Directorate of Soil Survey, East Pakistan
Soil Survey Project of Pakistan

RECONNAISSANCE SOIL SURVEY

SADAR AND MOULVI BAZAR SUBDIVISIONS

SYLHET DISTRICT

1965

Joint Project
Government of Pakistan - United Nations Special Fund
Executed by the Food and Agriculture Organization
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Dacca 1965

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Robert Brinkman
Technical Officer
(soil survey and photo interpretation)
Food and Agriculture Organization
of the United Nations

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SUMMARY OF FINDINGS

The soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, covers 2346 square miles. The area is situated in the northeastern part of East Pakistan, bordering the Assam and Tripura states of India.

The soils of about 40 percent (928 square miles) are well suited for agricultural development and, with use of fertilizers and moderate expenditure for irrigation and drainage, could produce high yielding crops throughout the year. The soils of about 22 percent (513 square miles) are moderately suited for agricultural use. With use of fertilizers and dry-season irrigation, most of these could produce high to moderately high yielding crops for part but not all of the year. Year-round crop production on these soils would require high expenditure for pump drainage. The soils of about 28 percent (648 square miles) are poorly suited for agriculture, and most of the remaining 10 percent is covered by complexes of soils which are very variable at short distances. On this land large-scale agricultural development would be difficult and expensive.

All the good and moderate agricultural land is already under cultivation. Land use is very nearly optimal under present circumstances. Increased yields of present crops and introduction of additional crops in the rotation would be possible after provision of large-scale irrigation and drainage and with use of fertilizers. As long as the potential of the good and moderate land throughout the Province is not yet fully utilised, high-cost agricultural development of poor agricultural land and heterogeneous land would not be economic.

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SEPARATE MAPS

Soil associations	scale 1:125.000, 2 sheets
Present land use	scale 1:250.000, 2 sheets
Land capability associations	scale 1:250.000, 2 sheets

INTRODUCTION

Aims and objectives

The primary purpose of this Soil Survey Report is to aid administrators of an agricultural programme, planners of agricultural development, agricultural officers and farmers to evaluate the agricultural potential of the Sadar and Moulvi Bazar subdivisions of Sylhet district, and to decide the best use and kind of development for the various kinds of soils.

A second purpose is to describe the soils and their relationships to each other, to geomorphology and to hydrology, and to illustrate part of the genesis and development of landscape and soils of the Province. Thirdly, this report as well as its companions on Dacca, Pabna and part of Comilla districts which are in preparation could serve as models for future reports by officers of the Directorate of Soil Survey, East Pakistan, after departure of foreign personnel.

Scope of the report

The report is provided with separate soil, land use and land capability maps. Each soil association shown on the maps is described in the report and its important chemical, physical and hydrological characteristics discussed in relation to land use and potential. Similar soils have been combined into land capability classes and subclasses. Land capability associations have been shown on a map, and the potential of each for development is discussed in the report. Relative suitability of each soil for a number of common crops has been estimated and listed.

Fieldwork was carried out between November 1964 and May 1965. Unless otherwise indicated, all data and statements in the report and maps refer to the situation at that time. Basic data and information in the report and maps need to be revaluated from time to time with changes in agricultural technology.

Methods used in survey

The soil survey of Sadar and Moulvi Bazar subdivisions of Sylhet district is classed as a reconnaissance survey. This means that associations of soils regularly occurring together were mapped rather than individual soils. Aerial photographs of scale 1:40,000 taken in 1953 were used as field base maps. Soil boundaries and soil series symbols were placed on these maps based upon information obtained by auger borings. These borings were made at intervals varying between 200 and 1500 feet within traverses depending on the complexity of the soil pattern. Traverses were located so as to obtain maximum information in the limited time available, and were about 3 to 6 miles apart. Locations in the field were continuously checked by photographic detail.

Most of the field work was done on foot, with a few traverses by bicycle or Land Rover. Most of the roads in the area run along, not across, the physical features: they were mainly used to transport the field parties to and from their work. For about 10 percent of the area, speedboats or a country boat were used to gain access to traverses.

During the field season, all soil series encountered were carefully described from dug pits, and a field identification legend was set up and extended as necessary. During survey, borings were made to a depth of 4 feet with a Dutch auger, and notes taken on any characteristics relevant to the classification and use of the soil. Soil reaction was measured in the field with the Hellige-Truog universal indicator, which has a range from pH 4 to 9.

Samples for laboratory analysis were taken from pits in dry areas or by auger from areas still submerged. One or more sets of samples were taken of representative profiles for each soil series. A profile description, a boxed profile and relevant field notes on soil environmental conditions were prepared at each sampling site.

After studying the field data and aerial photographs, mapping units were defined and delineated, consisting of one or more major soils and other soils occurring as inclusions. Phases were defined and mapped where otherwise similar soil associations occur under very different flooding conditions or topography, with consequent different land use and land capability.

Acknowledgments

Many people both inside and outside the Soil Survey Project have contributed to the realization of this report and the accompanying maps. Farmers throughout the area willingly shared their knowledge with us. We hope that this report will benefit them, even if indirectly.

Acknowledgments are gratefully made to the Deputy Commissioner, Sylhet District and members of his staff, as well as members of Basic Democracies throughout the survey area, for their kind assistance; to the District Agricultural Officer and his staff for their assistance and cooperation; to officers of the East Pakistan Rifles in border areas for their willing assistance; to the Principal, Basic Democracies Training Institute, and his staff for their great hospitality; to the Director and staff members, Tea Research Institute, Srimangal, and to tea estate managers and staff members, for assistance and hospitality, and for the technical discussions we had with them; to the Soil Fertility Expert (FAO) of the Soil Fertility and Soil Testing Institute, Dacca, for his assistance with the estimates of crop-soil relationships; to the Secretary, E.P. WAPDA, for providing the basic information contained in the Master Plan with supplements; to the Chief Soil and Agricultural Survey Officer, E.P. WAPDA, and members of his staff for helpful discussions and information contained in reports of detailed soil surveys; to the Deputy Surveyor-General and officers, Survey of Pakistan, Dacca, for provision of photographs and maps; to officers of Netherlands Engineering Consultants, Dacca, for up-to-date information on river courses; to the Project Manager, UNSF-FAO Hydrological Project, East Pakistan, for the daily rainfall and river level data used in figure 2; to Mr A.N. Burton, Geologist, Hunting Technical Services Ltd., for estimates of mineral composition of sands; and to my wife for map compilation and endless proof reading.

The report owes much to the Project Manager and Senior Soil Surveyor of the U.N. Special Fund-Government of British Guiana Soil Survey Project (1961-1964), whose reports were largely used as guide, and to the tenacity and untiring efforts of the first Project Commissioner, Soil Survey Project of Pakistan, but for whom this project might never have properly started.

Most of the field work was done by Messrs. M.M. Hassan, M.N. Islam, S. Rahman, S.M. Saheed and A.H.M. Murshid, Assistant Soil Survey Research Officers, who also did part of the map compilation and report writing, under the authority of Dr M.A. Islam, Director of Soil Survey. Laboratory analyses were carried out by Dr Munirul Huq, Soil Survey Research Officer and Messrs. Sarware Jahan Choudhury and Serajul Islam, Assistant Soil Survey Research Officers, under the guidance of Dr P.R. Hesse, F.A.O. Soil Chemist, who also did many special determinations.

The field work was completed, the maps were compiled and the report was written under the guidance and with the assistance and encouragement of Mr H. Brammer, Deputy Project Commissioner, under the authority of Dr P.R. Hesse, Acting Project Commissioner, Soil Survey Project of Pakistan.

GENERAL NATURE OF THE AREA

Location and extent, population and communications

The surveyed area comprises the Sadar and Moulvi Bazar subdivisions of Sylhet district, situated in the northeastern tip of East Pakistan, as indicated on the index map inside the front cover. The area lies between 24° and 25°15' north latitude and between 91°30' and 92°30' east longitude, and covers 2346 square miles. In the north, east and south the Indian border forms the boundary; in the west the Sunamganj and Habiganj subdivisions of Sylhet district.

According to the Population census 1961 (6), about 1,750,000 people live in the two subdivisions of the survey area. About 50 thousand live in Sylhet, Moulvi Bazar and Srimangal towns. More than 97 percent of the population lives in villages and hamlets. The population density is about 750 per square mile, compared with over 900 for East Pakistan as a whole. The increase in ten years from 1951 was 14 percent compared with 21 percent for East Pakistan. Figures are quoted in table 1.

Sylhet is linked with Dacca by a regular air service, at present six flights per week. Also, a metre-gauge railway line connects Dacca and the main port, Chittagong, with Sylhet town. This line with two branch lines, one from Sylhet to the west, the other from Kulaura to the northeast, serves an important part of the two subdivisions, and runs close to or through almost all of the tea area. Asphalt or gravelled all-weather roads connect most of the Police Stations with Sylhet and Moulvi Bazar towns. Many miles of gravelled road were rebuilt and asphalted in 1964-65. The road connection with Dacca was jeepable in the dry season 1964-65, and is expected to be all-weather motorable within a very few years. The many rivers, of which only the main ones are shown on the map, support extensive traffic, mainly by country boats, moving by oars or sail. Local traffic is mainly by small country boats throughout the flooded area - not confined to the rivers - in the rainy season and by boat, cart, bus and other means in the dry season.

Table 1. Population*

	Area sq. miles	Population (thousands)	Persons per sq. mile	% increase 1951 to 1961	Urban population (thousands)	% urban population
Sadar subdivision	1,301	1027	789		38	3.7
Sylhet municipality		38		14		
Moulvi Bazar subdivision	1,045	742	710		11	1.4
Moulvi Bazar municipality		7		9		
Srimangal town		4		34		
Sylhet district	4,785	3490	729	14 [2]	71	2.0
East Pakistan	55,126 [1]	50840	922	21	2641	5.2

1) About 1% of this is rivers
2) Lowest rate of any district in East Pakistan

* Data from Population census 1961 (6).

Climate and hydrology

The area has a pronounced tropical monsoon climate. The mean temperatures of the warmest and coldest month are 83° and 65°F respectively. Mean annual temperature is 76°F. About 95 percent of the annual rainfall occurs in the seven months from April to October. The rainy-season excess of rainfall over evaporation ranges from about 60 inches in the south of the area to more than 120 inches in the north. A narrow strip of land along the northern boundary gets more than 160 inches excess rainfall. As a comparison, rainy-season excess of rainfall over evaporation is about 40 inches in Dacca. The dry-season excess of evaporation over rainfall is about 8 to 10 inches, as it is throughout the country. Relevant data are given in figure 1 and table 2.

The Surma-Kusiyara floodplain not only receives about 1.5 to 3 times as much excess rain as the rest of the country, but also a very heavy run-off from the hills, especially in the north. A few miles to the northwest of the survey area lies the rainiest spot on earth: Cherrapunji, on the south flank of the Shillong plateau, with annual rainfall more than 400". This water enters the survey area through the Surma and Kusiyara rivers and through their many northern tributaries especially. The capacity of the rivers leaving the survey area is insufficient to evacuate this water at all rapidly, due to the very low elevations and the slight slope to the sea. As a result, all basins are inundated to great depths during the rainy season, while most of the relatively high floodplain areas remain submerged less deeply and for less time. Moreover, the deepest basins and the basins along the northern border are subject to very rapid rise of flood-waters after every heavy rain, since run-off from the surrounding land and the nearby hills respectively multiplies the effective volume of water manifold. The resulting drainage and flood control problems may well be greater than anywhere else in East Pakistan.

Data on daily rainfall and river levels of selected stations are given in the appendix. The Master Plan (3) gives extensive data in Supplement A: Climate and Hydrology.

Table 2. Annual rainfall and evaporation at Sylhet, Srimangal and Dacca*

Figures in inches	Sylhet	Srimangal	Dacca
annual rainfall	157.1	99.6	74.2
annual evaporation	43.3	48.4	42.8
rainy-season excess of rainfall	121.9	61.8	40.6
dry-season excess of evaporation	8.1	10.6	9.2

* Data from graphs and tables in Master Plan (3), except Srimangal rainfall average from records 1947-59, 1962 and 63, Meteorological Department, Chittagong (unpublished).

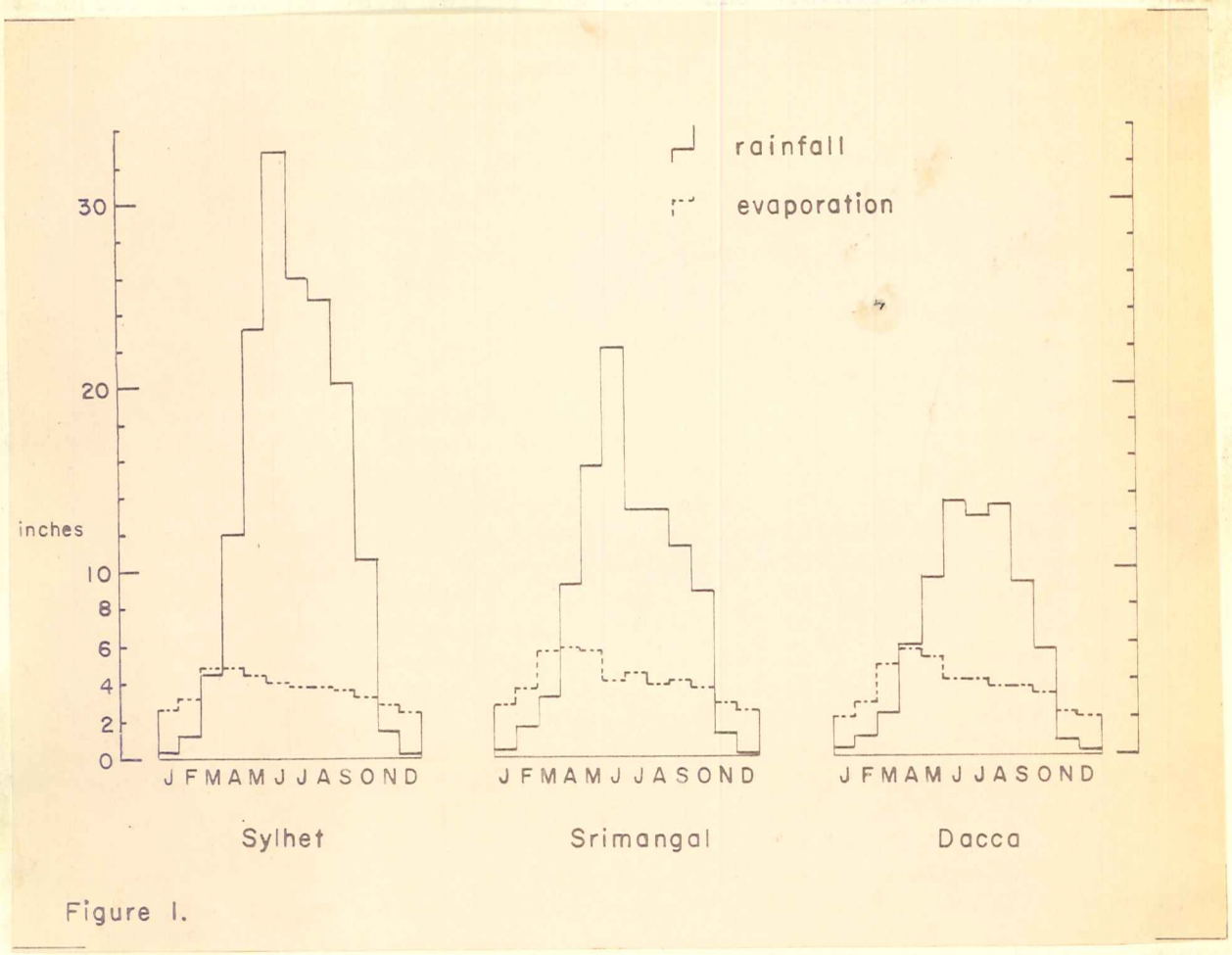

Figure 1.

Figure 1. Monthly rainfall and evaporation at Sylhet, Srimangal and Dacca*.

Geology and landforms

About 60 percent of the survey area is covered by the Surma-Kusiyara floodplain, consisting of relatively high areas a few hundred feet to a few miles wide, with broad basins in between. The relatively high areas are abandoned subrecent river levee systems, levelled to a very gently undulating topography. Only a very small part of the floodplain receives annual deposits of new sediment. The largest area of this recent sediment occurs in the northern part of Hakaluki haor, in the northeastern part of Moulvi Bazar subdivision. Here, the topography is less flat since the levees of spill channels and river courses have not yet been levelled with time. Nearly all of the land is flooded for some months of the year.

About 12 percent of the area is covered by subrecent piedmont plains and valleys, occurring wherever small streams have deposited sediment washed down from the nearby hills. This land is nearly level, but slopes down slightly from the hills and most of it is only flooded for a few days after every heavy rain.

About 3 percent of the area is occupied by older high terrace remnants ('high flats'), 20 to 30 feet above the level of the plain, with narrow valleys cutting through them. These are well drained and never flooded.

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* Data from graphs and tables in Master Plan (3), except Srimangal rainfall average from records 1947-59, 1962 and 63, Meteorological Department, Chittagong (unpublished).

Steep, rather low, strongly dissected hill ranges occupy the remaining 25 percent of the survey area. Most of them consist of sandy, silty and clayey material without hard rock, or with locally a little ironstone. The hills near the northern border and the central part of some of the highest ranges in the south contain sandstone and shale. Most of this is too soft for use, however.

More details on geology are given in the appendix.

Soils

Nearly all floodplain soils are seasonally flooded, have grey colours, little organic matter, and have silty or clayey texture. The topsoil is generally puddled, overlying a subsoil with coarse blocky structure. Stratified alluvium generally occurs below 3 or 4 feet, but may start from below the topsoil. Topsoil reaction ranges from medium acid in many levee soils to very strongly acid in most basin soils. In flooded (reduced) conditions most soils are neutral in the topsoil, however. Subsoil and substratum reaction ranges from medium acid to neutral in nearly all floodplain soils.

Most piedmont soils are intermittently flooded after heavy rains, have grey colours, little organic matter, and are very strongly to medium acid throughout. Some stratification is visible from shallow depth in many of the sandier soils. Part of the clayey soils have strong blocky structure below the topsoil, similar to most floodplain soils.

The piedmont terrace soils, covering a very small area, are well drained, have yellowish brown colours, slightly more organic matter than the floodplain and piedmont soils, and are strongly to very strongly acid throughout. They generally have silty to clayey texture and consist mostly of compressed wormcasts to 2-4 feet depth or more.

The hill soils are generally very steep to steep, well drained, have yellowish brown colours, little organic matter, and a very strongly to strongly acid reaction throughout. They generally rest on unconsolidated sands, siltstones or slightly hardened clays, but locally they are shallow on sandstone or shale.

Details of particular areas are given in the section on Soils below. Technical descriptions of soil series, analytical data and soil classification are placed in the Appendix.

Vegetation and land use

Natural vegetation has remained only on the more inaccessible hills and in small areas in the deep basins in the north. In the rest of the area either crops are grown or vegetation is strongly influenced by man.

About 38 percent of the surveyed area, nearly all of the piedmont plain and valleys and the relatively higher parts of the floodplain, are used for double cropped rice (aus and transplanted aman) with homesteads. Another 20 percent, the lower parts of the floodplain ridges and many basins, are used for single cropped rice (boro or broadcast aman). About 14 percent, nearly the whole hilly area, is under forest or bamboo, most of which is cut and used locally. About 13 percent, the basins in the north and the deepest basins elsewhere, are used as unimproved grazing land in the dry season. Some ridges running through them are used for thatching grass. About 6 percent, nearly all of the piedmont terrace and much of the higher parts of the piedmont plains and valleys, are used for tea, with rice in the lower land dissecting the area. Small parts of the hill land are also used for tea, mainly around piedmont valleys and terraces. About 4 percent of the survey area, where small hills and narrow piedmont valleys are intricately mixed, is used for homesteads and double cropped rice.

Traditional land use in Sylhet takes into account flooding and available water almost exclusively. Wherever water can be kept on the land and depth of seasonal flooding does not exceed about 4 feet, two crops of rice are grown: aus and transplanted aman. Wherever the depth of flooding exceeds 4 and is less than 10-12 feet, and where the water does not rise rapidly after heavy rains, broadcast aman rice is grown. Wherever dry-season water is available for irrigation by traditional methods, boro rice is grown. The deeply and rapidly flooded land remains under grass and is used for dry-season grazing. Hardly any jute is grown, and there are small areas of dry-season dry-land crops, like vegetables or tobacco, only where irrigation water is easily available.

The better drained piedmont land has been taken up by the tea industry, which also grows tea on the nearby hills where easily accessible. The less accessible hills remain under forest and bamboo, since operating costs for tea cultivation would be very high.

More details are given in the chapter on Present land use.

Potential development

Introduction and use of mixed fertilizers appears to be the most effective single measure to increase yields of crops presently grown. After introduction of fertilizers, dry-season irrigation would probably be the most economical measure to increase agricultural production still further. With irrigation, boro rice cultivation could be extended in the low lands, dry-land crops could be grown over vast areas (more than 900 square miles) of good land which are now barren for about four months every year; and total production of tea could be greatly increased on present acreage by overhead irrigation in the late dry season. The highest and most rapid returns might be obtained by concentrating the development efforts on these two improvements first, before committing vast capital expenditure to drainage and flood protection of moderate and poor, deeply flooded, agricultural land.

Potentialities and problems of development are dealt with in more detail in the chapter on Land capability.

SOILS

The information given below is set out in sequence from the youngest to the oldest sediments, and from the floodplain and piedmont to the hills. The relationship of individual soils to the different landscapes and parent materials is shown in table 3. The areas and percentages of the different soil associations shown on the map are listed in table 4.

The first chapter of this section - General nature of the soils - describes in general terms the kinds of soils occurring in the survey area. The second chapter - Soil associations - describes each of the mapping units, shown on the map by a number, in more detail and gives specific information on soils, land use and potential. Complete technical descriptions of each soil series are given in the appendix.

General nature of the soils

Most of the soils of Sadar and Moulvi Bazar subdivisions, Sylhet district, are developed over alluvial sediments, laid down in the last few thousand years, as in most of East Pakistan. Part are developed over mainly unconsolidated, folded Tertiary sediments occurring in hill ranges. In all these deposits, different soils have developed, depending mainly on age, texture and drainage. The source material of all the sediments appears to be rather uniform, and there are no major climatic differences within the survey area.

Twenty-six soil series have been recognized and described. Most of these do not occur in sufficiently large expanses to be mapped separately on the map scale used in this report. Generally it has been necessary to show soil associations, units containing two or more soils occurring together in a distinctive repetitive pattern within a particular part of the landscape. for instance, a pattern in which a lighter and a heavier textured soil occupy the relatively higher and lower parts of a wide floodplain ridge. The soil pattern is not very variable, however. Twenty-five different soil associations have been shown on the map.

In the Surma-Kusiyara floodplain there are a few small areas with recent soils. These are grey, generally stratified, silt loams to silty clay loams, occurring on gently undulating ridges and basins. In most of the floodplain there is no annual deposition of any appreciable amount of fresh sediment, however. Soils are older, somewhat more developed, and rainy-season floodwater is clear. The main soils on the relatively high floodplain areas consist of a grey, massive, puddled silt loam or silty clay loam topsoil, strongly to medium acid, overlying a grey mottled yellowish brown silty clay loam to clay subsoil with coarse blocky structure. The main basin soils are similar but generally clayey throughout, and have a very strongly acid topsoil. Stratified material, medium acid to neutral, occurs below 2 to 5 feet in most of the floodplain. Almost all soils are flooded during the rainy season, and dry out strongly by the middle of the dry season. Most of them appear relatively slowly permeable in the subsoil and substratum. Just below the ploughed layer there is generally a massive and slowly permeable ploughpan, 2 to 4 inches thick. Organic matter contents are generally low. Natural fertility is moderate, but appears to be maintained quite well in spite of continuous cultivation without much manuring. In most of the area topsoils become neutral in reaction after a few weeks flooding, to become acid again in dry season.

