Low	Low
Maduru Oya	7.7	0.42	1.08	0.6	1.07	0.05	1.17	Medm	Low
Kuda Oya	7.7	0.36	1.04	0.48	0.87	0.04	1.0	Medm	Low
Naran Oya	7.6	0.38	1.20	0.76	1.07	0.05	1.08	Medm	Low

The quality of irrigation water is good. However, the stream waters have some sailts and are classed as having a medium salinity hazard and this has to be borne in mind if these waters are to be used for irrigation. Again just one sampling does not give the complete picture and year round measurements need to be taken at least once a month.

3.3.2. Flood Risk

Block 503 lies entirely within the flood plain of Maduru Oya and Kuda Oya and were subjected to floods. The flood risk before and after the construction of the Maduru Oya dam (Acres, 1980) is presented in Table 8.

Table 8. **Estimated Flood risk in Maduru Oya.**

Return Period	Pre-dam Flood Peak m /s	Post - dam Flood peak m /s
5 year	907	677
10 year	1190	875
25 year	1590	1130

According to this data, the flood risk is about halved after the construction of Maduru Oya dam. This reduction is not sufficient to guarantee safe annual crop production during the rainy season.

Visual observations seem to confirm this estimate. However, it should be noted that only about 50% of the planned extent is developed and irrigated. Therefore the Maduru Oya reservoir is containing higher amounts of water during the rainy season reducing the potential to intercept flood flows. Also MARD (1991) reports that Kuda Oua and Naran Oya are blocked with anicuts thus impeding flood evacuation.

A further estimate was done on the capacity of the reservoir to intercept a recorded maximum flood peak. This data is presented in Table 9, and shows that the Maduru Oya reservoir cannot retain the whole flood peak even if it was empty at the time of flood occurrence.

Table 9. Total Capacity of Maduru Oya Reservoir in relation to maximum flood peak

Capacity of Reservoir mcm.	Maximum flood peak mcm.	Capacity of reservoir as a proportion of flood peak %
497	704 (19 to 28.12.1957)	71

4. LAND USE/VEGETATION COVER

The land use/vegetation cover of Block 503 is estimated to enable the exercise on environment impact assessment. The data of 1956 and 1979 as interpreted from available aerial photographs are used for this purpose.

4.1 Status in 1956

The land use/vegetation cover of 1956 is obtained from the 1956 aerial photographs and the series of maps produced by the Hunting Survey Corporation (1962). The data is presented in Table 10.

Table 10. Land Use & Vegetation Cover of Block 503 in 1956 (Hunting Survey Corporation 1962)

Land Use/Vegetation Category	Extent ha.	Proportion %
Low Yield Dry Zone Forest	1460	82
Non Productive Dry Zone Forest	260	14
Damana Grassland	80	4

The descriptions of the Land Use/Vegetation Category as described by Huntings are outlines below.

4.1.1. Low Yield Dry Zone Forest

Low Yield Dry Zone Forests are a subcategory under the Woodland main category. Woodlands are defined as all land on which trees are the dominant vegetation, whether these trees are of commercial value or not. The broad ecological classification Dry Zone Forest is based on species composition, which in turn is determined mainly by climatic factors especially the amount and periodicity of rainfall and the duration and frequency of periods of drought. The characteristic species of Dry Zone Forests are Chloroxylon swietenia (Satin), Terminalia arjuna (Kumbuk), Manilkara hexandra (Palu) Hopea cordifolia (Mendora), schlrivhrts oleosa (kon), Adina cordifolia (Kolon), Berrya cordifolia (Halmilla), Vitex pinnata (Milla), Drypetes sepiaria (Wira).

In the Low Yield Category the trees are normally less than 15 meters high, have small crowns and from a fairly open stand. The species Drypetes Sepiaria (Wira) is more dominant than the other species. In commercial terms, Low Yield forests have limited timber trees and much firewood.

On vegetation types, Gaussen (1964) classifies the forests in this region as Chloroxylon - Berrya - Vitex - schleichera Scrub - Woodland. Later (197) added Manilkara - Drypetes to the above association.

4.1.2. Non Productive Dry Zone Forest

In this category the species mentioned in the above section are present but are poorly grown. In addition Dimorphocalyx glabellus (Weliwanna) and pleurostylia opposite (Panakka) is common. Scattered with the trees are various scrub species. Economic value is mainly in terms of firewood.