Most of the piedmont plain consists of subrecent soils. They are poorly drained, and intermittently flooded, for a few days to less than about a week after heavy rains, in contrast to most floodplain soils, which are seasonally flooded for months at a time. The sandier soils, occurring mainly along the northern border of the survey area and around the hill range near Sylhet town, have a grey, massive, puddled topsoil with a ploughpan that is generally dense and hard when dry, overlying a grey mottled yellowish brown subsoil with massive or weak blocky structure, generally with stratification below less than two feet. Without

irrigation they dry out quickly in the dry season. The more silty and clayey soils, occurring mostly in the southern part of the survey area, have stronger subsoil structure and a ploughpan that is less hard. They dry out generally by the middle of the dry season. The most clayey piedmont soil is very similar in appearance, structure and land use to one of the main soils on the relatively high floodplain areas, the most important difference being its better drainability. The piedmont soils tend to be slightly more acid, but their natural fertility is similar to that of the floodplain soils. Only the sandier piedmont soils sustain the intensive cropping somewhat less well with little or no fertilizing.

The highest parts of the subrecent piedmont plain have somewhat poorly to moderately well drained soils, which are only subject to flash flooding for a few hours to one or two days after heavy rain. They generally have a greyish brown topsoil overlying a greyish brown mottled subsoil with generally weak or moderate blocky structure. Under rice cultivation the topsoil is puddled, with a ploughpan, and may be grey. Under dry-land crops (mainly tea, with gravity drainage, field drains 3 to 4 feet) the topsoil is often granular or blocky, with much evidence of earthworms. These soils are waterlogged for a large part of the rainy season if not artificially drained, and become very dry by the middle of the dry season. The topsoil is very strongly acid and the subsoil and substratum very strongly to medium acid. Natural fertility is considered relatively low to moderate, as is the organic matter content.

The well drained soils of the small area of older, high piedmont terrace have a brown to yellowish brown loamy topsoil with granular or fine blocky structure, overlying a deep subsoil with similar colours and structure. Throughout the soil there is much evidence of earthworm activity. There is no or slight waterlogging in the subsoil during the rainy season, but in the late dry season these soils become very dry. The reaction is very strongly to strongly acid, and organic matter content is generally moderate. Natural fertility is considered moderate. Almost all of these soils are under large-scale tea cultivation, and receive regular applications of fertilizer.

The hill soils are generally steep to very steep, well drained, and dry out by the middle of the dry season, earlier or later depending on the direction of the slope. Most soils have brown to yellowish brown colours, weak to moderate blocky structure, and a strongly to very strongly acid reaction. In many cases, unconsolidated bedded sands, slightly consolidated sandstones and shales or broken pieces of shaly rock were observed below 2 to 5 feet. The hill ranges along the northern border generally consist of a very little soil material over consolidated mixed sandstone and shale, which outcrops in many places. Here, soils are excessively drained, very shallow and droughty.

Table 3. Soils, parent materials and landforms

Land forms / Parent materials	SURMA-KUSIYARA FLOODPLAIN		PIEDMONT				HILLS
	levee complexes	basins	subrecent plains, valleys and fans	subrecent basins	subrecent valleys or low terrace	older dissected high terrace.	
Recent spill deposits	Kusiyara	Kadipur					
Subrecent alluvium (young Holocene)	Balaganj Goyainghat Kanairghat	Phagu Terchibari Tajpur Khasgaon	Bijipur Fritimpasa Itkhola Manu	Selapur	Jaflong Balisira Ratna		
Organic or mineral-organic deposits		Hakaluki		Juri			
Probably Old Holocene sediments						Lakhaichara Srimangal	
Probably Tertiary sediments, folded							Khadimnagar Barlekha Kulaura Beanibazar Tamabil

Table 4. Soil associations: area and percentage

Mapping units	Area, square miles: Sadar	Moulvi Bazar	Total	Percent
SURMA-KUSIYARA FLOODPLAIN			1429.1	60.7
Recent spill deposits			54.8	2.3
1 Kusiyara complex	13.7	21.8	35.5	1.5
2 Kadipur complex	9.8	9.5	19.3	0.8
Subrecent alluvium			1374.3	58.4
3 Goyainghat-Balaganj association	23.7	0.7	24.4	1.0
4 Goyainghat-Kanairghat association	395.0	170.3	565.3	24.1
5 Goyainghat-Kanairghat association, deeply flooded phase	124.4	1.0	125.4	5.3
6 Kanairghat-Phagu association	18.3	30.9	49.2	2.1
7 Phagu association	192.6	102.6	295.2	12.6
8 Phagu association, rapidly flooded phase	208.6	36.6	245.2	10.4
9 Hakaluki association	-	17.5	17.5	0.7
10 Phagu-Barlekha complex	2.4	1.8	4.2	0.2
11 Khasgaon complex	47.9	-	47.9	2.0
PIEDMONT			345.4	14.7
Subrecent piedmont plain			282.6	12.0
12 Bijipur association	57.0	-	57.0	2.4
13 Pritimpasa association	32.2	88.1	120.3	5.1
14 Manu association	-	89.4	89.4	3.8
15 Jaflong association	8.4	7.5	15.9	0.7
Older piedmont terrace			62.8	2.7
16 Srimangal association	1.0	54.5	55.5	2.4
17 Srimangal association, strongly dissected phase	-	7.3	7.3	0.3
HILLS			571.5	24.6
18 Khadimnagar association	26.9	-	26.9	1.2
19 Khadimnagar-Barlekha association	6.3	35.4	41.7	1.8
20 Barlekha association	-	235.8	235.8	10.1
21 Barlekha complex	-	66.1	66.1	2.8
22 Mangla Bazar complex	42.0	8.3	50.3	2.2
23 Beani Bazar complex	13.8	30.6	44.4	1.9
24 Juri complex	-	13.2	13.2	0.6
25 Tamabil association	20.4	-	20.4	0.9
Urban land	3.7	0.3	4.0	0.2
w Water	24.5	15.8	40.3	1.7
No photo coverage	28.4	-	28.4	1.2
Total	1301.0	1045.0	2346.0	100.0

Soil Associations

Under this heading, the mapping units of the soil map are described: the kinds of soils occurring in the association, their relationship and relative extent, the main land use and the potential of the area for development. The sequence of mapping units is the same as in table 4.

Surma-Kusiyara floodplain, recent spill deposits

1. Kusiyara complex. 30 square miles, 1.5 percent.

This association occurs on the northern and eastern edge of Hakaluki haor, an extensive floodplain basin in the northeast of Moulvi Bazar subdivision, and on the southern edge of Hail haor, a floodplain basin west of Srimangal. The soils are developed in recent alluvium. Every rainy season, there is fresh sedimentation. The areas are dominated by the grey, stratified, fine sandy loams to silty clay loams of Kusiyara series occupying the gently undulating levees of present and former spill channels. Locally, the silt loams of Balaganj series occur in narrow strips on the levees of larger rivers. Small areas are occupied by the recent massive greyish clay loams to clays of Kadipur series and the subrecent more compact and blocky, Phagu series in associated basins. The subrecent blocky silty clay loams of Goyainghat series occupy small parts of levees of larger rivers not buried by recent sediment. Most of the area is flooded to shallow or moderate depth during the rainy season, remains moist for 2-3 months and dries out by the middle of the dry season.

Most of the land is used for double cropped rice (aus and transplanted aman), but locally a major proportion is occupied by homesteads, unimproved grazing land or single cropped rice (broadcast aman or boro). Overall, they occupy a minor area, however. Locally small patches and strips near permanent water are triple cropped: two rice crops (aus and transplanted aman) and a dry-season dry-land crop (tobacco, vegetables, potatoes, oil seeds etc) with traditional methods of bucket or scoop irrigation. Land use association 1.

Possibilities of development are limited by the undulating topography and the annual deposition of locally thick layers of new sediment which make provision of large-scale irrigation difficult. The soils have generally ~~kky~~ good physical properties, however, and they remain moist longer in the dry season than other floodplain soils. Land capability association 6: IIIWr.

With modern management, including use of complete fertilizers, and small-scale pump irrigation in the dry season, much of the land could produce high yields of two rice crops and one dry-land crop per year. With large-scale flood control and drainage the source of sediment would be cut off. This would stop the gradual improvement of the adjoining deep basin soils by new sediment which is now taking place naturally.

2. Kadipur complex. 19 square miles, 0.8 percent.

This association occurs in the northern part of Hakaluki haor, an extensive floodplain basin in the northeast of Moulvi Bazar subdivision. The soils are developed in recent and subrecent alluvium. Every rainy season, some sediment is brought in, further infilling this basin area. The greyish brown to greenish grey massive clay loams to clays of Kadipur series have covered the major part of the basin areas. Locally, major parts of the grey, more compact, blocky clays of Phagu series and small ridges of the similar Kanairghat series remain uncovered by recent sediment. Recent loamy spill deposits of Kusiyara series encroach upon the area from the north. There are many small patches of permanent water. Most of the land is deeply and rapidly flooded in the rainy season, remains moist for 2-3 months and dries out late in the dry season.

Most of the association is used as unimproved grazing land, with many areas of single cropped rice (boro) cultivated with traditional bucket or scoop irrigation from nearby permanent water. Locally, much mustard and linseed are grown on both Kadipur and Kusiyara soils without irrigation. Land use association 3.

The main limitation to agricultural development is the deep and rapid flooding of much of the land. The changing topography due to the annual deposition of new sediment would make it difficult to plan large-scale irrigation structures. The physical properties of the recent soils are good, and they remain moist longer in the dry season than other flood-plain soils. Land capability association 8: IVWd.

With modern management, including use of complete fertilizers and pump irrigation in the dry season, very high yields of boro rice could be expected, or a variety of good dry-season dry-land crops could be grown. To use the land in the rainy season, flood protection and large-scale pump drainage would be required. With the rapid rise of flood water to great depth, and the enormous excess of rainfall, it is doubtful whether this would be economic. Also, this would cut off the annual deposition of new sediments which now improves the land by raising its level and providing better soil structure.

Surma-Kusiyara floodplain, subrecent alluvium

3. Goyainghat-Balaganj association. 24 square miles, 1.0 percent.

This association occurs generally in narrow strips on subrecent levees, mainly along the Kusiyara river. The soils are developed in sub-recent and some recent sediments. Balaganj series generally occurs on the highest ridges, and Goyainghat series on the slightly lower areas, on very gently undulating topography, both occupying a major overall proportion. Either may be dominant in small areas. Minor areas of Kanairghat series generally occupy the lowest parts, and small patches of Kusiyara series are scattered near spill channels. Most of the land is flooded up to 1-3 feet for 2-5 months during the rainy season, and dries out early in the dry season.

Goyainghat series consists of a grey puddled silt loam topsoil over a grey mottled silty clay loam subsoil with blocky structure; Balaganj series generally has a silt loam texture throughout, less strong structure, and may be stratified below 2 or 3 feet; Kanairghat series consists of a grey puddled silty clay loam topsoil over a grey mottled silty clay or clay subsoil with strong blocky structure; and Kusiyara series has silt loam to silty clay loam textures throughout, is stratified from shallow depth and has weak subsoil structure.

Most of the land is used for double cropped rice (aus and transplanted aman), and a major but varying proportion, about a fifth on the average, is occupied by homesteads. Wherever permanent water occurs in creeks or ponds, less than about 3 or 4 feet below the land, small areas, especially of Balaganj series, are triple cropped: two rice crops and a dry-season dry-land crop with traditional bucket or scoop irrigation. Land use association 1.

The main limitation of this area for agricultural development is soil droughtiness in the dry season. Land capability association 3: IIW.

With modern management, including use of complete fertilizers for every crop and dry-season pump irrigation, high yields could be obtained of two rice crops (aus, sown early with irrigation, and transplanted aman) and a dry-season dry-land crop. Alternatively, with flood protection and pump drainage, the land could be used for sugarcane or a rotation of dry-land crops throughout the year. For this, it would be essential to plough deeply in order to destroy the ploughpan, which has developed in all the soils as a result of repeated ploughing under wet conditions.

Goyainghat-Kanairghat association. 691 square miles, 29.4 percent.

4. Normal phase. 566 square miles, 24.1 percent.
5. Deeply flooded phase. 125 square miles, 5.3 percent.

This association occupies most of the extensive, very gently undulating, relatively high floodplain areas throughout Sadar and Moulvi Bazar subdivisions. The soils are developed in subrecent alluvium of the Surma and Kusiyara rivers and their tributaries, in levee systems of present and former river courses which have been levelled to their present low relief since their deposition. Most of the area is covered by Goyainghat and Kanairghat series, in roughly equal overall proportions, either of them being dominant in areas up to 1 or 2 miles across. Goyainghat series tends to occur at higher elevations than Kanairghat series. Minor areas, generally on the crests of ridges, are covered by Balaganj series. Phagu series occupies some minor local depressions. Kusiyara and Kadipur series occur on ridges and in basins respectively of small recent spill deposits, mainly close to the Kusiyara river. The normal phase of this association is flooded up to 1-5 feet for 2 to 5 months, the deeply flooded phase up to 4-12 feet for 4-7 months. The soils remain moist for a rather short period and are dry for most of the dry season.

Goyainghat series consists of a grey puddled silt loam topsoil over a grey mottled silty clay loam subsoil with blocky structure, Kanairghat series is similar but has a silty clay loam topsoil over silty clay or clay; Balaganj series generally has a silt loam texture throughout, less strong structure and a stratified substratum below 2 to 3 feet. Phagu series has a grey clay topsoil over a grey mottled clay subsoil with strong blocky or prismatic structure; Kusiyara series has silt loam to silty clay loam textures throughout, weak structure, and evidence of stratification generally from below the topsoil, and Kadipur series is a friable silty clay loam to silty clay with weak structure and some evidence of stratification.

Most of the normal phase is used for double cropped rice (aus and transplanted aman), and a major part, between 15 and 25 percent generally, is covered by homesteads. Locally some single cropped rice (broadcast aman) is grown in depressions, and in a few places double and single cropped rice occur in roughly equal proportions. Very small areas are triple cropped where permanent water occurs at a high enough level to permit irrigation of a dry-season dry-land crop by traditional scoop or bucket method. Land use association 1.

The deeply flooded phase is mostly used for a single rice crop (broadcast aman). Small slightly higher areas are under homesteads, triple cropping or double cropped rice, and small depressions under dry-season rice (boro), generally with traditional irrigation from ponded water, or unimproved grassland. Also, one small level area is mostly under grassland. Land use association 2.

The main limitation of this association is dry-season droughtiness. In addition, the deeply flooded phase is limited to only one rainy-season rice crop under present circumstances. Land capability association 3: IIW for the normal phase, and 5: IIIWd for the deeply flooded phase.

With modern management, including use of complete fertilizer and dry-season pump irrigation, either by large-scale schemes or by portable pumps and from tubewells or open water, the normal phase could produce high yields of two rice crops (early aus with some irrigation, and transplanted aman) and a dry-season dry-land crop, and the deeply flooded phase moderate to high yields of one rice crop (broadcast aman) and a dry-season dry-land crop per year. With flood protection and pump drainage in addition, the normal phase could produce sugarcane or a rotation of dry-land crops, and the deeply flooded phase two rice crops and a dry-land crop, or two dry-land crops with one rice crop. In view of the very heavy rainfall, 1-1/2 to 3 times as much excess rainfall as in Dacca, the economics of this

would have to be calculated carefully, especially for the deeply flooded phase. For the immediate future the benefits of pump drainage are expected to be marginal for the deeply flooded phase.

6. Kanairghat-Phagu association. 49 square miles, 2.1 percent.

This association occurs in some of the shallower basins in the southwestern part of Sadar subdivision. Kanairghat series occupies the ridges in the basin, which are levee remnants of abandoned river channels, and Phagu series occupies the intervening basin areas, in about equal overall proportions. In one small area Goyainghat series takes the place of Kanairghat. Most of the land is flooded up to 5-12 feet for 4-7 months in the rainy season, and dries out relatively early in the dry season.

Kanairghat series consists of a grey silty clay loam surface over a grey mottled silty clay or clay subsoil, Phagu series has a clay texture throughout and is slightly more acid; Goyainghat series consists of a grey silt loam surface over a grey mottled silty clay loam subsoil.

Most of the land is used for single cropped rice - broadcast aman or boro depending on availability of irrigation water in the dry season. In one of the basins, double cropped rice (aus and transplanted aman) is grown extensively on the higher ridges. A minor percentage of the land is under homesteads. Land use association 2.

The main limitations for agricultural development are the dry-season droughtiness and the deep seasonal flooding. Land capability association 5: IIIWd.

With modern management, including use of complete fertilizers and local or large-scale dry-season pump irrigation, high yields could be obtained from crops grown at present and a dry-season dry-land crop could be grown in addition. If flood protection and pump drainage are provided for the surrounding higher land in order to diversify the agriculture, it might be economical to extend the scheme to these shallow basins so that three crops could be grown with limited depth of flooding.

Phagu association. 540 square miles, 23.0 percent.

7. Normal phase. 295 square miles, 12.6 percent.
8. Rapidly flooded phase. 245 square miles, 10.4 percent.

This association occupies most of the extensive basin areas in the subrecent Surma-Kusiyara floodplain throughout Sadar and in the northern part of Moulvi Bazar subdivision. The association is dominated by Phagu series. In one area a major proportion of Kanairghat series was observed occurring on floodplain ridges, in another area a major proportion of Tercharibari series in many small closed depressions. Scattered throughout the association are small percentages of many soils: Kanairghat and Goyainghat series on ridges in the basin; Kusiyara and Kadipur series in small spill areas; Tercharibari series in closed depressions. Locally there are small patches of mixed mineral-organic soils of Hakaluki series; of the dense, hard, cracking clays of Tajpur series; and small scattered hills of Barlekha and Beani Bazar series. Most of the normal phase is flooded up to 4-12 feet, most of the rapidly flooded phase up to 6-15 feet for 5 to 8 months per year. Most of the land is moist for 1-2 months only after the floods recede and dries out by the middle of the dry season.

Phagu series consists of grey firm clay with strong blocky structure throughout, with much mottling in the subsoil. Kanairghat series consists of a grey puddled silty clay loam topsoil over a grey mottled silty clay to clay subsoil with strong blocky structure; Goyainghat series consists of a grey puddled silt loam topsoil over a grey mottled silty clay loam subsoil with blocky structure; Kusiyara series consists of friable silt loam to silty clay loam, stratified below a shallow depth; Kadipur series is a friable silty clay loam to silty clay, massive, with little evidence

of stratification; and Tercharibari series is a greenish grey or grey plastic and sticky clay which remains wet for most or all of the year.

Most of the normal phase of this association is used for single cropped rice - broadcast aman or boro depending on availability of dry-season irrigation water. Locally a major proportion, up to a third of the land, is under unimproved grazing land, but generally this occupies small areas only, as does double cropped rice. Locally there are few scattered homesteads, on high ridges or on earthen platforms. Land use association 2.

The rapidly flooded phase is dominantly used for dry-season grazing. Small areas are under single cropped rice - broadcast aman and boro, the latter locally occupying a major proportion where traditional methods can provide irrigation water. In a few places short-season dry-land crops, mostly mustard, are broadcast on the wet soil following the retreating water, which ripen before the soil dries out completely. Land use association 3.

The main limitations for agricultural development of the normal phase are the seasonal deep flooding and the great volume of rain water which would have to be pumped out and the droughtiness in the later part of the dry season. Development of the rapidly flooded phase is limited in addition by the disastrously rapid rise and locally great speed of floodwater after heavy rains in the hills to the north, on the Shillong plateau, either of which is enough to destroy broadcast aman rice. Land capability association 5: IIIWd for the normal phase, and 8: IVWd for the rapidly flooded phase.

With modern management including use of balanced fertilizers and large-scale or local pump irrigation, on the normal phase a very good boro rice crop could be grown, or moderate to high yields could be expected of broadcast aman rice and of a short-season dry-land crop adapted to the fine-textured soils. Because of the combination of deep flooding and the very large seasonal excess of rainfall, flood protection and pump drainage would be extremely expensive, more so than in any other part of the province.

Both dry-season irrigation and protection against early floods would be required on the rapidly flooded phase to make a large-scale expansion of boro rice cultivation feasible. It is doubtful whether this would be economic. Rainy-season flood protection and pump drainage would raise even bigger proolems than on the normal phase.

9. Hakaluki association. 18 square miles, 0.7 percent.

This association occupies two large nearly level basin depressions in the Kusiyara floodplain, in the northern part of Moulvi Bazar subdivision. The soils are developed in mixed organic and mineral subrecent floodplain deposits. Hakaluki and Phagu series both occupy major proportions of the association, and together cover almost all of it. Small areas of Kadipur series are found in the eastern edge of the basin depression near the Juri river; and the narrow and gently undulating levees of some old distributary channels are occupied by Kanairghat series. Most of the land is seasonally flooded to more than 10-14 feet for 7-9 months, and floodwaters rise rapidly. The topsoil dries out generally within about 2 months after the water recedes, but the peaty subsoil of Hakaluki series remains wet nearly all year.

Hakaluki series consists of a grey friable clay topsoil over a black or dark grey peaty subsoil which is soft and sticky. Phagu series is a grey mottled clay with strong blocky structure in topsoil and subsoil. Kadipur series is a grey friable silty clay loam to silty clay with little structure, and Kanairghat series consists of a grey silty clay loam topsoil, often massive, over a grey mottled silty clay to clay subsoil with blocky structure.

Almost all of this association is used as unimproved grazing land, and small areas near channels or ponds with permanent water are used for boro rice cultivation with traditional methods of irrigation. In the last few years, the area under boro has been expanded with the aid of portable diesel irrigation pumps. Land use association 3.

The main limitations for agricultural development are the deep and rapid seasonal flooding, the droughtiness of the topsoils in the late dry season, and the relatively low bearing capacity when wet of the Hakaluki series. Land capability association 8: IVWd.

With modern management, including use of complete fertilizers and large-scale or local dry-season irrigation, most of the land could produce high yields of boro rice. For this to be economical, some limited protection against early floods would be necessary. Complete water control, including flood protection and pump drainage, would entail vast expenditure which may not be economic.

10. Phagu-Barlekha complex. 4 square miles, 0.2 percent.

This association occurs in a few small patches, east of Sylhet town and near Moulvi Bazar town. It consists of floodplain basins with scattered hills. The soils are developed in subrecent floodplain alluvium and in Tertiary unconsolidated sediments and their outwash material. Phagu series occupies the basin sites which cover half to three-quarters of the area. Low hills with Barlekha series and very narrow outwash strips with Pritimpasa series and a very poorly drained variant of it occupy the remainder.

Phagu series consists of a grey clay with strong blocky structure which is mottled in the subsoil. Barlekha series is a brown or yellowish brown fine sandy clay loam to silty clay loam occurring on sloping to very steep topography, and Pritimpasa series is a grey fine sandy clay loam to silty clay loam with weak structure.

The low land is used for grazing and boro rice cultivation; the hills are used for homesteads. Land use association 5.

The main limitations for agricultural development are the deep flooding of much of the low land, the dry-season droughtiness of both the low land and the hills, and the strong dissection and scattered occurrence of the hills. Land capability association 13: IIIWd-IVDe.

With modern management, including use of complete fertilizers and local pump irrigation, good yields of boro rice could be obtained on the low land. The hills would remain under homesteads. For large-scale drainage and irrigation, the small areas of this complex would have to be included with the adjacent basins (Sadar) or the higher floodplain area (Moulvi Bazar).

11. Khasgaon complex. 48 square miles, 2.0 percent.

This association occurs near the northern border of Sadar subdivision in a series of floodplain basins at the edge of the northern piedmont areas. The basins are nearly level, the levees running through them gently undulating. The soils are developed in mostly subrecent floodplain deposits with some piedmont material. Khasgaon series occupies a major proportion throughout the association. Phagu series occupies locally a major part of the basin, especially near the southern border, but is a minor component (less than about 15 percent) overall. Pritimpasa series occupies relatively high piedmont margins in the north and much of a system of narrow, high levees criss-crossing the area, with Bijipur series occurring in minor percentages. This levee network along channels and rivers is the lower end of the extensive piedmont plains and fans to the north. The soils are intermittently flooded to shallow depth for periods of generally less than two weeks after heavy rain in the hills

to the north. Small patches of spill deposits, Kusiyara and Kadipur series , have been observed locally. Most of the area is flooded deeply for 5-8 months, with frequent rapid changes in water level depending on the amount of rain in the hills. Khasgaon, Kusiyara and Kadipur soils remain moist for about 2-3 months after the floods recede and dry out relatively late in the dry season, but the others dry out rapidly.

Most of the area is covered by unimproved grazing land, with much bush and some reed on the ridges. Locally some of the ridges are used for double cropped rice (aus and transplanted aman) with or without a dry-land crop irrigated by traditional methods, or for single cropped rice (broadcast aman) where inundation depths are greater. Small patches in the basins, near the edge of permanent ponds, are used for boro rice, and some mustard is grown without irrigation by broadcasting the seed following the retreat of the water. There are hardly any permanent homesteads in this association. People live on the small hill ranges and on the piedmont plains to the north, and on the floodplain ridges to the south. Land use association 3.

The main limitation for agricultural development is the deep and rapid flooding of much of the land, both by the extremely heavy local rainfall (exceeding 200 inches annually) and the run-off from the Shillong plateau to the north, outside the survey area, where rainfall is even heavier. Land capability association 8: IVWd.

ith modern management, including use of fertilizers and some small-scale pump irrigation, both boro rice and short-season dry-land crops could be extended. Limited protection against early floods might be necessary. It may be economic to cultivate fibre crops (tall grass or reed) for paper production. It would probably not be practical to attempt large-scale flood protection and pump drainage, since these basins serve as a kind of regulator, limiting the peak flows and peak levels of the rivers flowing out, to the benefit of the better land downstream.

Piedmont

Subrecent piedmont plains, valleys and fans

12. Bijipur association. 57 square miles, 2.4 percent.

This association occurs on the piedmont plain surrounding the hills near Sylhet town and on the piedmont fans in the northwest of Sadar subdivision against the northern border. Bijipur series is found throughout the areas and occupies a major proportion. Around the hill range near Sylhet it is dominant. Locally Pritimpasa series occupies a major percentage, but its overall proportion is minor. At the boundary between piedmont and floodplain, some small areas with a major proportion of Goyainghat series have been included. Two of the piedmont fans against the northern border consist almost completely of Bijipur series, partly the normal phase and partly a shallow to very shallow phase over sand. Locally, small hills occur with the steep, well drained yellowish brown or brown Khadimnagar sandy loam.

Bijipur series consists of grey mottled friable sandy loam to loam with weak blocky structure, and with some stratification below the subsoil. Pritimpasa series has a similar profile with fine sandy clay loam to silty clay loam texture. Goyainghat series consists of a grey silt loam surface over a grey mottled silty clay loam subsoil with strong blocky structure.

Most of the land is used for double cropped rice (aus and transplanted aman), with homesteads occupying about a fifth to a sixth of the area. Locally, small patches of forest on the outlying hills, and single cropped rice are included: broadcast aman in spots of deeply flooded piedmont margin, and boro wherever seepage or local surface water makes its cultivation possible. Land use association 1.

The main limitation for year-round agricultural production is the droughtiness in the dry season. The main limitation for diversification is the poor drainage and intermittent flooding after heavy rains. Land capability association 2: IIDw.

With modern management, including adequate applications of complete fertilizers and dry-season pump irrigation, high yields could be obtained of two rice crops and a short-season dry-land crop per year. Irrigation might be most economic using tubewells and portable or somewhat bigger stationary pumps. With properly laid out gravity drainage to adequate depth, including diversion drains at the foot of the hills, good annual or perennial dry-land crops could replace rice if varieties are adapted to the heavy rainfall (over 150 inches in Sylhet, over 200 inches near the northern border) and the very humid atmosphere. It might be worthwhile to test whether with proper water control tea could not be expanded on to this association.

13. Pritimpasa association. 120 square miles, 5.1 percent.

This association occurs on piedmont plains and wide piedmont valleys near the northeastern border of Sadar subdivision and throughout Moulvi Bazar subdivision. Pritimpasa series occupies a major proportion of the association. None of its associates occupies more than a minor overall percentage, but locally Bijipur, Itkhola or Jaflong series and in one area also Manu series, occupy a major proportion. In a narrow strip along the adjoining hills, there may be a major percentage of outlying hillocks with the rocky Tamabil series, the well drained Khadimnagar sandy loam and the well drained Barlekha fine sandy clay loam to clay loam.

Pritimpasa series consists of a grey friable fine sandy clay loam topsoil over a grey mottled subsoil of the same texture, with weak blocky structure. Bijipur and Itkhola series are similar soils with sandy loam and silty clay to clay textures respectively; Jaflong series is a better drained sandy loam to silt loam with a brownish, mottled subsoil with weak structure. Manu series consists of a grey firm silty clay loam to silty clay topsoil over a grey mottled clay subsoil with strong blocky structure.

Most of this association is used for double cropped rice (aus and transplanted aman). Minor patches in the plain are under homesteads, some narrow strips along creeks are triple cropped with dry-season irrigation by hand, and many of the hillocks are under forest or homesteads. Land use association 1.

The main limitation for year-round agricultural production is the dry-season droughtiness, and for diversification of agriculture the poor drainage and intermittent flooding after heavy rain. Land capability association 2: IIDw.

With modern management, including use of balanced fertilizers and dry-season irrigation either by portable Diesel pumps or large-scale fixed installations, this land could produce high to very high yields of two rice crops and a short-season dry-land crop per year. With adequate provisions for gravity drainage, including diversion drains along the foot of the hills, a wide range of dry-land crops could be grown throughout the year. It might be worthwhile to experiment with extension of tea cultivation on this land with adequate and sufficiently deep gravity drainage.

14. Manu association. 89 square miles, 3.8 percent.

This association occurs on subrecent piedmont plains and in wide subrecent piedmont valleys in the southern and eastern part of Moulvi Bazar subdivision. Manu series dominates the association, with minor overall percentages of Itkhola and Pritimpasa series, which may occupy up to about a third of the association in small areas. Locally, often

near small creeks, there are very narrow strips of the sandy Bijipur series, and small areas of Kanairghat series occur near the boundary with Goyainghat-Kanairghat association.

Manu series consists of a grey silty clay or silty clay loam surface over a grey mottled clay subsoil with strong blocky structure, similar to Kanairghat series and grading into it, but occurring in piedmont position and not seasonally flooded. Itkhola series has similar textures but weaker structure; Pritimpasa series is a fine sandy clay loam to silty clay loam with weak structure.

Most of the land is used for double cropped rice (aus and transplanted aman), with about a fifth to a quarter of the land under homesteads. Locally, the area under homesteads is minor, and a few small areas are used for broadcast aman rice. Land use association 1.

The main limitations for agricultural development are droughtiness in the second half of the dry season and the poor drainage and intermittent flooding combined with the relatively slow permeability in the rainy season. Land capability association 2: IIDw.

With modern management, including use of complete fertilizers and dry-season irrigation, either large scale or by portable pumps from tube-wells, this association could produce high yields of two rice crops and one short-season dry-land crop per year. With protection against flash floods after heavy rain and adequate gravity drainage in addition, dry-land crops like sugarcane could be grown throughout the year.

15. Jaflong association. 16 square miles, 0.7 percent.

This association occurs on the higher part of a subrecent piedmont fan near the northern border of Sadar subdivision, in two small patches northeast of Sylhet and on the high edge of a piedmont plain in the southwest of Moulvi Bazar subdivision. The latter occurrence is possibly a remnant of a slightly older, low (about 3 feet) piedmont terrace. Jaflong series is dominant on the fan in the north, a shallow to very shallow phase over sand covering about 20 to 30 percent. The normal phase of this series and Balisira series each cover a major part of the area in the southwest. Small low patches of Bijipur series and in the southwest scattered hillocks of Barlekha series each occupy a minor proportion.

Jaflong series consists of a friable loamy topsoil, grey to brown in colour, over a brown mottled loamy subsoil with weak structure. Balisira series consists of a brownish loamy topsoil over a brownish fine sandy clay loam to silty clay loam subsoil with moderate structure. Bijipur series is a poorly drained, friable, grey mottled sandy loam to loam; Barlekha series is a sloping to steep, well drained, brownish fine sandy clay loam to silty clay loam.

Most of the land is used for tea cultivation with provision of gravity drainage to a depth of 3-4 feet. Most of the shallow phase over sand is covered with scrub. On the northern fan, about a third of the land is used for double cropped rice (aus and transplanted aman) and small patches are under homesteads. In the southwestern area, double cropped rice, forest and homesteads each occupy a minor percentage. Land use association 8.

The main limitations for agricultural development are the imperfect drainage and occasional intermittent flooding after heavy rains, and the droughtiness in the second half of the dry season. Land capability association 2: IIDw.

With modern management, including gravity drainage and fertilizers as presently used, and sprinkler irrigation in the early and late dry season in addition, very high yields of tea could be obtained on most of the land. The areas would be well suited for mechanization (overhead irrigation and possibly picking in future). The shallow phase over sand

would need sprinkler irrigation at frequent intervals in every dry period, and would be expensive to keep in production.

Srimangal association. 63 square miles, 2.7 percent.

16. Normal phase. 56 square miles, 2.4 percent.
17. Strongly dissected phase. 7 square miles, 0.3 percent.

This association occupies high (30 feet) older piedmont terrace remnants in the central and southern part of Moulvi Bazar subdivision, and a very small area near the northeastern border of Sadar subdivision. Srimangal series occupies nearly all of the terrace remnants proper, with locally major percentages of Lakhaichara series. Scattered hillocks of Barlekha and Khadimnagar series occupy a small percentage. The generally narrow valleys filled in with recent piedmont alluvium, which criss-cross the terrace area, occupy a minor overall proportion, but locally, especially in the strongly dissected phase, cover up to about a third of the association. They have Itkhola and Pritimpasa series as major soils, with locally also Balisira series occupying an important part.

Srimangal series consists of a brown friable fine sandy loam to sandy clay loam topsoil with granular structure, over a brown faintly mottled finer textured subsoil with moderate blocky and granular structure. Lakhaichara series is similar but has a sandy loam texture; Barlekha and Khadimnagar series are sloping to very steep brownish soils, generally less deep than Srimangal series, and of sandy clay loam to clay loam and sandy loam textures respectively. Itkhola and Pritimpasa series are poorly drained, grey mottled clays and fine sandy clay loams to silty clay loams respectively; and Balisira series is an imperfectly drained brownish mottled fine sandy clay loam to silty clay loam.

Almost all of the normal phase is used for tea, with small patches of hill soils under forest, with homesteads, tea labourers' villages and some factory compounds occupying a small proportion of the terrace remnants proper, and with double and single cropped rice (aus transplanted aman and boro) grown in the valley bottoms with poorly drained soils. The main land use on the strongly dissected phase is grassland (much of it tall thatching grass) on the terrace remnants, and double cropped rice (aus and transplanted aman) in the poorly drained valleys. Locally, much of the terrace land is used for homesteads, and a small percentage for tea. Land use association 8 for the normal phase, 4 for the strongly dissected phase.

The main limitation for obtaining maximum returns from the normal phase is the droughtiness in the later part of the dry season. Agricultural development of the strongly dissected phase is limited by the irregular relief and short, steep slopes in addition. Land capability association 1: IIDd for the normal phase 4: IIIDr for the strongly dissected phase.

With modern management, including use of fertilizer and widely spaced open drains as at present, and dry-season overhead irrigation in addition, very high tea production could be achieved on the normal phase. The steep terrace edges occurring at frequent intervals make it less suitable for mechanization than some of the more level land (Jaflong association, or Pritimpasa or Bijipur associations). The strongly dissected phase could be used for small-scale cultivation of perennial dry-land crops on the high land, and for cultivation of two rice crops and a dry-land crop on the low land with irrigation by portable Diesel-powered pumps and tubewells. The irregular and strong dissection and the narrow valleys preclude large-scale improvements.

18. Khadimnagar association. 27 square miles, 1.2 percent.

This association occupies the low, strongly and steeply dissected hill range extending from Sylhet town to the east-northeast. The soils are developed in mostly unconsolidated, generally sandy and steeply dipping Tertiary rocks (Dupitila geological series). The area is dominated by Khadimnagar series. Minor areas throughout the hills, wherever finer textured strata outcrop, are covered by Barlekha series. The upper colluvial reaches of the narrow piedmont valleys, which occupy a very small percentage of the area, are covered by Lakhaichara series, grading into Jaflong series in the upper part of the alluvial valleys. The lower valleys are occupied mainly by Bijipur series. None of these soils occupies more than a minor percentage.

Khadimnagar series is a steep, well drained, friable, brownish sandy loam. Barlekha series is a similar soil with fine sandy clay loam to clay loam subsoil textures. Lakhaichara series is a well drained, level to steep, friable brown soil occurring in valleys or piedmont terrace remnants. Jaflong series is an imperfectly drained brownish mottled sandy loam; Bijipur series is a poorly drained grey mottled sandy loam to loam. All the soils dry out by the middle of the dry season.

Most of the area is under forest, part planted and part depleted natural forest and bamboo. Minor areas are under tea, mainly around the larger valleys with Lakhaichara and Jaflong soils, almost all of which are used for tea cultivation. The small areas of Bijipur soils are used for double cropped rice. A small percentage of the area is occupied by homesteads and villages, mainly along the edges. Land use association 9.

The main limitations for agricultural development are the dry-season droughtiness and the very steep slopes, making access difficult and clear cultivation very hazardous. Land capability association 7: IVDe.

With modern management, including soil conservation measures and use of fertilizer as on present tea areas and with dry-season overhead irrigation from tubewells in addition, high yields of tea could be obtained on slopes of favourable aspect. This would entail high costs for development and maintenance. Other possible perennial crops, too, would require expensive dry-season irrigation for optimum yields. The area is well suited for intensive forest management, and possibly also for rubber.

19. Khadimnagar-Barlekha association. 42 square miles, 1.8 percent.

This association occurs on strongly and steeply dissected topography, in the northern part of the low hill ranges south of Fenchuganj and along the western border, and in a few outlying parts of the range in the northeast of Moulvi Bazar subdivision. The soils are developed in mostly unconsolidated, sandy to silty, generally steeply dipping, Tertiary rocks (Dupitila geological series). Both Khadimnagar and Barlekha series occupy major proportions of the area, either of them being dominant locally. In a few places, for example in parts of the area south of Fenchuganj, Beani Bazar and Kulaura series occupy a major percentage, but their overall extent is minor. Small areas are occupied by Bijipur, Pritimpasa and Itkhola series. Almost all the soils dry out by the middle of the dry season.

Khadimnagar series is a steep, well drained, friable brownish sandy loam. Barlekha series is a similar soil with fine sandy clay loam to clay loam subsoil textures. Beani Bazar series is a sloping to steep, moderately well drained silty clay loam with brownish topsoil and brownish mottled subsoil. Kulaura series is a well drained, steep, brownish soil with sandy loam to silty clay topsoil and clay to silty clay subsoil. Bijipur, Pritimpasa and Itkhola series are poorly drained, intermittently flooded, grey mottled soils of fine sandy loam, clay loam and clay textures respectively.

Most of the land is under forest, with locally relatively large areas of tea, mainly near piedmont terrace or high piedmont valleys, locally near the piedmont and floodplain, there are some areas with grass - mainly tall thatching grass. Tea and grass cover a minor overall proportion. The small area of poorly drained piedmont soils is mainly used for double cropped rice (aus and transplanted aman), and there are some scattered homesteads along the edge of the association. Land use association 9.

The main limitations for agricultural development are the dry-season droughtiness and the very steep slopes, making access difficult and clear cultivation very hazardous. Land capability association 7: IVDe.

With modern management, including soil conservation measures and use of fertilizer as on present tea areas, and with dry-season overhead irrigation from tubewells or open water in addition, high yields of tea could be obtained on slopes of favourable aspect. This would entail high expenditure for development and maintenance. Other possible perennial crops, too, would require expensive dry-season irrigation for optimum yields. The association is well suited for intensive forest management, and possibly also for rubber.

20. Barlekha association. 236 square miles, 10.1 percent.

This association occurs on strongly dissected, steep topography and occupies a major part of the hill ranges throughout Moulvi Bazar subdivision. It is dominated by Barlekha series, with small areas of Khadimnagar, Kulaura, Srimangal and Ratna series. Locally, Khadimnagar and Kulaura series occupy a major proportion.

Barlekha series is a steep, well drained, brownish soil with fine sandy clay loam to clay loam texture; Khadimnagar and Kulaura series are similar soils with sandy loam and clayey textures respectively, Srimangal series is a level to steep, deep, well drained, brown piedmont terrace soil with clay loam texture; and Ratna series is an imperfectly drained piedmont soil with a grey mottled silty clay topsoil over a brownish silty clay to clay subsoil. Almost all of the land dries out by the middle of the dry season.

Almost all the land is covered by forest, with some bamboo. There is a small overall percentage of tea concentrated near piedmont terrace or piedmont valley areas. Land use association 9.

The main limitations for agricultural development are the dry-season droughtiness and the steep slopes making access difficult and clear cultivation very hazardous. The rocks may be generally unfavourable for obtaining tubewell water. Land capability association 7: IVDe.

With modern management, including soil conservation measures and use of fertilizers as on present tea areas, and with dry-season overhead irrigation in addition, high yields of tea could be obtained on slopes of favourable aspect. This would entail high expenditure for development and maintenance. Water could probably be made available by surface storage, damming favourably situated valleys in the hill ranges, rather than by tubewells. Other possible perennial crops, too, would require expensive dry-season irrigation for optimum yields. Most of the association, except for the highest parts of the hill ranges south-southwest of Kulaura, is well suited for intensive forest management and possibly for rubber.

21. Barlekha complex. 66 square miles, 2.8 percent.

This association occurs on a complex of hills, high piedmont valleys and some low piedmont valleys and high piedmont terrace remnants, at the edge of many of the hill ranges in Moulvi Bazar subdivision. Barlekha series is a major component throughout the association, with varying and locally major proportions of Kulaura, Jaflong, Balisira and Ratna series. Small areas of Srimangal series and of Bijipur, Pritimpasa, Itkhola and Manu series occur in many parts of the association, and there are a few small patches of Selapur and Juri series.

Barlekha series is a steep, well drained, brownish fine sandy clay loam to clay loam; Kulaura series is a similar soil with clayey texture; Jaflong, Balisira and Ratna series are imperfectly drained, generally brownish mottled piedmont soils with fine sandy loam, clay loam and clayey textures respectively. Srimangal series is a level to steep, well drained, deep brownish piedmont terrace soil; Bijipur, Pritimpasa and Itkhola series are poorly drained, intermittently flooded, grey mottled piedmont soils with fine sandy loam to loam, clay loam and clayey textures respectively; and Manu series is similar to Itkhola series but has strong blocky subsoil structure. Selapur and Juri series are very poorly drained, seasonally flooded, almost permanently wet piedmont basin soils, with clay and peat textures respectively.

The major land use in most of the area is tea, but locally double cropped rice (aus-transplanted aman), homesteads or forest may cover a high proportion of the land. A few very small areas of boro rice are included. Land use association 8.

The main limitations for agricultural development are the dry-season droughtiness of most soils, the steep and strongly dissected topography of the hills, and the imperfect natural drainage of most of the piedmont soils. The latter, however, has been corrected by field drains throughout the tea area, affording adequate gravity drainage for excess water. Land capability association 11: IVDe-IIDd.

Since most of the land in this association which is fit for tea cultivation is already under tea, the main improvement would be provision of dry-season overhead irrigation to obtain optimum yields. Water could probably be provided either by surface storage in the adjoining hills, or possibly by tubewells where the adjacent hills are covered by the Khadimnagar-Barlekha association. With modern management, including use of balanced fertilizers and, where possible, dry-season pump irrigation, the present rice growing areas could produce two good rice crops and a short-season dry-land crop per year.

22. Mangla Bazar complex. 50 square miles, 2.2 percent.

This association occurs in Sadar subdivision in scattered areas from Fenchuganj to about 10 miles north of Golapganj, and in Moulvi Bazar subdivision in a narrow area northeast of Barlekha. Its name is derived from the rather densely populated area south of Golapganj, called Mangla Bazar. It occupies a landscape of low hills closely dissected by a network of mostly rather narrow piedmont valleys. The hill soils are developed in unconsolidated folded Tertiary sediments, the valley soils in subrecent piedmont deposits of different textures. Khadimnagar and Barlekha series on the hills, and Bijipur and Pritimpasa series in the piedmont valleys all occupy variable but major overall proportions. Khadimnagar series is the dominant hill soil in the northernmost areas; Barlekha is locally dominant in the area in the northeast of Moulvi Bazar subdivision. Many different soils occur in small or very small percentages: the clayey, well drained, brownish Kulaura and the moderately well drained, mottled Beani Bazar series on the hills; the poorly drained Itkhola, a very poorly drained variant of Pritimpasa series, and permanently wet peat patches with Juri series in the valleys; and some small intrusions of two floodplain soils, the clayey, structured Phagu and the silty clay loam Goyainghat series.

Khadimnagar series is a steep, well drained, brownish sandy loam. Barlekha series is a similar soil with fine sandy clay loam to clay loam textures. Bijipur series is a poorly drained, intermittently flooded, grey mottled sandy loam to loam, and Pritimpasa series is a similar soil with fine sandy clay loam to silty clay loam textures.

The hills are mainly under homesteads, with forest also occupying a major proportion. Locally in the east of the survey area, forest is dominant with small areas of homesteads and tea. The dominant land use on the piedmont soils is double cropped rice (aus and transplanted aman), with local inclusions of single cropped rice (aman or boro), and patches of triple cropped land. Land use association 6.

The main limitations for agricultural development are the steep slopes and the strong dissection of the hills, the intermittent flooding and poor drainage of the valleys, and the series droughtiness in the late dry season almost throughout the area. Land capability association 12: IVDe-IIDw.

With modern management, including use of complete fertilizers and small-scale pump irrigation in the dry season, much of the poorly drained valley land could give high yields of two rice crops and a short-season dry-land crop per year. Modern production of perennial dry-land crops on the hills would require use of fertilizers, adequate conservation measures, and dry-season irrigation which may not be practicable. Large-scale development in this association is precluded by the strong dissection and the heterogeneity at short distances.

23. Beani Bazar complex. 44 square miles, 1.9 percent.

This association occurs in an area around Beani Bazar Police Station in Sadar subdivision, and in various areas near the eastern border of Moulvi Bazar subdivision. It occupies a landscape of low hills, closely dissected by a network of generally narrow piedmont valleys. The hill soils are developed in generally silty and clayey unconsolidated folded Tertiary sediments, the valley soils in subrecent piedmont soils of different textures. Barlekha and Kulaura series occupy major proportions in most of the area. Poorly drained, intermittently flooded piedmont soils also cover a major percentage, but proportions of individual soils vary widely from place to place. Many soils are important constituents locally: the steep, moderately well drained, mottled Beani Bazar series and the steep, well drained brownish Khadimnagar sandy loam on the hills; and the poorly drained, intermittently flooded, grey mottled Bijipur, Pritimpasa, Itkhola and Manu series in the valleys. Small patches of water, and of the poorly drained, seasonally flooded recent alluvial Kusiyara and Kadipur series, are included in the Beani Bazar area.