4.1.3. Damana Grassland

Damana Grasslands have been defined as dry, open grasslands with or without scattered clumps of forest trees. In Block 503 the few patches of Damana Grasslands contain clumps of trees. Imperata cylindrica (Iluk) is the characteristic and dominant grass species.

These lands are of poor quality for grazing. They are generally burned over so that the subsequently emerging young shoots may be grazed.

4.2. Status in 1979.

By 1979 the Land Use Vegetation cover had undergone a drastic change. The extent are presented in Table 11.

Table 11. Land Use & Vegetation Cover of Block 503 in 1979

Land Use/ Vegetation Category	Extent ha.	%
Low Yield Dry Zone Forest	120	7
Non productive Dry Zone Forest	170	9
Damana grassland	690	39
Shifting cultivation	450	25
Paddy	370	20

The descriptions of the first 3 categories are kept essentially the same as described by Huntings in 1962 for comparison purposes. The other 2 categories are described below.

4.2.1. Shifting Cultivation

In this category, lands belonging to the state are encroached upon by cultivators, Who fell most of the trees except the big ones and cultivate short term crops. The shrubs and big branches are slashed around July. August and after drying they are burned giving a weed free seed bed.

With the onset of rains in September / October a range of crops are seeded. The crops generally grown are millets, maize, pumpkin, cassava, chilies, green gram, cowpea, brinjal, upland paddy etc. When the weed competition is too intense and soil fertility declines after 1 or 2 cropping seasons. the land is abandoned and a new plot is cleared for cultivation. Decades ago the rotation cycle of a shifting land had been about 15 years, but has reduced recently to less than 3 years.

4.2.2. Paddy

There is a tract of about 300 hectares at the Southern end of Block 503 having irrigated paddy under the Pimburattewa Irrigation Scheme. In addition farmers are cultivating about another 50 hectares of paddy under irrigation. Irrigation Water for these lands are obtained from Kuda Oya and Naran Oya and their branches by a system of makeshift anicuts and distribution canals. Paddy cultivation is done mainly during the major rainy season Maha (October to February).

4.3 Present Status and Trends

The present status in land use is generally the same as in 1979. Due to the adverse security situation mentioned before detailed checking could not be done. Also recent aerial photographs could not be obtained.

The trends in land use and vegetation cover are that the major extent of forest cover obtaining in 1956 had been converted to shifting cultivation, grassland and paddy land. Most of the forest cover in Mahaweli System B Left Bank was cleared in anticipation of the Mahaweli Development Work. The trees Were used for timber and charcoal production, and most of these clearing activities were commenced around 1980. However, the forests in Block 503 were already cleared by 1979 mainly in anticipation of development associated with the Pimburattewa Irrigation Scheme. Since the Pimburattewa Scheme did not extend substantially into the Block 503 area, some shifting cultivation and paddy cultivation is being carried out in part of the Block. At present there is no useful natural vegetation nor unique ecology to conserve or preserve in Block 503.

5. LAND SUITABILITY

The development plans proposed recently for Block 503 are outlined in Section 1.1 of this report.The Land Evaluation Methodology of the Food and Agriculture Organisation (F.A.O.) is used to judge the suitability of the lands for the proposed uses. MARD and MASL officials and a study of MARD reports.

5.1 Land Evaluation System.

According to the F.A.O. Framework for Land Evaluation (1976) land is evaluated with respect to particular requirements of specific types of land use. The specific types of land use are referred to as Land Utilization Types (LUTS) and represent a unique combination of the production factors land, labour, capital and management.

Land suitability classes and subclasses used for the land suitability evaluation are listed below.

Classes:

Lands are classified into five suitability classes for each LUT as follows according to the degree of suitability for the projected use.

Class SI: Highly Suitable.

Land having no significant Limitations to sustained production under a given use.

Class S2: Moderately Suitable.

Land having limitations which together constitute a moderately severe Limitation for sustained production under a given use. These limitations will either reduce productivity appreciably below the levels in class S1 lands or require considerably increased inputs to maintain similar Production levels.

Class S3: Marginally Suitable.

Land which has limitations that, in aggregate, are severe enough to reduce productivity or require increased inputs to such an extent that benefits are only marginally greater than the costs.

Class N1: Currently Not Suitable.

Land having limitations which may be surmountable in time but which cannot be corrected with existing knowledge at currently acceptable cost. The limitations are so severe as to preclude successful sustained use of the land in the given manner.