Barlekha series is a steep, well drained, brownish fine sandy clay loam; Kulaura series is a similar soil with clayey textures. Bijipur series has sandy loam to loam textures; Pritimpasa fine sandy clay loam to silty clay loam; Itkhola silty clay to clay texture and moderate blocky structure; and Manu series has a silty clay loam to silty clay topsoil over a clay to silty clay subsoil with strong blocky structure. Kusiyara series is a friable loam to silty clay loam with stratification from shallow depth, and Kadipur series is a friable silty clay loam to silty clay occurring in basins in association with Kusiyara ridge soils.

Most of the hills are used for homesteads, with small areas under forest or grass. Most of the valleys are used for double cropped rice (aus and transplanted aman), with small patches of single cropped rice (boro). Land use association 6.

The main limitations for agricultural development are the steep slopes and the close dissection of the hills, the intermittent flooding and poor drainage of the valleys, and the serious droughtiness in the late dry season almost throughout the area. Land capability association 12: IVDe-IIDw.

With modern management, including use of balanced fertilizers and small scale dry-season pump irrigation from tubewells or stored surface water where possible in the nearby hills, much of the valley land could produce high yields of two rice crops and a short-season dry-land crop per year, and the homestead land could produce higher yields of some dry-land crops. Irrigation may not be practicable, however, because of the close dissection and soil heterogeneity at short distances.

24. Juri complex. 13 square miles, 0.6 percent.

This association occurs in the Juri valley, on both sides of the Juri river, comprising an intricate mixture of low hills, piedmont, and peat-filled depressions. The hill soils are developed in unconsolidated folded Tertiary sediments, the piedmont soils in clayey outwash material, and the organic soils in peat which formed where the outwash did not reach. Barlekha, Manu, Selapur and Juri series all occupy variable and locally major proportions, and Itkhola series occupies minor areas.

Barlekha series is a steep, well drained, brownish fine sandy clay loam to clay loam; Manu series, poorly drained and intermittently flooded, consists of a grey silty clay loam to silty clay topsoil over a grey mottled silty clay to clay subsoil with strong blocky structure; Selapur series, a piedmont depression soil, is a very poorly drained, seasonally flooded and almost continuously wet, plastic and sticky, grey to dark grey clay; and Juri series, also occurring in piedmont depressions, is very poorly drained, seasonally flooded, almost continuously wet, consisting of a thin grey clay or black peat topsoil over a dark greyish peat to clayey peat subsoil. Itkhola series is similar to Manu but has less strong structure.

The hills are under homesteads, tea and forest in varying proportions, most of the clayey piedmont is used for double cropped rice, and the organic soils and some of the lowest clay piedmont depression edges are used for boro rice, growing without or with little dry-season irrigation. Small patches of poor grassland also occur in the depressions. Land use association 7.

The main limitations for agricultural development are the dissected and heterogeneous nature of the area, the steep slopes of the hill soils, the permanent wetness of much of the valley soils and the seasonal wetness and drought of the remainder. Land capability association 9: IV.

With modern management, including use of fertilizers, higher yields could be expected of present crops. Large-scale development, or even small-scale pump irrigation in the dry season, would have limited effect and be expensive.

25. Tamabil association. 20 square miles, 0.9 percent.

This association occupies a number of low, generally steep and strongly dissected hill ranges near and along the northern border of Sadar subdivision. The soils are developed in generally consolidated, folded Tertiary rocks, probably Surma and Tipam geological series. Most of the area is covered by Tamabil series. Minor areas are occupied by moderately deep Khadimnagar and shallow Barlekha series on rock, which locally account for up to a third of some areas. Pritimpasa series occupies most of the narrow piedmont valleys included in this association.

Tamabil series is a sloping to steep, excessively drained, shallow to very shallow, stony and rocky soil of generally loamy texture. Khadimnagar series is a steep, well drained, brownish sandy loam, Barlekha series is a similar soil of fine sandy clay loam to silty clay loam texture. Pritimpasa series is a poorly drained, intermittently flooded, grey mottled fine sandy clay loam to silty clay loam.

Dominant land use is forest, mainly used for firewood and bamboo. Locally minor areas are used for grassland, tea, pineapples and homesteads. Much of the small area of Khadimnagar and Barlekha soils is used for citrus and tea, while Pritimpasa soils are used for double cropped rice. Land use association 9.

The shallowness, stoniness, erodibility and limited water holding capacity of the dominant soil severely restrict the possible use of this association. Land capability association 10: VDe.

Wherever the land is accessible, it could probably be used for forest and building sites. Wherever slopes are not too steep, roads necessary for adjacent areas could be built economically on these soils.

AGRICULTURE IN RELATION TO SOILS

The first chapter of this section contains some general statements about agricultural use and management which apply to the whole or most of the mapping area, and deals with the different factors affecting the productivity of the land. Most soils, however, require some sort of special management practices* if they are to produce satisfactory yields, and crop suitabilities vary widely between soils and between crops. For this more detailed information, the following chapters on Land capability classification and Crop suitability should be consulted.

FACTORS AFFECTING USE AND MANAGEMENT

Flood protection, drainage and irrigation

Inadequate water control and heavy, strongly seasonal rainfall are the main limitations to intensive land use and optimum crop production. In most of the mapping area, low elevations and little relief make flood control, drainage and irrigation of prime importance in any development programme. Most of the soils in their present condition are subject to flooding during the rainy season and nearly all soils are short of water in the dry season. In addition to pump drainage, large parts of the area would need protection against the high river levels in the rainy season.

Some seasonally inundated soils are much more difficult to drain and protect against floods than others because of their lower relative elevation and the great head of water against which one would have to pump and protect. Because of this difference, otherwise similar soils have to be placed into different land classes. Considerable variation in drainability exists between different soils, apart from their relative elevation. Goyainghat and Kanairghat series are moderately permeable throughout and would be relatively easy to drain for dry-land crops, while Tajpur series is very slowly permeable and difficult to drain, and Hakaluki or Juri series constantly receive seepage water from surrounding areas through their permeable subsoils and are thus more difficult to drain.

A special problem in this survey area is the rapid rise of flood-waters in the basins near the northern border and the deep parts of the basins throughout the area after every rain locally or in the hills to the north. For any rainy-season cropping to be safe and economic in these basins, proper flood protection would be imperative. At present these basins are used for dry-season grazing or locally some broadcast aman, which fails in many years.

Rainy-season drainage is an undertaking involving vast capital expenditure because of the enormous quantities of excess rainfall to be pumped out (near Sylhet town approximately 120 inches in 7 months, near Moulvi Bazar about 60 inches), and the high heads against which they must be pumped. For dry-season irrigation the quantities to be pumped are many times less; about 10 inches would supply the needs of actively growing plants during the whole of the dry season. The pumping heads would be of the same order as for drainage. Unlike drainage and flood protection, which are large-scale operations, provision for irrigation can be made in various ways and in areas of widely varying size. One man with a traditional scoop or bucket can irrigate one to three acres. One portable Diesel-powered pump may serve a block of a hundred acres. A set of tubewells or a dammed

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*Management practices include drainage, irrigation, crop rotation, fertilizing, crop protection against diseases and pests, use of adapted crop varieties and proper tillage.

reservoir and a sprinkler system could supply a thousand acres of hilly land not easily irrigated otherwise. Larger areas could be supplied with irrigation water by canals and pumping stations. For all dry-land crops except those on hills and piedmont terraces, it would be essential to provide dry-season drainage to evacuate excess irrigation water and prevent waterlogging. Especially with flood or furrow irrigation, this is a very real danger on all but the most permeable soils.

Fertility

The natural fertility* of the hill and piedmont terrace soils is generally low. Without fertilizing, these soils would not be capable of producing even moderate crops continuously. The natural fertility of the floodplain and piedmont plain soils is moderate. These soils are capable of producing fair crops for many decades with very little fertilizing.

Almost none of the soils is naturally fertile enough to satisfy the rising demands of the present economy. The agricultural production of the area can be raised considerably by application of mixed fertilizers. Experiments by the Soil Fertility and Soil Testing Institute, Dacca, show an economic response of rice on most soils with an application equivalent to 40 lbs N, 40 lbs P_2O_5 and 40 lbs K_2O per acre per crop. More detailed experiments are in progress, and there are indications that higher application will boost yields and profit still further. For tea, the Tea Research Station, Srimangal gives detailed fertilizer advice, which is largely followed by the good gardens.

The present soil survey would enable trials of fertilizers on different crops to be conducted with greater efficiency than at present. With trials on known soils in known landscape units, an important source of variability will have been eliminated, and optimum fertilizer applications may be arrived at for specific soils and specific crops.

The rivers entering the area bring sediment, which is largely taken to land further west, e.g. Habiganj subdivision. A small percentage is deposited as spills and infillings of some basins. These deposits after a few years' weathering generally support more dry-season dry-land crops than most other soils of the area, mainly because of their superior physical characteristics: the absence of a plough pan and the better water holding capacity. The rest of the area receives very little, if any, sediment annually from the rivers. The sustained, though relatively low, productivity of most of the area is due to the gradual release of the elements in the mineral reserve of the soils rather than to new sediment.

Neither salinity, nor acidity, nor lack of specific micronutrients are a problem at present. After a number of years of modern management with greatly increased yields and more crops per year than at present, the Agricultural Officers should be on the lookout for possible deficiency symptoms, to be corrected by judicious additions of specific micronutrients.

Physical properties

Physical properties such as structure, texture, permeability, or bearing capacity, influence the management requirements of a given soil. Most of these factors cannot be changed, so management and crops have to be adapted to the soil physical properties.

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*A fertile soil contains adequate nutrients in proper balance to supply the needs of the crops grown, either naturally or through fertilizing. To be productive, a fertile soil must also have adequate water supply and drainage, either natural or artificial, favourable physical characteristics and good response to management.

Soil structure can be modified by cultivation, but response varies with different crops and different soils. Soils like Kusiyara series can be cultivated with ease and they develop a good open structure for dry-land crops. In contrast, soils like Tajpur can be cultivated only when wet and with difficulty, to produce a thin puddled layer for rice cultivation. It would be almost impossible to produce a satisfactory structure for dry-land cropping in this soil. When subject to wet cultivation for many years, soils like Bijipur may develop a plough pan which is very dense and hard when dry.

Ease of cultivation and soil physical conditions can be maintained or improved by introduction of a modern steel plough, like the one developed in the Ganges-Kobadak project; by cultivating for dry-land crops under favourable moisture conditions only; by growing a deep-rooting crop at least once in one or two years; and, for dry-land cropping, by destroying the plough pan with a ripping implement, without inverting the topsoil.

Most of the hill soils are not cultivated due to the unfavourable topography and danger of erosion. Here and on the steep edges of the high terraces, great care should be taken to keep a good ground cover at all times.

PRESENT LAND USE

Cropping systems and land use

At present, the major land use or cropping systems of the area are a double rice crop (aus-transplanted aman), a single rice crop (broadcast aman or boro), unimproved rough grazing land, tea, and bamboo or firewood forest. A small part of the land is used for a double or single rainy-season rice crop and a dry-season dry-land crop (aus-aman-rabi crops or aman-rabi crops), for perennial crops like pineapples, oranges and jack-fruits and for homesteads with a variety of dry-land crops on a very small scale. Hardly any jute is grown in the area.

Farmers grow a double crop of rice (aus and transplanted aman) wherever the limited depth of flooding permits harvest of aus and transplantation and proper growth of aman. This is the case on nearly all land flooded less than 3-4 feet, except near the Jayantia hills where the flood water rises too rapidly and moves too fast over the land. Wherever dry-season water is available and the soil can be easily tilled dry with the wooden country plough, dry-season dry-land crops are grown. Wherever the soil is flooded to shallow depth or can be flood-irrigated in the dry season, boro rice is grown. On land which is too deeply flooded for aus-transplanted aman and which has no available winter water for boro cultivation, broadcast aman is grown. In the eastern and northern parts of Sadar subdivision the yield of the broadcast aman is very uncertain due to repeated rapid rise of water level and locally onrush of water over the land, to neither of which it is adapted. Locally large areas of this land are entirely bare of vegetation due to repeated failure of rice and subsequent overgrazing of the few weeds that spring up. In other places, with less pressure of population, this land liable to rapid flooding is left under natural grass, and used for pasture. Here the cattle keep the scrub in check, except on the higher ridges which have scattered trees and dense scrub of varying height. In these areas, where the topsoil has not become compact and hard due to exposure, some small patches are used for winter crops, mainly mustard and linseed, which are sown in freshly ploughed land following the edge of the retreating water after the rainy season.

Tea is grown on most of the well and moderately well drained land with favourable topography. Where the slopes are too steep or dissection is too strong, forest remains.

No comprehensive data on present yields are available at present. Farmers report yields of aus paddy from 450 lbs/acre on the sandier piedmont areas to 600-800 lbs/acre on most piedmont and floodplain areas. Reported yields of transplanted aman paddy vary from 600 to 1000 lbs/acre throughout the area and of broadcast aman from 600 to 900 lbs/acre. Boro paddy yields are generally estimated to be 800 to 1200 lbs/acre, but in some basins in the west of Sadar subdivision up to 1800 lbs/acre, all without or with little manuring. Yields of aus and transplanted aman paddy fertilized with the doses currently recommended by the Agricultural Officers appear to range from 1200 to 2000 lbs per acre. The main problem in extending the use of fertilizers in the survey area is not one of benefit-cost ratio, which appears to be favourable, but of agricultural credit and of convincing the farmers of the benefits to be gained.

Table 5. Land use associations: area and percentage

	Land use associations	Area, square miles			Percent	Soil associations
		Sadar	Moulvi Bazar	Total		
1	Double cropped rice land with homesteads and little single cropped rice land	521.6	370.3	891.9	37.9	1,3,4,12,13,14
2	Single cropped rice land with few homesteads and little double cropped rice land and grassland	335.3	134.5	469.8	20.0	5,6,7
3	Grassland with some single cropped rice land	266.3	63.6	329.9	13.9	2,8,9,11
4	Complex of grassland with some double cropped rice land.	-	7.3	7.3	0.3	17
5	Complex of grassland with single cropped rice land and homesteads	2.4	1.8	4.2	0.2	10
6	Homesteads with double cropped rice land, little single cropped rice land and forest	55.8	38.9	94.7	4.1	22,23
7	Complex of homesteads, single cropped rice land, tea and forest	-	13.2	13.2	0.6	24
8	Tea land with some scrub land	9.4	128.1	137.5	5.9	15,16,21
9	Forest with little tea land	53.6	271.2	324.8	14.0	18,19,20,25
	Urban land	3.7	0.3	4.0	0.2	
w	Water	24.5	15.8	40.3	1.7	
	No photo coverage	28.4	-	28.4	1.2	
	Total	1301.0	1045.0	2346.0	100.0	

Land use associations

Land use in the survey area varies widely even within very small areas. Therefore, it is not feasible to delineate every kind of land use separately. Land use associations have been defined and delineated on the map, generally comprising two or more kinds of land use in stated proportions. The relationship between soil associations and land use associations and their extent are shown in table 5. The land use associations are described below.

1. Double cropped rice land with homesteads and little single cropped rice land. 892 square miles, 38 percent.

This association occurs throughout the survey area on the relatively high floodplain areas that are seasonally flooded to shallow depth and on the intermittently flooded piedmont plains and wide valleys.

Most of the land is used for double cropped rice (aus and transplanted aman). About a fifth of the area is occupied by homesteads. A minor percentage of the land where flooding depth is greater, is used for single cropped rice: boro where dry-season water is available for irrigation, broadcast aman where it is not. Narrow strips of land along permanent water, especially on the lighter textured soils, are triple cropped (aus and transplanted aman with an irrigated short-season dry-land crop).

2. Single cropped rice land with few homesteads and little double cropped rice land and grassland. 470 square miles, 20 percent.

This association occurs almost throughout the survey area in the deeply but not rapidly flooded floodplain basins.

Most of the land is used for single cropped rice: boro wherever dry-season water is available for traditional irrigation, and broadcast aman where it is not. Unimproved grassland occupies a generally small but varying percentage. A few high ridges are used for double cropped rice (aus and transplanted aman), locally with a short-season dry-land crop in addition. A few homesteads are scattered in the area, generally on low earthen terraces on high ridges, but locally on high man-made mounds.

3. Grassland with some single cropped rice land. 330 square miles, 14 percent.

This association occurs almost throughout the survey area, but mainly in the northern part of Sadar subdivision, in deeply and rapidly flooded floodplain basins.

Most of the land is used for rough grazing in the dry season. A generally minor, but locally important percentage around depressions, where ponded water is available for traditional irrigation, is used for boro rice. Small areas are used for broadcast aman rice, but this fails almost regularly due to rapid rise or sudden onrush of flood water. Small patches, especially in the northern part of Sadar subdivision, are used for mustard, broadcast immediately following the retreating floodwater and maturing before the land dries out completely.

4. Complex of grassland with some double cropped rice land. 7 square miles, 0.3 percent.

This association occurs in two small areas in the southern part of Moulvi Bazar subdivision, adjacent to hill ranges, on closely and strongly dissected terrace remnants with narrow piedmont valleys.

Most of the strongly dissected terraces are used for grassland (much of it tall thatching grass), with locally many homesteads and a little tea. The valley bottoms are used for double cropped rice (aus and transplanted aman).

5. Complex of grassland with single cropped rice land and homesteads. 4 square miles, 0.2 percent.

This association occurs in a few small patches east of Sylhet town and near Moulvi Bazar town on floodplain basins with scattered hills.

The basin areas are used as unimproved grazing land and part for boro rice cultivation. The hills are used for homesteads.

6. Homesteads with double cropped rice land, little single cropped rice land and forest. 95 square miles, 4.1 percent.

This association occurs mainly in the central and eastern part of the survey area on a landscape of low hills closely dissected by a network of piedmont valleys.

Most of the hills are under homesteads, with a varying but locally major proportion of forest and little thatching grass. In a few places in the east, some tea is grown on the hills. Most of the valleys are used for double cropped rice (aus and transplanted aman) with local patches of single cropped rice (broadcast aman or boro) and triple cropped land.

7. Complex of homesteads, single cropped rice land, tea and forest. 13 square miles, 0.6 percent.

This association occurs in the Juri valley, on both sides of the Juri river, on an intricate mixture of low hills with piedmont valleys and peat-filled depressions.

The hills are under homesteads, tea and forest in varying proportions. Most of the valleys are used for double cropped rice (aus and transplanted aman), and the organic soils and some of the lowest clay depression edges are used mainly for boro rice, growing with little if any dry-season irrigation, with small patches of poor grassland.

8. Tea land with some scrub land. 137 square miles, 5.9 percent.

This association occurs in an area near the northern border of Sadar subdivision and widely scattered throughout Moulvi Bazar subdivision, on higher parts of the piedmont plain and on the high older piedmont terrace remnants dissected by low piedmont valleys, with locally a major percentage of low hills.

Most of the area is used for tea. Near the northern border, the sandier soils are under scrub. A generally small but varying proportion of the hilly land is under forest, and most of the low piedmont valleys are used for double cropped rice. Small patches of homesteads, tea factory compounds and villages, thatching grass and single cropped rice are scattered in most of the area.

9. Forest with little tea land. 325 square miles, 14 percent.

This association occurs in a few areas near Sylhet town and near the northern border of Sadar subdivision, and in large areas throughout Moulvi Bazar subdivision, on generally steep and strongly dissected hill ranges.

Most of the land is under depleted natural forest. Locally there are forest reserves, replanted forest and large areas of bamboo. A generally small percentage is used for tea cultivation, but locally relatively large areas of tea occur especially around the wider piedmont valleys or near piedmont terrace. Minor areas are used for grassland (thatching grass), homesteads, pineapples, citrus and jackfruit. The small area of narrow, poorly drained piedmont valleys is used for double cropped rice.

LAND CAPABILITY

Introduction

Land capability classification is a method of grouping the soils of an area to show their relative suitability for sustained production of common agricultural crops.

The classification outlined below is designed to suit the agricultural conditions of East Pakistan. It is similar in basic structure to the U.S. Soil Conservation Service classification (11). Soils placed in the highest class have the least limitations for agricultural use and relatively little effort is required to produce high crop yields. In successively lower classes, there are increasingly severe limitations for agricultural use and increasingly great effort, in terms of expenditure, is required to produce high crop yields. Soils in the lowest class are unfit for economic agricultural use. This classification is also similar in structure to that used in the Soil Surveys in British Guiana (1). However, it includes one additional class, very good agricultural land, to cater for the superior agricultural soils found in East Pakistan.

Under the climatic conditions of East Pakistan, with a large excess of rainfall in the monsoon season*, most soils are, in practice, limited to the production of wet-land crops (mainly rice) during the monsoon season whether they are flooded or not. This is not regarded as a serious limitation on the capability of the soils, since rice is the staple grain crop of the region, the crop most farmers grow by preference. More emphasis has been placed, therefore, on the capability of soils to produce satisfactory crops throughout the year than on the range of crops that could be grown. Never-the-less, even with soils that are seasonally flooded, those that have the highest total productivity are almost always those that also have the widest range of crop possibilities in the dry season.

Implicit in the classification is a statement of the potentiality of the soils for improvement. Class I soils will respond best to good management. The lower classes have successively lower potentialities for improvement. This factor is used as a major criterion differentiating class III from class IV soils. In the case of class III soils, improvement to a high level of productivity, although difficult, is considered feasible and economic, in class IV, improvement to a high level of productivity is considered impractical or uneconomic. This aspect is stressed since, under the Master Plan (3), proposals exist for providing flood protection, drainage and/or irrigation almost throughout East Pakistan within the next twenty years.

Since rice will remain an important crop in East Pakistan within the foreseeable future and even the most ambitious flood protection schemes are unlikely to reduce inundation levels to below 3-6 feet in all basin areas, land levels in relation to flooding will remain of importance in the future in determining the kinds of crops that can be grown. The traditional land classification system, recognizing high, medium high, medium low and low land, has therefore been taken cognizance of in developing the land capability classification presented below.

Outline of classification

Two levels of generalization are recognized. Land Capability Class and Land Capability Subclass. The first and broadest grouping, Land Capability Class, is identified by Roman numerals I to V. Class I land (very good agricultural land) has least limitations for crop

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* Rainy-season excess of rainfall over evaporation at Sylhet, more than 120 inches and at Dacca, 40 inches. Dry-season excess of evaporation over rainfall 8 to 10 inches throughout the Province.

Classes II, III, IV and V have increasingly severe limitations for crop production, Class V (non-agricultural land) being considered unfit for economic agricultural use. The soils within each Land Class have limitations of about the same degree. The kinds of limitations may vary, however, within the class.

At the second level of generalization, the Land Capability Subclass, soils having the same dominant kind or kinds of limitations for agricultural use are grouped together. Because of the special environmental conditions obtaining in East Pakistan, it has been considered desirable to make a primary separation between soils that are subject to flooding for part of the year and those that are not. These might be termed major subclasses. They are indicated by capital letters: D for soils lying above normal flood level; W for soils subject to flooding for part or all of the year.

Beyond the major subclasses, ordinary subclasses are differentiated, if required, according to the dominant limitation - other than monsoon-season flooding - affecting agricultural use of the soils. Ordinary subclasses are indicated, where appropriate, by small letters added after the major subclass designation. The following ordinary subclasses are recognized in the present survey area.

d - soils restricted in use due to droughtiness in the dry season.

e - soils restricted in use due to erosion hazard.

r - soils having irregular local relief hindering irrigation, drainage or tillage.

w - soils restricted in use due to excess water (in the dry season in major subclass W soils; in the monsoon season in major subclass D soils).

In case of soils in Capability Class I and Subclass IIW, the major subclasses D and W are recognized but ordinary subclasses are not.

Class and subclass descriptions*

In the descriptions which follow, the term 'perennial dry-land crops' includes sugarcane, bananas and tree crops such as mango, jackfruit and citrus but not necessarily crops requiring specialized soil conditions, such as tea or palms of various kinds. 'Annual dry-land crops' include wheat, barley, millet, leguminous pulse and fodder crops, mustard, tobacco, vegetables, etc. 'Wet-land crops' include rice and jute.

'Crop production throughout the year' means production of one crop, or a rotation of two or more crops, which occupy the land for all or nearly all of the year, any remaining part of the year being required for land preparation. Crop possibilities include either perennial or annual dry-land crops or one or more wet-land crops, with or without a dry-land crop.

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* These descriptions fit within the more generally applicable land capability classification for East Pakistan (2), but the wording specifically applies to the present survey area. The soil series and phases included in every class and subclass are listed in table 6.

The term 'traditional management' means use of local seed and the traditional country plough (where applicable), a low level of manuring and absence of large-scale water control (flood protection, drainage and/or irrigation). The term 'modern management' implies use of a modern steel plough (where applicable), use of selected seed and adequate amounts of fertilizers, as well as plant protection and soil conservation practices where necessary. This term, in the present context, excludes large-scale water control, the need for which is discussed separately in each subclass description.

Class I. Very good agricultural land. Not mapped in the survey area.

Soils in this class have no to slight limitations for crop production throughout the year and the widest range of agricultural use. These soils are level to gently undulating and easy to cultivate.

Under traditional management, they can be used for crop production throughout the year and are at least moderately productive. With modern management, including some dry season irrigation, they are capable of giving very high yields throughout the year.

Class II. Good agricultural land.

Soils in this class have no to slight limitations for crop production during most of the year, but moderate limitations during the remainder of the year. These soils are level to gently undulating and easy to cultivate.

Under traditional management, they can produce satisfactory crops for most but not all of the year and are at least moderately productive. With modern management, including dry-season irrigation, these soils are capable of giving good to high yields throughout the year.

Subclass IIDd Soils in this subclass are well drained, level to very gently undulating, deep, permeable, loamy to clay soils.

Under traditional management, these soils can produce good yields of perennial crops, or two moderate dry-land crops, or one moderate wet-land and one moderate dry-land crop per year.

With modern management, including dry-season irrigation, these soils could give high yields of most perennial or annual dry-land crops throughout the year.

Good management should include maintenance of good soil cover and provision of safe disposal of surface run-off during the pre-monsoon and monsoon rains. Any problems of acidity or phosphate fixation are easily solved, respectively, by liming if required or placement of suitable phosphatic fertilizers.

Subclass IIDw Soils in this subclass are moderately well to poorly drained, intermittently flooded, level to very gently undulating, deep, moderately permeable, loamy to clay soils. Many of these soils are moderately to very acid.

Under traditional management, these soils produce two moderate wet-land crops per year and locally a moderate or poor irrigated dry-land crop in the dry season in addition.

With modern management, including dry-season irrigation and relatively inexpensive deep open drainage, these soils could produce high yields of either annual or perennial dry-land crops. Alternatively, with ponding of rain water and dry-season irrigation, they could produce two high yielding wet-land crops and a dry-land crop per year.

A good soil cover must be maintained in the rainy season. Acidity can easily be corrected, if desired, by liming and phosphate-fixing problems reduced by placement of suitable phosphatic fertilizers.

Subclass IIW This includes seasonally flooded, level to very gently undulating, easily cultivated, loamy to clay soils. In general, soils in this subclass have somewhat less favourable physical properties than soils in class I and are droughty in the dry season. No ordinary subclasses are recognized at present.

Under traditional management, these soils can produce moderate to good yields of two rice crops per year, with locally a short-season dry-land crop in addition where irrigation water is available.

With modern management, including dry-season irrigation, they could produce two good wet-land crops and one short-season dry-land crop per year. With expensive flood protection and pump drainage in the monsoon season in addition to dry-season irrigation, these soils could produce very high crop yields throughout the year, either of two wet-land crops and one dry-land crop per year, or of adapted annual or perennial dry-land crops throughout the year.

Class III. Moderate agricultural land.

Soils in this class have either moderate limitations for crop production throughout the year or severe limitations for crop production during one major season of the year and slight to moderate limitations during the remainder of the year. Limitations are dry-season droughtiness and either seasonal deep flooding (locally accompanied by rapid rise in water level or rapid flow of water resulting in occasional damage to or loss of crops), or irregular relief difficult to irrigate.

Under traditional management, they can either produce good to moderate crops during only one season of the year, or improvements are difficult to apply. With modern management, and with major expenditure for large-scale irrigation, drainage and/or land levelling, these soils could produce high yields of at least one crop per year or moderate to good yields during most or all of the year.

Subclass IIIWd This subclass includes seasonally deeply flooded, level to very gently undulating, clayey soils which become droughty in the dry season but which to not have an unfavourable structure for tillage or plant growth.

Under traditional management, these soils can produce one good rice crop per year, either broadcast aman or boro where dry-season irrigation water is available.

With modern management, including dry-season irrigation, these soils could produce one very good rice crop per year. With major expenditure on flood protection and pump drainage in addition, they could produce two very good wet-land crops in the monsoon season and/a good to very good dry-land crop in the dry season.

Subclass IIIWr This subclass includes seasonally flooded soils occurring on young spill deposits, which have irregular topography of low relief.

Under traditional management, these soils produce two rice crops in the monsoon season and locally a dry-land crop in the dry season.

With modern management, including major expenditure on land levelling and dry-season irrigation, these soils could produce good to very good yields of annual crops throughout the year.

Class IV. Poor agricultural land.

Soils in this class have severe limitations for crop production throughout the year. Limitations may be due to the effects of one or more of the following factors: seasonal deep flooding combined with poor soil structure; severe erosion hazard; or severe risk of crop loss or damage by on-rush or rapid rise of floodwater. These soils have little potentiality for improvement.

Under traditional management, they can either produce a poor to moderate crop growing for only part of the year or they can sustain a poor to moderate perennial crop. With modern management, major expenditure would be required on land development to make the soils produce good crops, but this would not generally be feasible or economic except, in some cases, for special crops.

Subclass IVDe This includes well to moderately well drained soils with unfavourable relief and a severe erosion hazard. They are steep, at least moderately deep and permeable.

Traditionally, these soils are used for forest (including bamboo-land), permanent grassland (including grazing and thatching grass), settlement sites, or, in a few places, perennial tree crops.

With modern management, these soils can produce good yields of some perennial crops on slopes of favourable aspect. Expensive overhead irrigation may be needed to give high yields of some crops. Arable crops could only be grown safely with prohibitive expenditure on terracing. Forest and forest crops would do very well on most of these soils, but poor accessibility limits exploitation in some areas.

Subclass IVWd This subclass includes seasonally deeply and rapidly flooded loams to clays and soils with organic layers which have low bearing capacity when wet, all becoming very dry in the dry season.

Under traditional management, most of these soils remain under grass-land which is grazed in the dry season. The clay soils are difficult to cultivate with the traditional country plough.

With modern management, including the use of heavy tillage equipment, dry season irrigation and limited flood protection where necessary, these soils could produce one good to very good rice crop in the dry season. Heavy expenditure would be required on flood protection and pump drainage to make these soils suitable for crop production throughout the year, but this would generally not be feasible or economic.

Subclass IVWw Soils in this subclass are seasonally deeply flooded clays or organic soils with low bearing capacity, which remain wet through most or all ofthe dry season.

Under traditional management, these soils produce one very poor to moderate rice crop per year or remain under grazed grassland.

With modern management, which may require the use of special tillage equipment, dry-season irrigation and limited flood protection, one good to very good rice crop could be produced in the dry season. Heavy expenditure on flood protection and pump drainage would be required to make these soils suitable for crop production throughout the year, but this would generally not be feasible or economic.

Class V. Non-agricultural land.

Soils in this class have very severe limitations which either make crop production impossible or very hazardous or cause very low yields. Limitations are shallow depth of soil and sloping to very steep topography.

Some areas may have productive use for forestry or recreation.

Subclass VDe Soils in this class are generally excessively drained, sloping to very steep, shallow, rocky or very stony soils. These soils have a severe erosion hazard. In addition, they are usually too steep and have too little soil or are too rocky or stony to be cultivable.

Under traditional management, these soils are generally used for supply of wood or bamboo, or for homesteads. Only at very high cost could some areas produce moderate yields of perennial crops. They are best used, if at all, for the production of wood or bamboo.

Table 6. Land capability classification

Land capability class	subclass	Soil series or phase
II	Dd	Normal phases of Lakhaichara Srimangal
	Dw	Bijipur Pritimpasa Itkhola Manu Jaflong Balisira Ratna
	W	Balaganj Normal phases of Goyainghat Kanairghat
III	Dr	Strongly dissected phases of Lakhaichara Srimangal
	Wd	Normal phase of Phagu Deeply flooded phases of Goyainghat Kanairghat
	Wr	Kusiyara
IV	De	Khadimnagar Barlekha Kulaura Beani Bazar
	Wd	Kadipur Tajpur Hakaluki Khasgaon Rapidly flooded phase of Phagu
	Ww	Terchibari Selapur Juri
V	De	Tamabil

Table 7. Land capability associations: area and percentage

Land capability associations		Area, square miles Sadar	Moulvi Bazar	Total	Percent	Soil associations
Mainly good agricultural land				927.8	39.5	
1. IIDd	Well drained, level	1.0	54.5	55.5	2.4	16
2. IIDw	Seasonally wet	97.6	185.0	282.0	12.0	12,13,14,15
3. IIW	Seasonally flooded to shallow depth	418.7	171.0	589.7	25.1	3,4
Mainly moderate agricultural land				512.6	21.8	
4. IIIDr	Well drained, strongly dissected	-	7.3	7.3	0.3	17
5. IIIWd	Seasonally deeply flooded	335.3	134.5	469.8	20.0	5,6,7
6. IIIWr	Seasonally flooded, with irregular relief	13.7	21.8	35.5	1.5	1
Mainly poor agricultural land				647.5	27.6	
7. IVDe	Well drained, steep	33.2	271.2	304.4	13.1	18,19,20
8. IVWd	Seasonally deeply and rapidly flooded	266.3	63.6	329.9	13.9	2,8,9,11
9. IV	Complex of well drained steep land and continuously wet land	-	13.2	13.2	0.6	24
Mainly non-agricultural land				20.4	0.9	
10. VDe	Shallow and steep	20.4	-	20.4	0.9	25
Poor and good agricultural land				160.8	7.1	
11. IVDe-IIDd	Complex of well drained steep and well drained level land	-	66.1	66.1	2.8	21
12. IVDe-IIDw	Complex of well drained steep land and seasonally wet land	55.8	38.9	94.7	4.1	22,23
Moderate and poor agricultural land				4.2	0.2	
13. IIIWd-IVDe	Complex of seasonally deeply flooded and well drained steep land	2.4	1.8	4.2	0.2	10
Urban land		3.7	0.3	4.0	0.2	
Water		24.5	15.8	40.3	1.7	
No photo coverage		28.4	-	28.4	1.2	
Total		1301.0	1045.0	2346.0	100.0	

Land capability associations

As is the case with soils, land capability classes and subclasses generally cannot be delineated separately on a reconnaissance map. Therefore, land capability associations have been delineated and defined, comprising one or more land capability classes in stated proportions. The relationship of soil associations and land capability associations and their extent are shown in table 7. The land capability associations are described below.

1. IIDd. Mainly well drained, level land. 56 square miles, 2.4 percent.

This association comprises the normal phase of the Srimangal association (16), occurring in the central and southern part of Moulvi Bazar subdivision, and a very small area near the northeastern border of Sadar subdivision. It consists mainly of flat-topped, well drained high piedmont terrace remnants ('high flats') with locally some scattered hills, and dissected by narrow, poorly drained, intermittently flooded, interconnected valleys.

The high terrace remnants would be well suited for almost any crop during the rainy season, provided adequate soil conservation measures are taken, especially near the terrace edges. The steep edges are strongly susceptible to erosion unless an adequate and continuous soil cover is maintained. In the late dry season the land becomes very dry, and would benefit greatly from overhead irrigation. This is the best tea land in Sylhet, and nearly all of it is already under tea. Natural fertility is relatively low, but this is corrected by fertilizing. Yields are generally high, but could be increased appreciably with adequate overhead irrigation.

The hills are steep to very steep, have a serious erosion hazard unless an adequate soil cover is maintained, and are more difficult of access. They are only suited for forestry or crops like thatching grass, tea or rubber. Dry-season irrigation on these soils is much more difficult and expensive than on the terrace. Without irrigation, tea will give good to poor, but not optimum annual yields.

The small area of valley soils is well suited for rice cultivation in the rainy season, but development for dry-land crops would be very expensive. In the dry season, short-season dry-land crops like vegetables could probably be grown making use of the excess capacity of overhead irrigation for the adjacent tea areas.

2. IIDw. Mainly seasonally wet land. 283 square miles, 12 percent.

This association comprises the Bijipur, Pritimpasa, Manu and Jaflong associations (12, 13, 14 and 15), occurring northeast of Sylhet and near the northern border in Sadar subdivision, and scattered almost throughout Moulvi Bazar subdivision. It consists of the poorly to locally moderately well drained, intermittently flooded outwash plains and valleys near the hill ranges, with locally some scattered hills.

All of the soils are of relatively low natural fertility and would need fertilizer for optimum yields. Most of the plains and valleys are well suited for cultivation of aus and transplanted aman paddy in the rainy season. With pump irrigation from tubewells, rivers or small irrigation dams in valleys of the nearby hill ranges, rice yields would be higher and less susceptible to early-or late-season drought, and most of this land could produce a short-season dry-land crop in addition. Alternatively, a long-season dry-land crop could be grown omitting one of the rice crops. With adequate gravity or relatively inexpensive pump drainage in addition, including interceptor drains at the foot of the hills, a number of annual or perennial dry-land crops could be grown, for example tea on Bijipur, Pritimpasa and Jaflong associations and sugarcane on Pritimpasa, Manu and Jaflong associations. Tea would require overhead irrigation for optimum yields, sugarcane could be grown with furrow irrigation.

The scattered hills are generally used for homesteads. They need not be taken into account for development.

3. IIW. Mainly land seasonally flooded to shallow depth. 590 square miles, 25.1 percent.

This association comprises the Goyainghat-Balaganj association and the normal phase of the Goyainghat-Kanairghat association (3 and 4), occurring on relatively high floodplain areas almost throughout the survey area.

These soils are of moderate but well sustained natural fertility. They would need applications of fertilizers for optimum yields. Most of this land is well suited for cultivation of aus and transplanted aman paddy. A small area would need relatively inexpensive pump drainage for these crops to be grown successfully. With dry-season pump irrigation from rivers or tubewells, rice yields would be higher and less susceptible to early-or late-season drought, and the land could produce a short-season dry-land crop like oilseeds or grains in addition. Alternatively, a long-season dry-land crop like wheat, or groundnuts (on the lighter soils) could be grown omitting one of the rice crops. With relatively expensive flood protection and pump drainage in addition, including adequate field drains, a number of annual or perennial dry-land crops could be grown instead of rice, for example sugarcane, groundnuts or wheat. This might be less economic than rice cultivation, however.

4. IIIDr. Mainly well drained, strongly dissected land. 7 square miles, 0.3 percent.

This association comprises the strongly dissected phase of the Srimangal association (17), occurring in two small areas in the southern and southeastern parts of Moulvi Bazar subdivision. It consists of mainly sloping to steep, strongly dissected, well drained terrace remnants with many narrow poorly drained valleys occupying up to a third of the area.

The soils are of relatively low natural fertility and would require fertilizers for optimum yields. The terrace remnants are moderately well suited for most crops that give a good ground cover, but the strong dissection makes access and management costs high and makes it difficult to provide the irrigation essential for high yields. The terrace remnants would be well suited for homesteads.

The valleys are generally well suited for cultivation of aus and transplanted aman paddy. With use of complete fertilizer high yields of both could be obtained. With dry-season pump irrigation from small streams or tubewells, cultivation of short-season dry-land crops would be possible in addition, or of long-season dry-land crops omitting one of the rice crops. Only with relatively expensive gravity drainage, including interceptor drains at the foot of the hills, would it be possible to grow dry-land crops in the monsoon season. This may not be economic, however.

5. IIIWd. Mainly seasonally deeply flooded land. 470 square miles, 20 percent.

This association comprises the deeply flooded phase of Goyainghat-Kanairghat, the Kanairghat-Phagu and the normal phase of Phagu associations (5, 6 and 7), occurring in relatively low floodplain areas throughout Sadar and in the northern part of Moulvi Bazar subdividion.

The soils are of moderate but well sustained natural fertility. They would need fertilizer applications for optimum yields. Most of this land is well suited for cultivation of broadcast aman or, with dry-season irrigation, boro paddy. Small higher areas are suitable for cultivation of two rainy-season rice crops. With modern management

and large-scale dry-season pump irrigation, high yields of boro paddy could be obtained on most of the land. With some field drainage in addition, dry-season dry-land crops adapted to the fine textured soils could be grown.

With major expenditure for flood protection and pump drainage, this land could produce two good wet-land crops in the rainy season. The economics of this would have to be carefully calculated. To attempt to drain these soils for cultivation of dry-land crops during the rainy season would be prohibitively expensive.

6. IIIWr. Seasonally flooded land with irregular relief. 36 square miles, 1.5 percent.

This association comprises the Kusiyara complex (soil association 1), occurring in the margins of two floodplain basins in Moulvi Bazar subdivision.

The land is of moderate natural fertility and would need fertilizers for optimum yields. Most of it is well suited for small-scale cultivation of aus and transplanted aman paddy, and for short-season dry-land crops in the dry season. Provision of irrigation, which could raise yields appreciably, is difficult and relatively expensive due to the irregular land surface and the yearly addition of new sediments on part of the land. With flood protection and pump drainage the higher parts would be well suited for dry-land crops throughout the year, for example sugarcane, but on a small scale due to the irregular topography. The lower parts would still be most suited for small-scale paddy cultivation. It is doubtful whether pump drainage would be economic on this land.

7. IVDe. Mainly well drained steep land. 304 square miles, 13.1 percent.

This association comprises the Khadimnagar, Khadimnagar-Barlekha and Barlekha associations (18, 19 and 20), occurring in the hill ranges near Sylhet and Fenchuganj towns in Sadar and throughout Moulvi Bazar subdivisions.

Natural fertility is relatively low, and all of the land needs fertilizers for optimum yields of agricultural crops. The generally steep and very steep slopes make a good soil cover essential and effectively limit this land to production of forest or adapted perennial crops. Dry-season overhead irrigation would be needed for optimum yields of crops like tea or citrus, but the steep topography makes this very expensive. Also because access and maintenance are expensive, most of this land would be best suited for production of wood or bamboo. Limited areas with relatively favourable topography, for example around piedmont valleys, would be suitable for perennial crops like tea and probably citrus and rubber. Part of the valleys in these areas could serve to impound water for irrigation of good agricultural land nearby.

Possibly the highest central parts of the hill range south-south-east of Kulaura could provide stone in large quantity, but access roads would be expensive to build.

8. IVWd. Mainly seasonally deeply and rapidly flooded land. 330 square miles, 13.9 percent.

The association comprises the Kadipur complex, the rapidly flooded phase of Phagu association, Hakaluki association and Khasgaon complex (soil associations 2,8,9 and 11), occurring in generally deep basin areas, mainly in the northern half of Sadar and locally in Moulvi Bazar subdivisions.

Natural fertility is generally moderate, locally high. No fertilizer data are at present available. Most of this land is not suited for rainy-season cultivation, but could produce good yields of boro paddy with dry-season irrigation and limited flood protection in the

late dry season. Cultivation of short-season dry-land crops like adapted oilseeds, or production of fibre crops like reed or tall grass for paper manufacture might be possibilities. Flood protection and pump drainage for crop production in the rainy season would be prohibitively expensive. Moreover, the basins, especially in the north of Sadar subdivision, act as a buffer for the floodwater pouring in from the North after every heavy rain, and effectively reduce the peak flows and levels of inundation further south.

9. IV. Complex of well drained steep land and continuously wet land. 13 square miles, 0.6 percent.

This association comprises the Juri complex (soil association 24), occurring on both sides of the Juri river. It consists of an intricate mixture of low hills, intermittently flooded, poorly drained, interconnected valleys and seasonally flooded, permanently wet depressions with partly clayey, partly peaty soils.

Natural fertility is generally low and needs to be supplemented by fertilizers for optimum yields. The dissected and very heterogeneous nature of the land makes large-scale development difficult and expensive. Even small-scale pump irrigation would be difficult to provide on the hills. These would be best suited for homesteads, tea, or rainy-season dry-land crops on a small scale.

The intermittently flooded valleys are well suited for cultivation of aus and transplanted aman paddy, and, with small-scale pump irrigation, for a short-season dry-land crop in addition. This irrigation might be relatively expensive to provide. The depressions are very difficult to drain due to seepage water from the surrounding areas. Most of them are only fit for cultivation of boro rice.

Any roads which have to pass through this association could best be situated on the high edge of the piedmont, close to the hills, even if this means a longer road than straight through the depressions. Any causeway over the peaty soils will give continuing trouble due to settling and seasonally poor bearing capacity of the road surface.

10. VDe. Mainly shallow, rocky or stony, steep land. 20 square miles, 0.9 percent.

This association comprises the Tamabil association (25), occurring on a number of low, generally steep and strongly dissected hill ranges near the northern border of Sadar subdivision.

The shallowness, stoniness, erodibility and limited water holding capacity of most of the soils severely restrict the possible use of this area. Wherever the land is accessible, it would probably be most suitable for forest or building sites. Where slopes are not too steep, roads necessary for adjacent areas could be built economically on this land. The surface rocks do not seem suitable for use in building or foundations. The small inclusions of less shallow soils and valleys could be and are used for perennial crops like tea or citrus. They would need dry-season irrigation for adequate growth and production.

11. IVDe-IIDd. Complex of well drained steep and well drained level land. 66 square miles, 2.8 percent.

This association comprises the Barlekha complex (soil association 21), occurring in the central and southern part of Moulvi Bazar subdivision, adjoining the hill ranges. It consists of scattered, generally steep, hills and hillocks, with variable and locally major proportions of somewhat poorly to moderately well drained outwash valleys. Much of the latter area now has adequate gravity drainage for tea. Small areas of high well drained terrace remnants, also under tea, and of poorly drained, intermittently flooded outwash valleys occur almost throughout this association.

Natural fertility throughout the area is relatively low and needs to be supplemented by fertilizer. Much of the land that is artificially or naturally well drained is well suited for tea cultivation, but would need dry-season irrigation for optimum yields. The steep land, while not very difficult of access, would be expensive and difficult to provide with adequate overhead irrigation. The poorly drained, intermittently flooded land would be suited for two rice crops and a short-season dry-land crop with dry-season irrigation, but part could be used for tea with flood protection and gravity drainage, including interceptor drains at the foot of the hills, in addition to overhead irrigation.

12. IVDe-IIDw. Complex of well drained steep land and seasonally wet land. 95 square miles, 4.1 percent.

This association comprises the Mangla Bazar and Beani Bazar complexes (soil associations 22 and 23), occurring mainly from Beani Bazar to the south, along and east of the road to Kulaura, and near Golapganj and Fenchuganj. It consists of densely scattered generally steep hills and hillocks, occupying more than half of this unit, and narrow, poorly drained, intermittently flooded, interconnected valleys.

The steep slopes and the strong dissection would provoke sheet and gully erosion if the hills were cultivated for arable crops, or cleared and left bare during the rainy season. They could be used for crops which cover the ground almost continuously, but these would suffer from serious drought in the later part of the dry season. The natural ferti ity of the hills is low. Only with modern and intensive management, high yields of several perennial dry-land crops could be expected. This would require the use of adequate amounts of complete fertilizer, lime if needed for the crop under consideration, and sprinkler irrigation in the late dry season. These measures may not be economic, however. The hills would be generally well suited for forest.