Class N2: Permanently not Suitable.

Land having limitations which appear so severe as to preclude any possibilities of sustained use of the land in the given manner.

Sub. Classes:

Land suitability are defined in terms of the dominant kinds of limitation that reduce the productivity of the land for a given use. Class S1 lands have no significant limitations and therefore no subclasses. Classes S2, S3 and N1 land have subclasses which are indicated by the symbol of the land quality that is limiting. Subclasses for class N2 land are not defined as in many cases the number of limitations are too numerous to show in a table.

m = limitations of moisture availability
i = limitations of irrigability
o = limitations of drainage deficiency
n = limitations of plant nutrient availability
a = alkali and/or saline problems
f = flood hazard

Land Utilization Types (LUTS), refer to specific types of land uses, that would be practised in the area under consideration and the lands are being evaluated with regard to their suitability for these Land Utilization Types. The key attributes of the Land Utilisation Types are produce, capital use, power source, size of holding, infrastructure requirements, technical knowledge of the land users and the technology employed.

A land utilization type therefore describes a set of conditions for a kind of land use, which are conducive for optimal sustained production. Some of the specifications may be in accordance with current practices, while others refer to a potential improved setting which would be widely adopted in future during project implementation.

5.1.1. Irrigated Paddy

Irrigated paddy grown on state granted 1 hectare allotments by peasant farmers. Paddy cultivation being a traditional occupation among farmers, adequate technical knowledge is prevalent. Farmers have low capital resources.

Cropping Seasons.

Maha (January to March) Yala (May to August)

Varieties

BG 276/5 (31/2 months)
BG 34/8 (31/2 months)
BG 94/1 (31/2 months)

Land preparation to bury weeds and gradually crete a slow permeable hardpan by animals or tractors. Initial land development using tractors, into flat terraces (with 0-0 gradient) across the slope.

Irrigation layout generally inthe form of basins as large as possible,to facilitate machine operations. Irrigation issues at 7 day intervals using a 14-28 liter/second (0.5 to 1 cusec) irrigation stream to supply net field water requirements and ensure standing water in basins.

Each terrace to have a drain to a depth of 0.5 meters with a capacity of 10-15 liter/second per hectare to cater for surface drainage. Continuously functioning main drains to be 2 meter deep with a capacity of 10-15 liter per second per hectare.

Market orientation commercial with subsidiary subsistance. Assured market at guaranteed prices with collection preferably at farm gate or in close proximity to farms. Advisory services available from the Agriculture Department and the Mahaweli Economic Agency. Credit, agricultural inputs and agricultural insurance available.

Agricultural operations such as weed control and pest control increasingly achieved using agro-chemicals. This trend needs to be reversed because of environmental considerations and also because of increasing prices of agrochemicals. Other operations such as sowing, harvesting etc. done manually. However, threshing by machines would probably be widely adopted.

5.1.2 Irrigated Traditional Upland Annual Crops.

Irrigated upland annual crops grown on state granted 1 hectare allotments by peasant farmers (Dimantha and de Alwis 1985). Farmers do not have much knowledge of irrigation practices for upland crops. At the start farmers will have low capital resources. Supported by a strong Agricultural Extension Service, crop management is expected to become highly efficient following recommendations of the Department of Agriculture.

Cropping Seasons and Crops.

Maha	**Yala**
Soyabeans (110/120 days)	Chilies (150 days (once in 2 years)
Groundnuts (110/120 days)	Soyabeans (80/90 days)
Maize (105 days)	Onions (75 days)
	Pulses (90 days)
	Vegetables (60/120 days)

Individual crops or crop combinations to be grown according to the capability of farmers. Chilies plus greengram, chilies plus soyabeans have been found to be promising crop combinations giving high returns.

Maha: Planting in January Harvest March

Yala: Planting in April Harvest: June/September

Land preparation by animals or 2 wheel tractors. Precise land development into graded bench terraces around 100 meters long and at 0.2 to 0.8 per cent slope.

Irrigation layout generally furrows at 60 cm. spacing and 0.4 - 0.8% slope or furrowed basins with furrows at 60 cm. spacing and terraces at 0.2 - 0.5% slope. Irrigation issues at 7 day intervals to supply 150 to 160 % of net field water requirements (assuming 60 to 70% on farm application efficiency) using a 14 lit/sec. stream for graded furrows and 5 lit./sec. for furrowed basins.