The valleys are generally well suited for cultivation of aus and transplanted aman paddy. With use of complete fertilizer high yields of both could be obtained. With dry-season irrigation from small streams or tubewells, cultivation of a wide range of dry-land crops would be possible: short-season crops in addition, or long-season ones omitting one of the rice crops. Only with relatively expensive gravity drainage, including interceptor drains at the foot of the hills, it would be possible to grow dry-land crops in the monsoon season. This may not be economic, however.

13. IIIWd-IVDe. Complex of seasonally deeply flooded and well drained steep land. 4 square miles, 0.2 percent.

This association comprises the Phagu-Barlekha complex (soil association 10), occurring in the margin of some basins east of Sylhet town and near Moulvi Bazar town. It consists of basins or basin margins with numerous scattered low hills, many with a fringe a few yards wide of outwash material surrounding them.

The hills are probably best suited for homesteads, for which most of them are actually used, and for small-scale production of dry-land crops in the rainy season if a good ground cover is maintained. Year-round cultivation of dry-land crops on the hills would require dry-season irrigation water in addition, which would be expensive to provide.

The basin areas can be used for boro paddy cultivation with small-scale pump irrigation, possibly from tubewells. Rainy-season cultivation would require flood control and pump drainage, which should only be considered in connection with the extensive adjoining basins in Sadar, and with the adjacent higher floodplain area in Moulvi Bazar subdivision.

CROP SUITABILITY

Introduction

As an aid to the users of this report and accompanying maps, the various kinds of soils have been rated relative to their suitability for the production of a number of common crops. These ratings are called Crop Suitability Classes and range from Class 1 for the most suitable soils to Class 4 for the least suitable.

These ratings are similar to Land Capability Classes, but two important differences should be noted. A rating for crop suitability is a grading for individual crops whereas for land capability it is a grading for overall crop production. Moreover, a crop suitability rating takes into account only the most favourable season of the year for the soil-crop combination under consideration, whereas a land capability rating is based on the limitations of a soil for crop production throughout the year.

Each soil has certain physical and chemical characteristics which affect its response to management and influence yields. For instance, soils best suited for sugarcane production are well drained, medium or moderately fine textured, fertile or responsive to fertilizer applications and have a high base status. Other crops such as rice or tea have different requirements. Therefore, soils in the same land capability class may be differently rated for crop suitability.

The soils are graded according to their present condition or that expected to exist for the next ten years or so under traditional or modern management. If capital improvements are made, as, for example, by providing flood protection or irrigation, then a revised grading of crop suitabilities will be needed for the new situation. Similarly, changes will need to be made with improvements in agricultural technology such as, for instance, the introduction or breeding of improved crop varieties.

Definitions of classes

Suitability Class 1: Well suited

With traditional management, the crop grows well and would produce moderate to high yields. For the crop under consideration, the soil has favourable physical and hydrological characteristics during at least one cropping period per year, has a moderate or high fertility level and is responsive to good management. With modern management, the crop would produce high or very high yields.

Suitability Class 2: Moderately suited

With traditional management, the crop would produce poor to moderate yields or be subject to occasional hazard of failure. The soil may have somewhat unfavourable physical or hydrological characteristics for the crop under consideration, a medium or low fertility level or the response to management may be low.

With modern management, crop yields would be moderate to high. Moderate expenditure on flood protection, drainage and/or irrigation or a relatively high intensity of management would be needed for the crop to produce very high yields.

Suitability Class 3: Poorly suited

Under traditional management, the crop either would not grow, would produce poor yields or would be subject to great hazard of failure. The soil has unfavourable water relations or physical or chemical characteristics, or low fertility not easily corrected, limiting suitability for the crop under consideration. Response to management is low.

Modern management together with major expenditure for water control improvements or with very intensive management practices would be required for the crop to give moderate to high yields. Generally, the crop must be considered as marginal and is not recommended for the soil under consideration.

Suitability Class 4: Not suited

Under traditional management, little, if any, production may be expected from the crop. The soil has severe physical, chemical and/or hydrological limitations for the crop under consideration and response to management is low.

Only with prohibitively high expenditure for major improvements, and very intensive and special management, could a moderate or good yield be expected of the crop under consideration, but this would be considered uneconomic.

Although the ratings given are the result of careful consideration by agricultural specialists, they are estimates and should not be regarded as final. Large-scale expansion of crops now grown on a small scale, or commercial cultivation of newly introduced crops should be preceded by properly managed field trials.

The list of crops is not exhaustive and only gives examples of several representative crops. Absence from the list should not be taken as necessarily indicating a lack of adaptation to local conditions.

The information in table 8 gives the farmer or agricultural planner an opportunity to consider alternative crops or rotations for a given area. Detailed recommendations for management of the various crops, however, are beyond the scope of this report. The user of the land should consult his local Agricultural Officer; the Soil Fertility and Soil Testing Institute, Dacca; the Agricultural Development Corporation, Dacca; or the Tea Research Station, Srimangal where applicable for specific fertilizer recommendations and for advice concerning other management problems.

Notes to table 8

* Broadcast aman: Wherever farmers can grow aus and transplanted aman, they grow these crops in preference to broadcast aman.

* Improved pasture: Considered in the rainy season for piedmont terrace and hill soils, in the dry season for other soils.

Table 8. Crop suitability ratings by soil series and phase

Soil series or phase	wet-land crops					annual dry-land crops				perennial dry-land crops					
	Rice				Jute	Wheat	Tobacco and vegetables		Legumes	Improved pasture	Sugarcane	Bananas	Pineapples	Citrus	Tea
	Boro	Broadcast aman	Transplanted aman	Aus											
SURMA-KUSIYARA FLOODPLAIN															
Recent spill deposits															
Kusiyara	3	*	2	2	2	2	1	1		1	2	3	3	4	4
Kadipur	2	3	3	3	2	3	4	3		2	4	4	4	4	4
Subrecent alluvium															
Balaganj	3	*	1	1	3	2	2	2		2	2	3	3	4	4
Goyainghat, normal phase	3	*	1	1	2	2	2	2		1	2	3	3	4	4
deeply flooded phase	2	1	3	3	3	3	4	2		1	3	4	4	4	4
Kanairghat, normal phase	3	*	1	1	2	2	2	2		1	2	3	3	4	4
deeply flooded phase	2	1	3	3	3	3	4	2		1	3	4	4	4	4
Phagu, normal phase	2	1	3	3	3	3	4	3		1	3	4	4	4	4
rapidly flooded phase	2	3	4	4	4	3	4	3		2	4	4	4	4	4
Terchibari	1	3	4	4	4	4	4	4		3	4	4	4	4	4
Tajpur	3	3	4	4	4	4	4	4		2	4	4	4	4	4
Khasgaon	2	3	4	4	4	3	4	3		2	4	4	4	4	4
Hakaluki	2	3	4	4	3	3	4	3		2	4	4	4	4	4
PIEDMONT															
Subrecent piedmont alluvium															
Bijipur	4	*	1	2	3	3	2	2		2	3	2	2	3	3
Pritimpasa	4	*	1	1	2	2	2	2		2	2	2	2	3	3
Itkhola	3	*	1	1	2	2	3	3		1	2	3	3	4	4
Manu	3	*	1	1	2	2	2	2		1	2	2	2	4	4
Selapur	1	3	4	4	4	4	4	4		3	4	4	4	4	4
Juri	2	3	4	4	4	4	4	4		3	4	4	4	4	4
Jaflong	3	*	2	2	2	2	1	1		1	2	2	1	2	2
Balisira	3	*	2	2	2	1	1	1		1	1	1	1	2	2
Ratna	3	*	1	1	2	1	1	2		1	1	2	2	2	2
Older piedmont terrace															
Lakhaichara, normal phase	4	*	2	3	2	1	1	1		1*	1	1	1	1	1
strongly dissected phase	4	4	4	4	4	4	3	3		2*	3	3	3	2	2
Srimangal, normal phase	4	*	2	3	2	1	1	1		1*	1	1	1	1	1
strongly dissected phase	4	4	4	4	4	4	3	3		2*	3	3	3	2	2
HILLS															
Khadimnagar	4	4	4	4	4	4	4	4		3*	4	3	4	2	2
Barlekha	4	4	4	4	4	4	4	4		3*	4	3	4	2	2
Kulaura	4	4	4	4	4	4	4	4		3*	4	3	4	2	2
Beani Bazar	4	4	4	4	4	4	4	4		2*	4	3	4	3	3
Tamabil	4	4	4	4	4	4	4	4		3*	4	4	4	4	4

APPENDIX

GEOLOGY

Geology and landforms

The survey area is bordered in the north by the abrupt scarp of the 4000 to 6000 feet high Shillong plateau, separating it from the Brahmaputra valley beyond. From the south, the northern tips of the Tertiary Tripura hill ranges intrude into the area, with elevations of 200 to more than 1000 feet. Northeast of Sylhet town and south of Fenchuganj, isolated low hill ranges occur, probably of the same age, but somewhat coarser textured. Most of the hills appear to belong to the Dupitila geological series, with some of the highest parts in the centre of the southern ranges belonging to the Surma and Tipam series. All of the rocks are unconsolidated except in the low ranges near the northern border and in the centre of some of the highest ranges from the south. Most of the hills occur in very steep, strongly dissected, uniformly low ranges, with outliers scattered in the surrounding plain. Hills with associated valleys occupy about 570 square miles, about 25 percent of the area.

Small areas of an old Holocene (Atlantic ?) (or young Pleistocene) piedmont terrace, about 25 to 30 feet above the present piedmont, are associated with several of the southern hill ranges. One small patch was observed near the northern border. The piedmont terrace with associated valleys occupies about 63 square miles, about 3 percent of the area.

Subrecent piedmont deposits (young Holocene) occupy the valleys in the hill ranges and the very gently undulating outwash plains surrounding them. The piedmont along the northern border and around the hill range near Sylhet town is loamy with some sandy material; around the southern hills it is mainly moderately fine and fine textured. The piedmont plains and wider valleys occupy about 280 square miles, about 12 percent of the area.

Most of the surveyed area is covered by subrecent floodplain deposits of the Surma and Kusiyara rivers and their tributaries. About half of the floodplain consists of clayey basins, about half of very gently undulating floodplain ridges and abandoned, levelled-out levee areas, mainly moderately fine and fine textured. A very small area, less than 60 square miles, is occupied by recent alluvium. The floodplain occupies more than 1400 square miles, about 60 percent of the surveyed area.

Geological and geomorphological history

On the basis of field evidence and some published geological information - Wadia (12); Geological Map (4) - the following history might be surmised. It is very tentative and subject to correction, since so few data are available.

Early Tertiary. Folding and faulting: formation of Shillong plateau with formation of vast piedmont deposits in the present surveyed area: coarser textured near the Shillong border, finer textured to the south.

Late Tertiary. Folding, thrust east-west: formation of these piedmont deposits into hill ranges north-south, deflected to northeast-southwest near the stationary Shillong plateau.

Early Pleistocene. Erosion of all of the hill ranges, except some more resistant centres of anticlines in the south, down to a base level (relative sea level) a few hundred feet above the present, causing the present generally concordant summits.

Late Pleistocene (Wurm glacial ?). Deep and strong dissection of the hill ranges, with valleys cut down many feet below the present base level, the sea level being more than 200 feet below present.

Early Holocene (Atlantic, about 6000-4000 B.P). Deposition of a piedmont plain to a base level (relative sea level) about 20 to 30 feet above the present, and deposition of the bluish-coloured, generally clayey, under-water sediment underlying the floodplain and piedmont areas at shallow depth. These two sediments could not very well be placed in the Riss-Wurm interglacial (late Pleistocene), since the subsequent very low sea level (more than two hundred feet below present) in the Wurm glacial would have caused much stronger and deeper dissection of the piedmont terrace than has actually been observed, and would have caused exposure, oxidation, soil formation and dissection in the bluish, reduced lake or bay underwater deposit.

Middle Holocene. Dissection of the piedmont terrace to a few feet below present base level.

Young Holocene. Deposition of a thin (2 to not much over 10 feet) layer of floodplain and piedmont sediments, overlying the previous underwater deposit, during a slight rise in relative sea level to the present, and concurrent and subsequent levelling of the abandoned levee complexes to their present very gently undulating relief.

Present. Continued infilling of a few low-lying basins in the subrecent floodplain by sediment from the Kusiyara and tributaries, forming gently undulating spill levees and basins. Continued slow levelling of the very gently undulating subrecent floodplain and piedmont areas. Most of the sediment now carried by the rivers is deposited further to the west, in the low-lying area of Habiganj subdivision.

Mineralogy

A rapid preliminary examination of some six samples indicated that the composition of the sand fraction in most or all of the soils of the area may be about 60% quartz, 25% weathering feldspars, and the rest biotite, opaque iron minerals (magnetite, haematite, limonite), and a little amphibole, ilmenite, epidote and muscovite. As a comparison, a sample of Jamuna (Brahmaputra) alluvium showed less quartz (about 50%), much weathering feldspar, mica and more amphibole and relatively few heavy minerals.

No clay mineral work has been done in the present survey area. Data from related hill soils in the Chittagong Hill Tracts (unpublished information from the Forestal Survey, 1964-'65) show a major percentage of illite, minor percentages of kaolinite, quartz and weathered, partially expanding illite, absence to traces of montmorillonite, and absence to minor amounts of chlorite and vermiculite. No data for floodplain or piedmont soils are at present available.

Economic geology

Gas is produced in the hill range northeast of Sylhet. This is transported by pipeline to the Fenchuganj fertilizer factory, which produces urea.

Stones and pebbles, mainly sandstone and quartzite with some basic volcanics, are found near the border only in the beds of rivers draining the Shillong plateau. In the rainy season, fresh supplies come into the country from the hills. In the dry season, they are taken out and transported almost throughout the Province for use in subgrade and foundations.

Surface rocks in the hill ranges in the north of Sadar subdivision and almost throughout Moulvi Bazar subdivision appear to be little consolidated and of low quality for construction. Surface rocks in the high south-central part of the hill range south of Kulaura may be usable, but would be expensive to get out due to the unfavourable topography. Both quality and available quantity would have to be further investigated.

Glass sand is produced from a very localized bleached piedmont alluvial deposit on the Kulaura-Moulvi Bazar road, in the eastern part of the hill range intersected by the road.

Small deposits of laterite pebbles and larger stones are used locally for improvement of gravelled or unsurfaced roads.

Clay loam to silty clay floodplain sediments are extensively used for brick making.

HYDROLOGY

As an example of the hydrological conditions in the survey area, graphs were prepared (figure 2) of daily rainfall and water levels at a number of stations, for three months in the rainy season and two months in the dry season: May-July 1964 and January-February 1965. Rainfall stations are Sylhet and Srimangal for Sadar and Moulvi Bazar subdivisions respectively.

For Sadar, two of the three water level stations are on the river entering Pakistan from the Shillong plateau a few miles east of Jaintiapur, which is called Sari and Goyain river and Singer Khal for successive parts of its course until it joins the Surma river at the western border of Sadar. The first station, Sarighat, is located at the crossing of the Sylhet-Jaintiapur road with the river, the second, Salutikar, at the end of the road from Sylhet town to the north, and the third, Chhatak, where the Surma river leaves Sadar subdivision at its western border. In Moulvi Bazar subdivision, one station is at Juri, where the railway crosses the Juri river; one at Manu railway bridge, and one at Manumukh, where the Manu river enters the Kusiyara river.

General river bank levels in most of the survey area are about 1-6 feet below local peak inundation level, and 15-20 feet above low dry-season river level. The basins are generally 8-18 feet below local peak inundation level and 5-15 feet above low dry-season river level.

Rainy-season variations in daily rainfall at Sylhet and, by inference, in the hills to the north, are closely correlated with sudden rises of water level, often exceeding 10-20 feet in a few days at Sarighat. The first basins downstream are not suitable for arable cropping in the rainy season due to this repeated deep and rapid flooding. These basins, however, act as buffers, reducing peak inundation levels and decreasing the rate of rise and fall downstream, as is evident from the graphs for Salutikar and Chhatak.

Rainy-season rainfall in Moulvi Bazar subdivision is less excessive than in Sadar, and much less than in the hills to the north. Therefore, even without basins, as at Manu Railway Bridge, the variations in river levels are less extreme. Upstream in the Juri valley there are a number of shallow basins which already reduce peak levels before Juri railway bridge. The vast basin area of Hakaluki haor, east of Fenchuganj, and some basins southwest of Fenchuganj have effectively removed any peaks due to short-period rainfall at Manumukh.

In the dry season the basins do not operate as buffers since they are out of water at the time. Then, only the date of arrival of peak levels is delayed with increasing distance downstream (see 7 February in the graphs), but peak levels are not reduced.

Observed dry-season discharges in the smaller rivers are close to zero except after rain. Even the Surma and Kusiyara rivers have dry-season discharges generally not exceeding a few hundred cubic feet per second. Assuming a total irrigation requirement of 12 inches in 5 months, and a total usable flow of 400 cubic feet per second, only about 200 square miles could be irrigated from the rivers. This calculation is only a very rough estimate, but it shows clearly that availability of subsurface water in floodplain and piedmont areas should be investigated, as well as possibilities for water storage by dams in the rivers. A discussion of these problems for the whole of East Pakistan is given in the Master Plan, supplement A (3).

Figure 2. Daily water levels and rainfall

2.A. Sadar subdivision

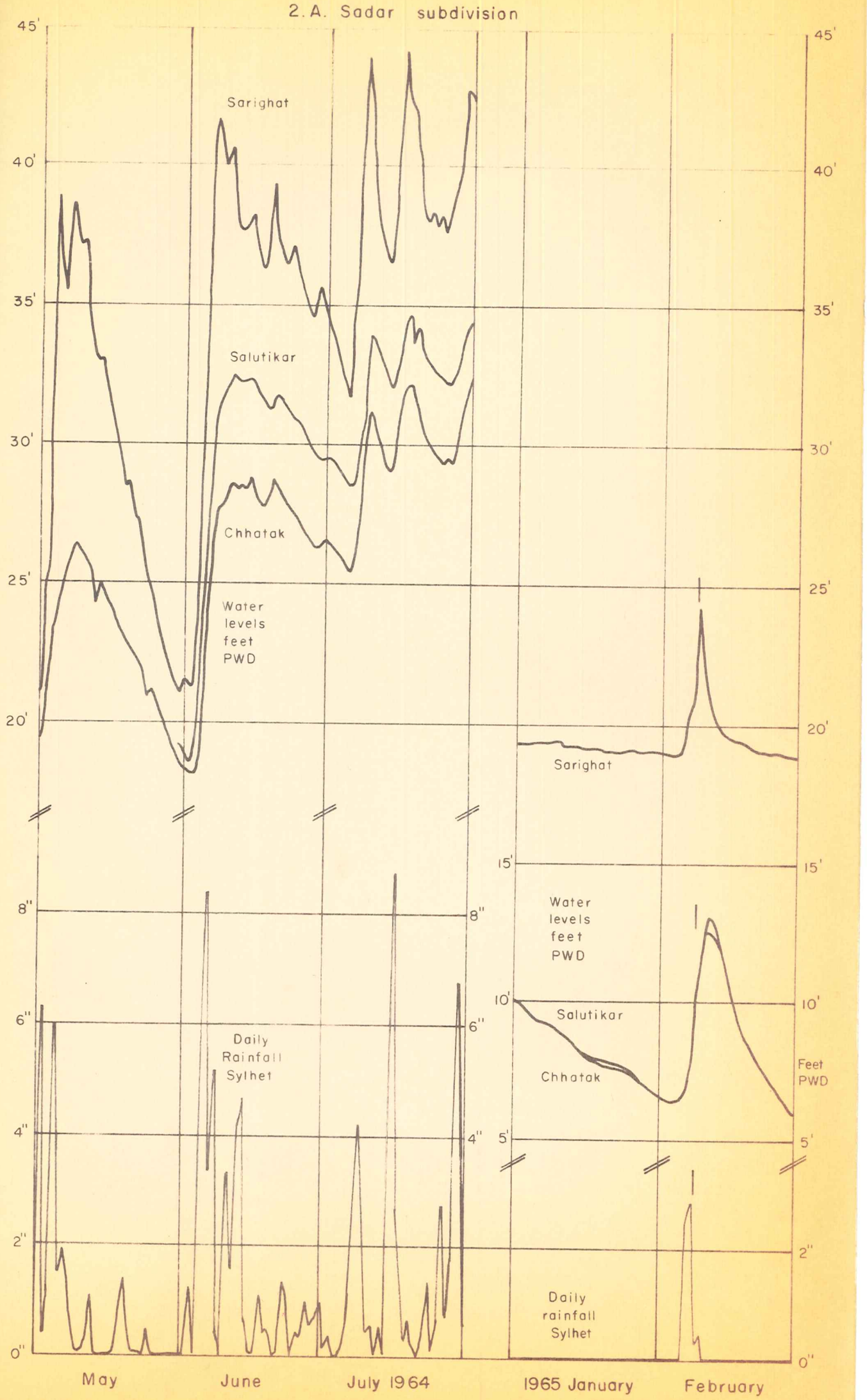
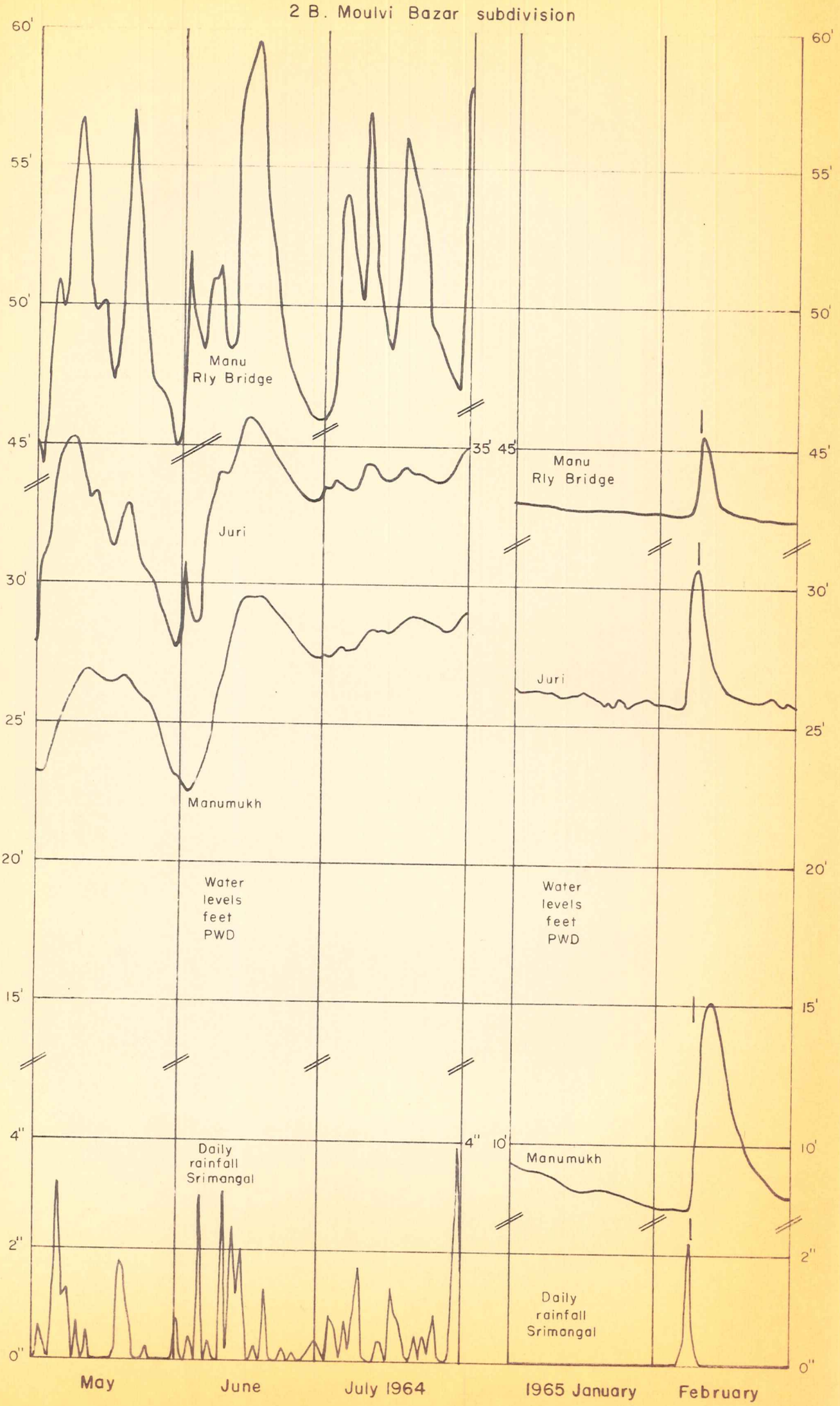


Figure 2. Daily water levels and rainfall

2 B. Moulvi Bazar subdivision



SOILS

Soil classification

Correlation of our present soil series has been attempted into two world classification systems: the FAO definitions (7) and the USDA Soil Classification (10).

The following correlation is tentative and subject to change, since on the one hand the classification systems are neither yet final nor complete, and on the other the correlation is not yet supported by sufficient analytical data.

Two new subgroups were defined to accomodate soils within the USDA Soil Classification. Paraquic Dystrochrepts are Dystrochrepts like the Typic but having many distinct mottles with chromas higher than 2 within 30 inches of the surface. (This definition would narrow the range of the Typic subgroup but would cause no further changes). Vertic Normaquepts are Normaquepts like the Typic but having slickensides that are not close enough to intersect. Clay percentage and exchange capacity of clay exceed 30, and cracks wider than 1 cm reach to a depth of more than 30 cm in the dry season. (This definition would narrow the range of the Typic subgroup but would cause no further changes).

Table 9. Correlation of soil series in the USDA Soil Classification

USDA Soil Classification subgroups	Soil Series	Possible family differentiae
Typic Normaquepts	Kusiyara	(acid to non-acid) loamy, level
	Balaganj	(non-acid) loamy, level
	Pritimpasa	(acid) loamy, level
	Bijipur	(acid to locally non-acid) loamy, level
	Kadipur	clayey, concave, acid
	Terchibari	clayey, concave, acid
	Khasgaon	clayey, concave, acid
	Selapur	clayey, concave, acid
Aeric Normaquepts	Goyainghat	clayey, level, non-acid
	Kanairghat	clayey, level, non-acid
	Itkhola	clayey, level, non-acid
	Manu	clayey, level, acid
	Phagu	clayey, concave, acid
Vertic Normaquepts	Tajpur	clayey, concave, acid
Thapto Histic Normaquepts	Hakaluki	clayey, concave, acid
Histosols (no subdivision)	Juri	(dystrophic ?)
Typic Dystrochrepts	Khadimnagar	sandy (steep)
	Barlekha	loamy (steep)
	Lakhaichara	loamy (level to locally steep)
	Kulaura	clayey (steep)
	Srimangal	clayey (level to locally steep)
Paraquic Dystrochrepts	Jaflong	loamy, level
	Beani Bazar	clayey (sloping to steep)
Aquic Dystrochrepts	Balisira	loamy, level
	Ratna	clayey, level
Lithic Haplorthents	Tamabil	loamy, steep, acid

In the FAO classification, Tamabil series would be included in 2. Lithosols, and Juri series in 35. Organic soils. 4. Alluvial soils would include Selapur and Terchibari series. If the present definition could be changed from ...undifferentiated, wet... to ...undifferentiated or little differentiated, at least seasonally wet..., the following soils would also be included: Kusiyara, Kadipur, Balaganj, Khasgaon and probably Itkhola series.

In the absence of a definition of Grey Hydromorphic soils and Low Humic Gley soils, mentioned in the General Legend of the FAO classification, it is not possible to place the following soils: Goyainghat, Kanairghat, Phagu, Tajpur, Bijipur, Pritimpasa, Manu and possibly Itkhola series.

If the definition of 10. Acid Brown Forest Soils could be changed to include soils under a monsoon climate and with massive to coarse or medium granular or fine angular blocky wormcast structure (not crumbs but massive peds), the following soils would be included: Lakhaichara, Srimangal, Khadimnagar, Barlekha and Kulaura series.

Jaflong, Balisira, Ratna and Beani Bazar series appear to be intergrades between the previous group and hydromorphic soils. They have a relatively high exchange capacity and no eluvial horizon, so they would not intergrade to the Ferruginous Tropical soils. Hakaluki series probably is an intergrade between hydromorphic and Organic soils.

Series descriptions

The series descriptions each contain a statement on occurrence, parent material and associated soils; a short general description of the soil; a representative profile description (for which analytical data are given in the next chapter of the appendix), present land use, and the land capability subclass.

All reactions given are determined in moist or dry soil, except where otherwise stated. The topsoils of most floodplain and many poorly drained piedmont soils become about neutral in reaction after flooding for about two weeks. After drying out in the dry season they become acid again.

The coatings mentioned in many descriptions below are not clay skins in the usual sense: the clay percentage of the horizon containing them may be higher or lower than of the overlying and underlying horizons. The coatings may be thin flows of surface material of all available grain sizes. The horizons with coatings, therefore, are not argillic but have been included in the cambic horizons.

The horizon nomenclature of the Soil Survey Manual Supplement (8) has been followed. It should be noted that all B horizons in the descriptions are cambic horizons. Colour notation is according to the Munsell Soil Color Charts (5).

The drainage has been described in accordance with the Soil Survey Manual (8). Where relevant, the terms 'seasonally flooded, seasonally dry' or 'seasonally flooded, permanently wet' have been added. Within the text, additional data are given on flooding depth and duration where applicable, and on estimated moisture conditions in the dry season.

The descriptions are given in alphabetical order.

Balaganj series

The Balaganj series consists of poorly drained seasonally flooded, seasonally dry soils developed in subrecent to recent floodplain alluvium of the Kusiyara and Surma rivers and their tributaries, occurring generally in small bands on the highest parts of levees and abandoned levee complexes, in association with Goyainghat, and less frequently Kanairghat series.

These soils have a grey to light brownish grey finely mottled, friable silt loam to fine sandy loam topsoil with massive or cloddy structure and strongly acid reaction, overlying a grey mottled strong brown to dark brown, friable silt loam subsoil with moderate coarse angular blocky structure and medium acid reaction. They are generally flooded to shallow depth for 2-5 months during the rainy season. They remain moist for a short period and become dry early in the dry season.

They differ from associated Goyainghat and Kanairghat soils in their coarser texture, less strong structure and thinner and discontinuous coatings, and from the similar Kusiyara series in their somewhat stronger structure, presence of some coatings, less stratification and rather more level topography.

Soil profile: Balaganj series

Loc: Site 1, photo Sylhet 6/22. Near village Gulchander Bazar, Police Station Biswanath. Land use: double cropped rice (aus and transplanted aman). Flooded about 3 feet for 2-3 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Balaganj Police Station.

Horizon	Depth	Description
Ap1	0-5"	Silt loam; light brownish grey (2.5Y6/2 dry) with common fine distinct yellowish brown mottles; massive breaking into moderate coarse angular cloddy structure with common fine tubular pores; slightly hard when dry; many fine roots; strongly acid; abrupt smooth boundary.
Ap2	5-10"	Silt loam; pale olive (5Y5/3 dry) with common fine distinct strong brown mottles; moderate coarse and very coarse angular blocky structure with common fine tubular pores and thin patchy fine sand skins along vertical and horizontal ped faces; hard when dry; common fine and very fine roots; medium acid; abrupt smooth boundary.
B1	10-18"	Silty clay loam; grey (5Y5/1 dry) with common medium distinct strong brown mottles; moderate coarse and very coarse angular blocky structure with common fine tubular pores and thin patchy iron-manganese skins along vertical and horizontal ped faces and pores; slightly hard when dry; common very fine roots; medium acid; abrupt smooth boundary.
B21	18-25"	Silt loam, light brownish grey (2.5Y6/2 moist) with common/medium distinct strong brown mottles; moderate very coarse angular blocky structure with common fine tubular pores and thin patchy grey coatings along vertical and horizontal ped faces and pores; friable when moist; few very fine roots; medium acid; clear smooth boundary.
B22	25-35"	Loam, grey (5Y6/1 moist) with common medium distinct dark brown mottles; moderate very coarse angular blocky structure with common fine tubular pores and thin patchy coatings along vertical and horizontal ped faces and pores; friable when moist, medium acid; gradual smooth boundary.

Horizon	Depth	Description
B3	35-45"	Silty clay loam; grey (5Y6/1 moist) with common medium distinct strong brown mottles; weak very coarse and coarse prismatic structure with common fine tubular pores; friable when moist; medium acid; abrupt smooth boundary.
C1	45-56"	Silt loam; grey (5Y5/1 moist) with common coarse distinct dark brown mottles; massive, stratified, friable when moist; medium acid.

Range in characteristics

Subsoil texture may be fine sandy loam, or a thin band of silty clay loam may be present. Subsoil colour may be olive grey to pale yellow in some horizons, and reaction ranges to strongly acid in few cases. Stratification may start from as high as 2 feet.

Land use

Present land use is mainly double cropped rice (aus and transplanted aman) and homesteads, with some dry-season dry-land crops wherever permanent water is available for irrigation by traditional means. A few small areas on abandoned levees in areas of Phagu series are used for broadcast aman because of deep flooding. Land capability subclass IIW.

Balisira series

The Balisira series consists of moderately well to somewhat poorly drained moderately fine textured soils developed in subrecent piedmont materials. They occur on what is either a slightly dissected, somewhat older, 3-foot terrace or the higher gently undulating part of the subrecent piedmont plain near and in some hill areas in Moulvi Bazar subdivision. They are associated with the Jaflong series which occupies a larger part of the association; locally with Lakhaichara and Srimangal series occurring on high terrace remnants, with scattered outliers of hill soils; and with areas of the Manu or Pritimpasa associations extending below them toward the floodplain.

They have a yellowish brown to pale olive, generally friable, fine sandy loam to clay loam topsoil with massive to moderate coarse angular blocky structure, very strongly acid, overlying a greyish brown to dark yellowish brown, mottled yellowish brown friable fine sandy clay loam to silty clay loam subsoil with moderate coarse angular blocky structure, strongly to very strongly acid. The substratum is generally a grey mottled yellowish brown loamy sand. They are subject to occasional flooding after heavy rain. The areas under tea have gravity drainage.

They differ from the Jaflong and Ratna series in their finer and less fine texture respectively; from the Lakhaichara and Srimangal series in their poorer drainage; and from all other piedmont and floodplain soils in their better drainage and browner colour.

Soil profile: Balisira series

Location: Site 1, photo Sylhet 13/34. Near village Mobarukpur, Police Station Kulaura. Land use: double cropped rice (aus and transplanted aman). Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Balisira valley, south and southwest of Srimangal, Police Station Srimangal.

Horizon	Depth	Description
Ap	0-6"	Loam; pale olive (5Y6/3 dry) with few fine faint yellowish brown mottles, massive with many fine tubular pores; hard when dry, many fine roots; very strongly acid; abrupt smooth boundary.

Horizon	Depth	Description
A3	0-17"	Clay loam; greyish brown (2.5Y5/2 moist) with common fine distinct yellowish brown mottles; moderate coarse and very coarse angular blocky structure with many fine tubular pores; firm when moist; common fine roots; very strongly acid; clear wavy boundary.
B2	17-37"	Loam; grey (5Y6/1 moist) with many fine distinct yellowish brown mottles; weak coarse and very coarse prismatic breaking into coarse angular blocky structure with many fine tubular pores; friable when moist; very strongly acid; gradual boundary.
B3	37-50"	Sandy loam; light grey (N7/ moist) with many fine faint pale olive mottles; weak coarse and very coarse prismatic structure with many fine tubular pores; very friable when moist; very strongly acid; abrupt wavy boundary.
C1	50-76"	Clay loam; grey (5Y5/1 moist) with many medium distinct yellowish brown mottles; moderate coarse and very coarse prismatic structure with many fine and medium tubular pores and medium nearly continuous coatings along vertical ped faces and pores, and locally fine sand skins overlying coatings; moderately firm when moist; medium acid; clear wavy boundary.
IIC2	76-86"	Sandy loam; grey (5Y6/1 moist) with common medium distinct yellowish brown mottles; single grain structure; loose when moist; strongly acid; clear wavy boundary.
IIIC3	86-104"	Clay loam; grey (5Y5/1 moist) with few fine distinct yellowish red and yellowish brown mottles; weak coarse and very coarse prismatic structure with few fine and medium tubular pores and thin nearly continuous coatings along vertical ped faces and pores; friable when moist; strongly acid; clear wavy boundary.
IIIC4	104-109"	Silty clay loam, yellowish brown (10YR5/8 moist) with few fine distinct grey, strong brown and dark brown mottles; massive; firm when moist, very strongly acid; abrupt wavy boundary.
IIIC5g	109-130"	Silt loam; dark bluish grey (5B4/1 moist); massive; nonplastic and nonsticky when wet; neutral.

N.B. This profile has been described to more than 10 feet because the available exposure to this depth shows the bluish or greenish permanently reduced substratum. This generally clayey but in some cases loamy substratum was observed wherever deep exposures were available, below depths of 2 to 10 feet in the floodplain and below 6 feet or deeper in the piedmont area. Sea also Kanairghat series.

Range in characteristics

In part of the area under rice, the topsoil is grey. The substratum texture may range to clay.

Present land use

Tea and double cropped rice (aus and transplanted aman) occupy nearly all of this series, with some homesteads and tea labourers' villages on the remainder. Land capability subclass IIDw.

Barlekha series

The Barlekha series consists of generally steep, well drained soils developed in moderately fine textured little consolidated folded probably Tertiary sediments. They occur on moderately to very steep topography, in strongly dissected anticlinal hill ranges and scattered hills in association with Khadimnagar, Kulaura and small patches of Beani Bazar series, and with the different piedmont and piedmont terrace soils in the valleys and surrounding piedmont plains.

These soils have a generally yellowish brown, friable to very friable sandy loam to clay loam topsoil with massive to fine angular blocky structure, strongly to very strongly acid, overlying a yellowish brown to strong brown friable sandy clay loam to clay loam subsoil with weak subangular to moderate angular blocky structure, very strongly acid. Substratum is similar to subsoil or may be steeply dipping bedded little consolidated rock. These soils are droughty in the late dry season.

They differ from Khadimnagar series in their finer texture; from Kulaura and Beani Bazar series in their less fine texture; from Tamabil series in their greater depth of soil and the absence of consolidated rock strongly hampering root development; and from Srimangal and Lakhaichara series in their steep topography, often shallower profile and lesser porosity.

Soil profile: Barlekha series

Location: Site 2, photo Sylhet 8/37. Near village Mollapur, Police Station Beani Bazar. Land use: orange orchard. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Barlekha village, Police Station Barlekha.

Horizon	Depth	Description
A11	0-3"	Sandy loam; dark grey (N4/ moist); massive; very friable when moist; few very fine roots; strongly acid; clear wavy boundary.
A12	3-11"	Sandy loam; brown (10YR4/3 moist); massive with many fine tubular pores, friable when moist; few very fine roots; strongly acid; gradual smooth boundary.
B2	11-22"	Sandy clay loam, strong brown (7.5YR5/6 moist); weak coarse to fine subangular blocky structure with many fine and medium tubular pores; friable when moist; few very fine roots; very strongly acid; gradual boundary.
B3	22-42"+	Sandy clay loam, strong brown (7.5YR5/6 moist); massive with many medium tubular pores; firm when moist; very strongly acid.

Range in characteristics

The topsoil colour is grey to dark grey in a few cases. In a few borings and pits, some concretions were observed in the subsoil. The substratum is either similar to the subsoil, or consists of generally steeply dipping, bedded, little consolidated generally shaley and locally sandy rock.

Present land use

Most of the area of this series is under forest or bamboo. Small areas, mainly around piedmont valleys or piedmont terrace, are used for tea cultivation. Many of the small scattered hills of this series are used for homesteads, thatching grass or small pineapple or orange orchards. Land capability subclass IVDe.

Beani Bazar series

The Beani Bazar series consists of generally sloping to steep, moderately well drained soils developed in fine textured little consolidated folded probably Tertiary sediments. They occur on moderately to very steep topography, in strongly dissected low anticlinal hill ranges and scattered hills, in association with Barlekha and Kulaura series, and with Pritimpasa, Itkhola and Manu series in the valleys running throughout the area.

These soils have a brown to light yellowish brown, friable clay loam to silty clay loam topsoil with angular blocky structure, very strongly acid, overlying a pale olive to yellowish brown generally mottled yellowish red, friable silty clay loam to clay subsoil with medium and fine angular blocky structure, very strongly acid. Substratum is a dark brown to yellowish brown mottled generally yellowish red, firm clay. Most of this series occurs on small hillocks strongly dissected by a network of piedmont valleys. There is some doubt whether this is a moderately well drained hill soil or a truncated phase of Kulaura series. These soils are droughty in the late dry season.

They differ from all other hill soils and from the piedmont terrace soils in their poorer drainage, and from the Balisira and Ratna series in the absence of grey substratum colour, generally better drainage and very different physiography.

Soil profile: Beani Bazar series

Location: Site 2, photo Sylhet 10/13. Near village Dakhingul, Police Station Barlekha. Land use: homesteads, nearby forest. Series established in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Beani Bazar village and Police Station.

Horizon	Depth	Description
A1	0-5"	Clay loam; brown (10YR5/3 moist); moderate medium angular blocky structure with common fine and many very fine tubular pores; friable when moist; common fine roots; very strongly acid; gradual smooth boundary.
A3	5-20"	Clay; yellowish brown (10YR5/8 moist); moderate medium and fine angular blocky structure with many fine and very fine tubular pores; friable when moist; common fine and medium roots; very strongly acid; gradual smooth boundary.
B21	20-36"	Clay; strong brown (7.5YR5/8 moist) with common fine faint yellowish red mottles; strong medium and fine angular blocky structure with common fine and many very fine tubular pores; friable when moist; few fine roots; very strongly acid; gradual boundary.
B22	36-51"	Clay; yellowish brown (10YR5/8 moist) with many fine faint strong brown mottles; strong medium and fine angular blocky structure; firm when moist; very strongly acid; gradual smooth boundary.
B23	51-67"	Clay; brownish yellow (10YR6/6 moist) with many fine faint yellowish red and few fine distinct very dark grey mottles; strong fine angular blocky structure; firm when moist; very strongly acid.

Range in characteristics

Subsoil texture ranges from silty clay loam to clay, mottling colours from olive yellow to yellowish red. The deep substratum may be of any texture.

Present land use

Most of this series is under homesteads and forest or bush. Small areas are under thatching grass. Land capability subclass IVDe.

Bijipur series

The Bijipur series consists of poorly drained intermittently flooded soils developed in subrecent moderately coarse textured piedmont deposits. They occur in piedmont plains, valleys and fans, in association with Pritimpasa series, and with scattered hills and hillocks mainly of Khadimnagar series. Locally there are very sandy inclusions, generally only in bands of a few or a few tens of yards wide and small patches of very poorly drained soils. In some of the areas mapped near the northern border the normal phase of the Bijipur series is associated with a shallow phase over loose medium sand, which is considerably more droughty than the normal phase.

These soils have a grey friable sandy loam to loam topsoil with massive or cloddy, rarely granular structure, medium to strongly acid, overlying a grey mottled yellowish brown to strong brown friable or very friable sandy loam to loam subsoil with massive or weak blocky structure. Reaction may be slightly to strongly acid. These soils are intermittently flooded after heavy rain. On most of the land the water is ponded for rice cultivation. The soils are droughty in the late dry season.

They differ from the associated Pritimpasa series in their coarser texture; from the floodplain soils in the absence of seasonal flooding, their coarser texture, greater subsoil porosity and weaker structure; and from Jaflong series occupying slightly higher parts of the piedmont plains, fans and valleys in their poorer drainage, greater frequency and depth of intermittent flooding, their grey colour in top and subsoil and the presence of mottling throughout the profile.

Soil profile: Bijipur series

Site 20, photo Sylhet 6/30. Near village Khadimnagar, Police Station Sylhet. Land use: double cropped rice, (aus and transplanted aman). Shallowly flooded for 2 to 3 days after heavy rain. Series set up in soil survey of Sadar North and South subdivisions, Comilla district, 1965. Source of name: Bijipur village, Police Station Burichang, Comilla district.

Horizon	Depth	Description
Ap1	0-4"	Loam; grey (5Y5/1 moist) with common fine distinct strong brown mottles; massive with common fine tubular pores; friable when moist; many very fine roots; strongly acid; abrupt smooth boundary.
Ap2	4-6"	Loam; grey (5Y5/1 moist) with common fine distinct strong brown mottles; massive with few fine tubular pores; friable when moist; common very fine roots; medium acid; abrupt smooth boundary.
B1	6-11"	Sandy loam; grey (5Y6/1 moist) with few fine distinct yellowish brown mottles; massive with few very fine tubular pores; very friable when moist; few very fine roots; medium acid; abrupt wavy boundary.
B21	11-16"	Sandy loam; light grey (5Y7/1 moist) with common fine distinct brown and yellowish brown mottles; massive with common fine tubular pores; very friable when moist; few very fine roots; slightly acid; clear wavy boundary.
B22	16-26"	Loam; grey (5Y6/1 moist) with common fine distinct reddish brown mottles; massive breaking into weak medium angular cloddy structure with common fine tubular pores; slightly acid; abrupt smooth boundary.
C1	26-48"+	Loam; grey (5Y6/1 moist) with many medium and coarse distinct yellowish brown mottles and common fine distinct black concretionary mottles; massive breaking into weak medium angular blocky structure with common fine tubular pores; friable when moist; slightly acid.

Range in characteristics

The topsoil colour ranges from grey to (rarely) olive, the subsoil colour from light grey to olive grey or light brownish grey. The substratum may go to sand or clay with depth, but generally is sandy loam to fine sandy clay loam.

Present land use

Nearly all of this series is used for double cropped rice (aus and transplanted aman). Homesteads occupy only a small part wherever hills nearby afford easier protection from flash floods, but up to a quarter of the area where no hills are near. Small strips along creeks are triple cropped: a double rice crop and one of a variety of dry-season dry-land vegetables, potatoes, oil seeds or tobacco. All these are irrigated by traditional hand methods. Land capability subclass IIDw. The shallow phase over sand would be placed in land capability subclass IIIDw if mappable areas existed.

Goyainghat series

The Goyainghat series consists of poorly drained seasonally flooded, seasonally dry soils developed in subrecent moderately fine textured floodplain alluvium of the Surma and Kusiyara rivers and their tributaries, occurring on levees and levelled-out abandoned levee complexes, generally in association with Kanairghat series. They tend to occur in larger proportion near rivers and crests of abandoned levees than toward the basins.

These soils have a grey, medium to finely mottled, friable to slightly hard silt loam to silty clay loam topsoil with massive to cloddy structure over a thin angular blocky ploughpan which is very strongly to strongly acid. This overlies a grey mottled yellowish brown to dark brown, friable to firm clay loam to silty clay loam subsoil with coarse angular blocky structure, changing to prismatic with depth, and a medium acid to neutral reaction. The normal phase is flooded up to 1-4 feet for 1-6 months, the deeply flooded phase 4 to 10 feet for 4-7 months. They remain moist for a few months and become dry before the middle of the dry season.

They differ from the associated Kanairghat series in their less fine texture, from Balaganj series which generally occurs as inclusions on small high patches, in their finer texture and stronger structure; from Kusiyara series in their lack of stratification at shallow depth, stronger structure and presence of coatings; and from Fritimpasa series, which has similar texture and occurs on the piedmont plain, by their stronger structure, presence of coatings, and seasonal flooding.