Each terrace to have one drain to a depth of 0.5 meter with a capacity of 13 lit/sec/hectare. to cater for surface drainage. Main drains to be 2 meter deep with a capacity of 13 lit/sec/hectare. Main drains should be maintained to function continuously.

Market orientation commercial with subsidiary subsistence. Assured market at guaranteed prices at collection centers inclose proximately by farms. Setting up of soyabean and groundnut oil, livestock feed, cotton yarn processing plants. Access to agricultural credit at reasonable terms.

High input crop management according to Department of Agriculture recommendations.

5.1.3. Irrigation New Upland Crops.

Irrigated upland crops on lands leased on long term from the state (Cauley, 1991, Silva 1991). Farm sizes to be larger than 5 hectares. Farmers possessing or having access to expert knowledge on new crops, and large capital resources.

Crops

Gherkins, asparagus, melons, Zuchini, Potatoes, Exotic Vegetables, Fruits such as pineapples etc.

Cropping Seasons:

Year round cultivation without specific seasons.

Initial land development to be confined to basic land levelling with bulldozers. Land tilling for land preparation using tractors. Raised beds for planting of crops.

Irrigation water available under conventional gravity feed, lift and sprinkler or drip systems. Soil drainage by installing raised beds, interceptor drains and subsurface tile drains.

Maintenance of soil fertility by incorporating organic manure and green manure rotations.

Market orientation highly commercial, along with establishment of firm negotiated markets for produce. Cold chains for safe transport of produce.

5.1.4. **Fuelwood Plantations.**

Fuelwood plantations or produce fuelwood, limited construction timber and non timber products such as fruits, fodder medicine and vegetables.

Species: Glyricidia maculata, Sesbania grandiflora. Luceana leucocephala, Eucalyptus robusta, Artocarpus heterophyllus (Jak), Azadirachta indica (Neem), Magifera indica etc.

Plant establishment from seedlings raised in nurseries. No special land preparation except digging of planting holes. Selective thinning, selective harvesting. Field operations probably managed by local settler organizations.

5.1.5. **Pasture for Grazing/ Fooder for Livestock.**

Grazing or fodder pasture for livestock raising on variable size land holdings. Livestock enterprises based on grazing of range lands is inefficient and the carrying capacity does not exceed 2 head of cattle per hectare. Pasture lands to contain a mixture of grasses and legumes.

Pasture Species:

Grasses: Bracharia brizantha, Bracharia mutica, Cenchrus ciliarus (Buffel grass), Panicum maximum (Guinea grass varieties B and Hamil).

Legumes: Stylosanthus hamata, Centrosema pubescens.

Grasses to be established by cuttings (or seed in the case of Guinea grass) and legumes by seed. Wedding to be carried out until proper establishment. Regular fertilization to improve and maintain yield.

Rotational strip grazing or harvesting by establishment of paddocks will increase performance of pasture.

Hay and silage making to tide over dry periods.

The carrying capacity of pasture for manual harvesting and feeding for stall bred livestock is higher being at least 3 head of cattle per hectare.

5.1.6. Housing

Under this land utilization type, group or cluster housing is established. The holding size will be around 0.5 to 1 ha.

Houses will be single storey mostly, with a simple foundation. Domestic water supply either by wells in individual holdings or pipe borne. Waste water disposal into main drainage and sewerage disposal by septic tanks.

A variety of agricultural crops such as coconut, jak, breadfruit, mango, cashew, banana, citrus, papaw, cassava, dioscoreas, vegetables, ginger etc., will be grown in the home garden for home consumption and commercial marketing.

Other desirable infrastructure requirements are electricity supply, road network with bus service, schools, hospitals, community centers, shops in the vicinity.

5.2 Land Suitability Ratings.

Table 12 shows the land suitability ratings (classes and subclasses) of the land mapping units for the initially considered land utilization types.

Table 12. Land Suitability Ratings of the Land Units in Block 503.

Physiographic Unit	Soil Series	Irrigated Paddy	Irrigated Traditional Upland Crop	Irrigated New Upland Crops	Pasture	Fuelwood	Housing
Levee	Bulatiebbe	N1fmn	N1fin	S2fn	S3mf	S2mf	N2
Back slope	Timbiri Aru	S2f	N1fd	S3fd	S2f	S3df	N2
Back swamp	Odigar Villu	S3fa	N2	N2	S3fa	N2	N2

6. ENVIRONMENT IMPACTS

Due to the overall development activities in System B and C a number of off sites mpacts such as the alteration of the flow pattern in the stre and rivers, alteration of tidal intrusion patterns, extension of mangrove areas etc. are predicted (Tams, 1980. Acres, 1980). There will not be any significant change in these off site impacts due to the incremental development of about 1 - 2000 hectares in Block 503. Therefore only the direct impacts which would mostly be on site will be dealt with in this section.

6.1 Impacts on Flora

In section 4 it was shown that there is hardly any unique vegetation or ecology deserving conservation or preservation in Block 503. Over 80 per Cent of the original forest cover which was not the best of natural forests, have been removed by 1979. Grasslands and shifting cultivation lands are subject to destructive fires. Therefore any well planned development work would at least improve the vegetation cover.

6.2. Impacts on the Soil

6.2.1. Land Shaping

Normally any land cutting and filling activities could destroy the top soil and drastically reduce soil depth. The soils in soils in Block 503 have very deep soils and can tolerate a certain amount of soil cutting. Thus land shaping to remove surface imperfections and improve water management could have a net beneficial impact.

6.2.2. Soil Drainage

Around 90 per cent of the soils are imperfectly or poorly drained.Installation of improved drainage measures such as open drains, interceptors and sub surface tile drains should have a beneficial impact on the soil.

6.2.3. Irrigation

Irrigation of properly applied will have a beneficial impact by improving the moisture availability for plant growth in these soils situated in the Dry Zone. However, proper irrigation has generally not been practised in most Irrigation projects in Sri Lanka.

Farmers who have first access to irrigation water tend to over-irrigate, accompanied by adverse impacts such as rising water tables. Soil observations (Table 2) reveal a layer of salt accumulation around a meter to two depth. Rising water tables will transport salts to the surface layers.

6.2.4. Soil Erosion

Lands cleared and tilled for cultivation, are subject to soil erosion by wind and water. Heavy dry winds occur during May to September. Newly tilled lands, when dry, would loose substantial amounts of top soil.

Soil erosion by water occurs when bare soil is exposed to high intensity rains. Also high velocity irrigation streams would cause soil erosion.

7. MITIGATION OF IMPACTS

Only few adverse impacts are foreseen in section 6, as a result of development of Block 503, Some measures to over come these impacts are presented.

7.1 Vegetation Cover

Every effort must be taken to preserve the very few surviving trees. Further, priority could be given to new land use enterprises which afford permanent tree cover e.g. fuelwood enterprises. Pasture for grazing or fodder should be managed to preserve soil cover as far as possible by rotational strip harvesting, Where these measures cannot be adopted e.g. paddy or upland crops, trees lines or hedge lines should be planted at appropriate spacing.

7.2. Preserving Top Soil

Loss of top soil during land shaping could be minimized by stacking the top soil while the land is levelled. The stacked top soil should be spread over the levelled land, after the desired gradient is achieved.

The operation of stacking top soil and spreading it subsequent to the levelling will incur 50 to 100 per cent additional expenditure to a normal levelling operation. If funds and machinery are not available for this additional expenditure, the organic matter content of the soil could be built by incorporation of green manure.

7.3. Water Management

Adverse impacts due to over-irrigation should be avoided by adopting proper water management (Dimantha & De Alwis, 1985). As for as possible to prevent ground water table build-up. Seepage from irrigation canals should be stopped by lining. Ground water table build-up during heavy rains should be prevented by installing well designed drainage measures.

7.4. Soil Conservation

Soil erosion by wind and water should be minimised by maintaining good vegetation cover and installing well designed soil conservation measures.

As mentioned before, Where land use enterprise do not afford continuous cover, protective measures such as soil conservation bunds, drains etc. have to be constructed. The spacing and gradients have to be designed to suit the rainfall patterns and original land gradients.

The on-farm irrigation system too has to be designed to prevent soil erosion.

8. CONCLUSIONS

The proposed development of Block 503 will not cause adverse impacts on land and vegetation provided well planned land use enterprises are adopted as outlined in the above sections.

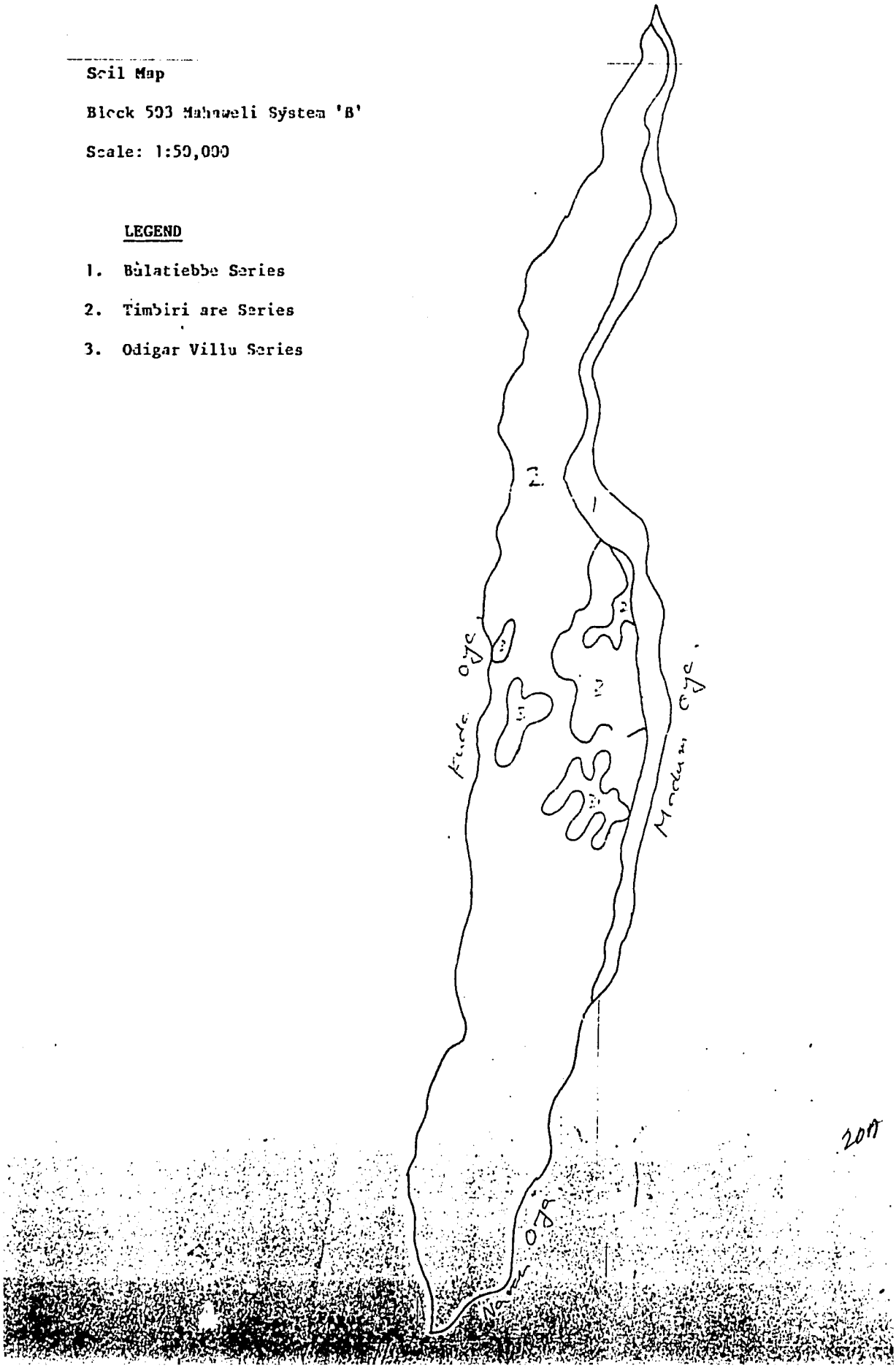
Soil Map

Block 503 Mahaweli System 'B'

Scale: 1:50,000

LEGEND

1. Bulatiebbe Series
2. Timbiri are Series
3. Odigar Villu Series



1956 Land Use/ Vegetation Cover Map

Block 503 Mahaweli System 'B'

LEGEND

1. Low Yield Dry Zone Forest
2. Non Productive Dry Zone Forest
3. Damana Grass Land

Figure ii

20B

1979 Land Use/Vegetation Cover Map

Block 503 Mahaweli System 'B'

Scale: 1:50,000

LEGEND

1. Low Yield Dry Zone Forest
2. NOn Productne Dry Zone Forest
3. Damana Grassland
4. Saipting Cultivation
5. Irrigation Paddy

Figure iii

-20c

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