Soil profile: Goyainghat series

Site 8, photo Sylhet 9/28. Near village Osmanpur, Police Station Balaganj. Land use: double cropped rice (aus and transplanted aman). Flooded about 2 feet for about 1 month. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Goyainghat Police Station.

Horizon	Depth	Description
Ap1	0-5"	Loam; pale olive (5Y6/3 moist) with few medium distinct yellowish red mottles; massive, breaking into weak medium and fine angular cloddy structure with many fine and very fine tubular pores and thin patchy yellowish red iron skins along pores; firm when moist; many fine and very fine roots; very strongly acid; abrupt wavy boundary.

Horizon	Depth	Description
Ap2	5-9"	Silty clay loam; grey (5Y5/1 moist) with common fine and medium distinct yellowish brown and few fine distinct very dark brown mottles; strong very coarse prismatic breaking into moderate coarse angular blocky structure with many very fine tubular pores and medium nearly continuous coatings along vertical and horizontal ped faces and pores; firm when moist; common fine and very fine roots; mildly alkaline; clear wavy boundary. This horizon is a plough pan.
B2	9-18"	Clay loam; grey (N5/moist) with many fine and medium distinct yellowish brown and few fine distinct very dark brown mottles; strong coarse prismatic breaking into moderate coarse angular blocky structure with many fine and very fine tubular pores and medium nearly continuous coatings along vertical and horizontal ped faces and pores; friable when moist; common very fine roots; mildly alkaline; clear wavy boundary.
B3	18-26"	Silty clay loam; grey (N5/moist) with many fine and medium distinct reddish brown and few fine distinct very dark brown mottles; strong very coarse prismatic breaking into weak very coarse angular blocky structure with common fine and very fine tubular pores and medium nearly continuous coatings along vertical ped faces and pores; friable when moist; few very fine roots; mildly alkaline; clear wavy boundary.
C1	26-41"	Silt loam; light yellowish brown (2.5Y6/2 moist) with many medium distinct dark brown mottles; moderate very coarse prismatic breaking into weak very coarse angular blocky structure with many fine and very fine tubular pores and thin nearly continuous silt and fine sand skins along vertical ped faces and pores; very friable when moist; few very fine roots; mildly alkaline; gradual wavy boundary.
C2	41-54"+	Silty clay loam; grey (5Y6/1 wet) with many medium distinct dark reddish brown mottles; weak very coarse prismatic breaking into angular blocky structure with common fine and very fine tubular pores and thin patchy coatings along pores; slightly plastic and slightly sticky when wet; few very fine roots; mildly alkaline.

Range in characteristics

Small areas of this series are normally flooded by a few inches of rain water only. The topsoil colour may be olive, the texture ranges from loam to clay in few cases. Subsoil colour may be olive grey and reaction may be mildly alkaline in rare cases. Locally, stratification was observed from 20 to 24 inches down. A variant with greyish brown to olive subsoil colours occurs in few small areas.

Land use

Present land use is double cropped rice (aus and transplanted aman) and homesteads on the normal phase and single cropped rice (long stem paddy, broadcast aman) on the deeply flooded phase. In few very small areas near permanent water, a dry-season dry-land crop is grown with traditional methods of irrigation. Land capability subclass for the normal phase: IIW, for the deeply flooded phase: IIIWd.

Hakaluki series

The Hakaluki series consists of poorly drained seasonally flooded, seasonally dry soils developed in subrecent mineral and organic materials in the Surma-Kusiyara floodplain. They occur in basins and basin depressions, in association with Phagu series, and locally with small patches of Kusiyara and Kadipur series. The peat is generally well decomposed and appears to be largely herbaceous in origin.

These soils have a grey to very dark greyish brown friable clay to peaty clay topsoil, very strongly acid, overlying peat or alternating clayey and peaty strata, generally soft and very sticky/when wet. They are deeply flooded for 7 to 9 months, and floodwater rises rapidly. The topsoil remains moist for less than 2 months in the dry season, but the peaty subsoil remains wet nearly all the year.

They differ from the associated Phagu series and all other floodplain soils in the presence of peaty material in the profile; and from Juri series, occurring in piedmont depressions, by their position in the landscape and the presence of a mineral topsoil throughout their area of occurrence.

Soil profile: Hakaluki series

Location: Site 3, photo Sylhet 11/32. In Hakaluki Haor, Police Station Kulaura. Land use: grazing land, short grass. Deeply flooded during rainy season. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Hakaluki Haor - a large basin area in the eastern part of Moulvi Bazar subdivision.

Horizon	Depth	Description
A1	0-5"	Clay; grey (N5/ moist) with many fine distinct yellowish red mottles; moderate coarse and very coarse prismatic structure with many very fine tubular pores and thin nearly continuous coatings along vertical and horizontal ped faces and thin patchy iron skins along horizontal ped faces; friable when moist; many fine and very fine roots; very strongly acid; abrupt wavy boundary.
IIC1	5-14"	Peat; black (5YR2/1 wet); weak prismatic and moderate medium angular blocky structure; friable when wet; many very fine roots; very strongly acid; clear smooth boundary.
IIC2	14-22"	Peat; black (5YR2/1 wet); strong coarse angular blocky structure, bedded material; slightly hard when wet; very strongly acid; clear boundary.
IIC3	22-35"	Peat; locally with some mineral material; dark grey (N4/ wet) with common fine brown pieces, weak thin platy structure, thinly bedded remnants of leaves and stems; friable when wet; very strongly acid; clear boundary.
A1b	35-40"	Clay with many organic remains, dark grey (N4/ wet); massive; very soft, very sticky and nonplastic when wet; medium acid (reduced).
C1gb	40-50"	Clayey peat; very soft, very sticky, nonplastic when wet. (no sample).

Range in characteristics

The topsoil colour may be greenish grey in places, structure is massive to prismatic or angular blocky, and reaction very strongly to slightly acid, varying with the degree of reduction. The depth to peaty material may vary from about 5 inches to slightly over 2 feet in places, and the peat thickness from 1 to more than 4 feet. The substratum may be very soft and semi-liquid.

Present land use

Hakaluki soils are used for grazing (unimproved grazing land), with small areas of single cropped rice (boro) where irrigation water is available in the dry season. Land capability subclass IVWd.

Itkhola series

The Itkhola series consists of poorly drained intermittently flooded soils developed in subrecent clayey piedmont deposits. They occur in piedmont plains and valleys, in association with Manu series, in which association it occupies a minor part, and with Pritimpasa series. They also occupy parts of small valleys in association with Barlekha and Kulaura hill soils.

These soils have a grey finely mottled silty clay to clay topsoil with massive or cloddy structure, very strongly to strongly acid, overlying a grey to light grey mottled yellowish brown, friable or slightly plastic and slightly sticky silty clay to clay subsoil with coarse angular blocky structure, without coatings or with coatings only on vertical ped faces, very strongly to medium acid. These soils are subject to intermittent flooding after heavy rain. On most of the land water is ponded for rice cultivation. The soils remain ~~wet~~ moist for about 2 months and dry out before the middle of the dry season.

They differ from the associated Manu series in the absence of clay skins on horizontal ped faces; from the other poorly drained piedmont soils by their finer texture; and from Selapur series, which occurs in piedmont basins in the Juri valley, in their less poor drainage and absence of vegetative matter mixed throughout the soil.

Soil profile: Itkhola series

Location: Site 1, photo Sylhet 18/29. Near village Itkhola, Kurmah tea estate, Police Station Kamalganj. Land use: double cropped rice (aus and transplanted aman). Flooded 2-3 days after heavy rain. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Itkhola village, Police Station Kamalganj.

Horizon	Depth	Description
Ap	0-4"	Silty clay loam; grey (5Y6/1 dry) with common fine distinct yellowish brown mottles, mainly along root channels; strong very coarse angular cloddy structure with many fine and common medium tubular pores; slightly hard when dry, friable when moist; many fine roots; very strongly acid; abrupt smooth boundary.
B1	4-10"	Silty clay loam; grey (5Y5/1 moist) with many fine distinct yellowish brown mottles; strong medium and coarse angular blocky structure with many fine tubular pores and thin nearly continuous coatings along vertical ped faces; friable when moist; common fine roots; very strongly acid; clear wavy boundary.
B2	10-21"	Silty clay; grey (5Y5/1 moist) with many fine distinct yellowish brown mottles; strong coarse prismatic and angular blocky structure with many fine tubular pores and thick continuous coatings along vertical ped faces; friable when moist; few fine roots; very strongly acid; gradual boundary.
C1	21-46"	Clay; grey (5Y5/1 moist) with many fine distinct yellowish ~~/~~brown mottles and scattered medium and coarse black concretions; moderate very coarse prismatic structure with common fine tubular pores and medium continuous coatings along vertical ped faces and pores; friable and slightly sticky when moist, concretions hard; strongly acid; clear wavy boundary.

Horizon	Depth	Description
C2	46-57"+	Clay, grey (N5/ moist) with common fine distinct yellowish brown and few fine distinct dark brown mottles; moderate very coarse prismatic structure with few very fine tubular pores and thin nearly continuous coatings along vertical ped faces; friable and slightly sticky when moist; medium acid.

Range in characteristics

Some small patches of a very poorly drained, seasonally flooded, grey to light grey clay valley soil with massive structure have been included. The substratum ranges from clay to clay loam.

Present land use

Itkhola soils are used for double cropped rice (aus and transplanted aman), locally some homesteads, and for a third crop in the dry season in a few places where irrigation water is available. The small patches of a very poorly drained variant are mostly under single cropped rice (broadcast aman). Land capability subclass IIDw.

Jaflong series

The Jaflong series consists of moderately well to somewhat poorly drained moderately coarse to medium textured soils developed in subrecent piedmont materials. They occur on gently undulating topography: on the higher parts of piedmont fans near the northern border, in small patches in piedmont valleys between the hills throughout the area, and in what is either a slightly dissected, somewhat older 3-foot terrace or the higher part of the subrecent piedmont plain near and in some hill areas in Moulvi Bazar subdivision. They are associated with Balisira series in the same positions, locally with Srimangal and Lakhaichara series occurring on much higher terrace remnants, with scattered outliers of hill soils, and with areas of the Manu or Pritimpasa associations extending below them toward the floodplain.

They have a very friable to friable sandy loam to silt loam topsoil, very strongly acid, overlying a light olive brown to dark yellowish brown mottled pale olive to dark brown, very friable to friable fine sandy loam to silt loam subsoil with massive or weak cloddy to moderate coarse angular blocky structure, very strongly to strongly acid. The substratum is generally grey mottled brown. Near the northern border of Sadar subdivision a small part of the area of this series is occupied by a shallow phase over sand. The soils are subject to occasional flooding after heavy rain. The areas under tea have gravity drainage. On part of the land water is ponded for rice cultivation.

They differ from the Balisira and Ratna series in their coarser texture; from the Lakhaichara and Srimangal series in their poorer drainage; and from all other piedmont and floodplain soils in their better drainage and browner colour.

Soil profile: Jaflong series

Location: site 7, photo Sylhet 5/33. In Burjan tea estate, Police Station Goyainghat. Land use: tea (undergrowth ferns and grass). Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Jaflong tea estate, Police Station Goyainghat.

Horizon	Depth	Description
A11	0-4"	Sandy loam; brown (10YR5/3 moist); massive, breaking into weak coarse angular cloddy structure with many fine tubular pores; very friable when moist; many fine and few medium and coarse roots; very strongly acid; abrupt smooth boundary.

Horizon	Depth	Description
A12	4-10"	Fine sandy loam; yellowish brown (10YR5/6 moist); massive breaking into weak coarse angular cloddy structure with many fine tubular pores; very friable when moist; common fine and medium and few coarse roots; very strongly acid; clear smooth boundary.
B21	10-18"	Fine sandy loam; dark yellowish brown (10YR4/4 moist) with few fine faint pale olive mottles; massive breaking into weak coarse angular cloddy structure with many fine pores; very friable when moist, common fine and few medium and coarse roots; very strongly acid; clear smooth boundary.
B22	18-25"	Fine sandy loam; olive (5Y5/3 moist) with common medium faint dark yellowish brown and yellowish brown mottles; massive with many fine tubular pores; very friable when moist; common fine and few medium and coarse roots; very strongly acid; clear boundary.
C1	25-50"	Loamy sand; grey (5Y5/1 moist) with few fine distinct light yellowish brown and common medium distinct yellowish brown mottles; single grain structure; very friable when moist; few coarse roots, very strongly acid; clear boundary.
C2	50-57"+	Loamy sand; grey (5Y5/1 moist); single grain structure; very friable when moist; few coarse roots, very strongly acid.

Range in characteristics

Under tea, the topsoil is brown to yellowish brown, massive or cloddy; under rice it is grey, massive to medium angular blocky. The substratum ranges from silt loam, locally silty clay loam, to loamy sand or sand: sand only near the northern border of Sadar subdivision.

Present land use

More than half of this series is used for tea cultivation. The shallow phase over sand remains under scrub. The rest of the land is used for double cropped rice (aus and transplanted aman), with locally a dry-season dry-land crop where irrigation water is easily available. Land capability subclass IIDw. The shallow phase over sand would go into land capability subclass IIIDw if mappable areas existed.

Juri series

The Juri series consists of very poorly drained seasonally flooded, permanently wet soils developed in probably subrecent organic deposits, occurring in the lowest parts of small piedmont depressions, mainly in the Juri valley. They occur in association with Selapur and Manu series which occupy the higher parts and highest margins of these depressions respectively.

These soils have a thin grey silty clay to black peat topsoil overlying a dark greyish brown to very dark grey peat to clayey peat subsoil, generally fibrous and with some woody fragments. They are flooded up to 3-7 feet for 5-8 months, and remain wet for most or all of the year.

They differ from all other piedmont and most floodplain soils in their organic profile; and from Hakaluki series in the absence of a mineral topsoil in the majority of cases, and in their location in piedmont depressions.

Soil profile: Juri series

Location: Site 3, photo Sylhet 11/34. Near village Juri, Police Station Kulaura. Land use: single cropped rice (transplanted aman). Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Juri river and village, Police Station Kulaura.

Horizon	Depth	Description
Ap	0-4"	Silty clay; grey (5Y5/1 wet) with common fine distinct brown mottles and scattered dead rice straw; massive with common fine tubular pores; plastic and slightly sticky when wet; many fine roots, medium acid; clear smooth boundary.
IIC1	4-20"	Clayey peat with abundant remains of mainly woody organic matter; slightly plastic and sticky when wet; medium acid; gradual smooth boundary.
IIC2	20-48"+	Clayey peat with many remains of sedges; very dark grey (10YR3/1 wet); massive, bedded and fibrous; slightly plastic and very sticky when wet, medium acid.

Range in characteristics

A thin mineral topsoil may be present or absent. The subsoil texture ranges from clayey peat to peat, consistence from plastic and slightly sticky to nonplastic and slightly to very sticky. Reaction ranges from medium to extremely acid.

Present land use

Most of this series is used for single cropped rice (transplanted aman, broadcast aman or boro, depending on flooding depth and water supply), the rest is poor grassland. Land capability subclass IVWw.

Kadipur series

The Kadipur series consists of poorly drained seasonally flooded, seasonally dry soils developed in recent floodplain alluvium of the Kusiyara river and its southern tributaries, occurring in very gently to gently undulating basins, generally associated with Kusiyara series on levees of spill channels and with Phagu series within the basins.

These soils have a dark greyish brown to greenish grey silty clay loam to clay topsoil with or without mottling, with generally massive or very coarse prismatic structure, overlying a dark greyish brown to greenish grey friable clay loam to clay subsoil with moderate medium angular blocky or prismatic structure without coatings, and locally with iron staining along ped faces, strongly to very strongly acid. They are generally flooded up to 10-15 feet for 5 to 7 months, and flood water rises rapidly. They are wet or moist for more than 2 months and dry out rather late in the dry season.

They differ from the associated Kusiyara series in their location in basins, finer texture, locally more greenish colour, and in the less clear stratification in the subsoil; from the associated Phagu series in their less developed structure, absence of coatings, more friable consistence, and locally less fine texture and more irregular relief. They differ from the Khasgaon series, occupying rather similar positions near piedmont edges in their more greenish colour, locally finer texture, and different associated higher soils: Kusiyara series as against Pritimpasa with Khasgaon.

Soil profile: Kadipur series

Location: site 1, photo Sylhet 9/36. Near village Bagla, Police Station Golapganj. Land use: single cropped rice (boro). Flooded up to 12-15 feet for 6-7 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Kadipur village, Golapganj Police Station.

Horizon	Depth	Description
Ap	0-8".	Clay, greyish brown (2.5Y5/2 wet) with common fine distinct yellowish brown and strong brown mottles, mainly along pores, moderate very coarse prismatic structure with common fine and medium tubular pores; plastic and slightly sticky when wet; common fine roots; very strongly acid in oxidized part and neutral in reduced part; clear broken boundary.
B21g	8-15"	Clay; greenish grey (5BG5/1 wet) with many medium distinct strong brown mottles; weak medium angular blocky structure with common fine and very fine tubular pores; plastic and slightly sticky when wet; common fine roots; very strongly acid in oxidized part and neutral in reduced part; gradual boundary.
B22g	15-28"	Clay; bluish grey (5B5/1 wet) with many coarse and fine distinct strong brown mottles; plastic and slightly sticky when wet; slightly acid; gradual boundary.
C1	28-32"	Clay; grey (N5/ wet) with common fine and medium distinct yellowish brown mottles; plastic and nonsticky when wet; very strongly acid; gradual boundary.
C2	32-48"	Clay; light grey (N6/ moist) with few fine distinct yellowish brown and brownish yellow mottles; plastic and slightly sticky when wet; very strongly acid.

Range in characteristics

Topsoil texture ranges from silty clay loam to silty clay, rarely clay; topsoil reaction from mildly alkaline to very strongly acid, probably dependent on the state of oxidation or reduction, since very different reactions were measured in reduced and oxidized portions of the same clod.

Land use

Present land use is unimproved grazing land, or single cropped rice (boro) where irrigation water is available in the dry season. Land capability subclass IVWd.

Kanairghat series

The Kanairghat series consists of poorly drained seasonally flooded, seasonally dry soils developed in subrecent clayey floodplain alluvium of the Surma and Kusiyara rivers and their tributaries, occurring on levees and levelled-out abandoned levee complexes, generally in association with Goyainghat series. They tend to occur in greater proportion towards the basins and in level areas than near river courses and levee crests.

These soils have a grey, finely mottled, friable to hard silty clay loam topsoil with generally massive or cloddy (Ap1) over coarse angular blocky (Ap2) structure, medium to strongly acid, overlying a grey mottled yellowish brown, friable to firm silty clay to clay subsoil with strong medium angular blocky to coarse prismatic structure, medium acid to neutral. The normal phase is flooded 1 to 4 feet for 1-6 months, the deeply flooded phase 4 to 10 feet for 5-7 months. The soil remains moist for a relatively short period and is dry for most of the dry season.

They differ from the associated Goyainghat series, and from Balaganj series occurring in small patches on high parts of the levees, in their finer texture, from Kusiyara series occurring in recent spill areas of various size in the presence of coatings on vertical and horizontal ped faces, finer texture and absence of stratification at shallow depth, and from the closely similar Manu series occurring in piedmont plain areas, in their slightly lower porosity and in their seasonal flooding as opposed to the flash flooding by rain water on Manu soils. They differ from associated Phagu soils in the basins by their lesser flooding depths, less fine textured topsoil and slightly less acid reaction throughout, and by the presence of thin silt skins in and below the ploughpan in many profiles, which are visible only in dry soil, however.

Soil profile: Kanairghat series

Location: site 1, photo Sylhet 9/26. Near village Suratpur, Police Station Balaganj. Land use: double cropped rice (aus and transplanted aman). Flooded 1-2 feet for about 4 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Kanairghat Police Station.

Horizon	Depth	Description
Ap1	0-4"	Silty clay loam, grey (5Y6/1 dry, 5Y5/1 moist) with common fine distinct yellowish brown and strong brown mottles around pores; moderate coarse and medium angular cloddy structure with many fine and medium tubular pores and thin patchy coatings along pores; friable when moist; many fine roots; medium acid; abrupt wavy boundary.
Ap2	4-6"	Silty clay, grey (5Y5/1 moist) with common fine distinct strong brown and very dark grey mottles; strong very coarse, coarse and medium prismatic structure with common fine tubular pores and thin patchy white silt skins and thin continuous coatings on vertical and horizontal ped faces; very firm when moist; common fine roots; slightly acid; clear smooth boundary, but horizon sticking to B2.
B2	6-17"	Clay, grey (5Y5/1 moist) with common fine distinct yellowish brown and strong brown and few fine distinct yellowish red mottles, strong coarse and very coarse prismatic and strong medium angular blocky structure, with common fine and few medium tubular pores and continuous coatings on vertical and horizontal ped faces and few patchy light grey silt skins, firm when moist, few fine roots; slightly acid; gradual smooth boundary.
B3	17-32"	Clay; grey (5Y5/1 moist) with many fine distinct yellowish brown and common fine distinct dark greyish brown mottles; moderate very coarse prismatic structure with many fine and few medium tubular and few medium vesicular pores and medium continuous grey and olive grey coatings on vertical ped faces, friable when moist; few fine roots; slightly acid; diffuse wavy boundary.
C1	32-48"	Clay; grey (N5/ moist) with many fine distinct yellowish brown and dark brown mottles; massive to very coarse prismatic structure with many fine and very fine tubular pores and medium patchy coatings on vertical ped faces; friable when moist; slightly acid; gradual boundary.
C2	48-63"	Clay; grey (N5/ moist) with many fine distinct yellowish brown and dark brown mottles; massive to weak very coarse prismatic structure with many fine and very fine tubular pores and medium patchy coatings on vertical ped faces; friable when moist; neutral; abrupt wavy boundary.
C3g	63-72"+	Clay; greenish grey (5BG5/1 wet, estimated) with common fine, medium and coarse greenish mottles, massive; plastic and slightly sticky when wet, moderately alkaline.

N.B. This profile has been described to six feet because the available fresh exposure to this depth shows the bluish or greenish permanently reduced substratum. This generally clayey but in some cases loamy substratum was observed wherever deep exposures were available, below depths of 2 to 10 feet in the floodplain and below 6 feet or deeper in the piedmont area. See also Balisira series.

Range in characteristics

Small patches of this series are normally flooded by a few inches of rain water only. The topsoil colour may be olive grey and the texture ranges from silt loam to silty clay. Subsoil structure ranges from coarse prismatic to coarse and medium angular blocky. In a few cases, stratification was observed below 20 to 24 inches. Substratum texture may be silty clay loam, and strong gleying may be present from about 4 feet. A variant with greyish brown to light olive brown subsoil colour occurs in few very small areas.

Land use

Present land use is double cropped rice (aus and transplanted aman) and homesteads on the normal phase and single cropped rice (long stem paddy, broadcast aman) on the deeply flooded phase. Small inclusions of this series in areas of Phagu under grazing grass generally support a stand of thatching grass with or without some 'hizal' trees, which can stand seasonal submergence to several feet. Land capability subclass for the normal phase: IIW; for the deeply flooded phase: IIIWd.

Khadimnagar series

The Khadimnagar series consists of generally steep, well drained soils developed in moderately coarse textured unconsolidated folded probably Tertiary sediments. They occur on moderately to very steep topography, in strongly dissected low hill ranges and scattered hills, in association with Barlekha series, and with Lakhaichara, Jaflong and Bijipur series in the valleys.

These soils have a dark yellowish brown to pale brown very friable to friable sandy loam topsoil with granular to fine angular blocky wormcast structure, generally very strongly acid, overlying a dark yellowish brown to brownish yellow very friable to friable sandy loam to loamy sand subsoil with massive to moderate medium cloddy structure, very strongly acid. The substratum is generally similar to the subsoil, but locally bedded, steeply dipping unconsolidated sandstone. These soils are droughty in the late dry season.

They differ from all other hill soils in their coarser texture; from the Lakhaichara and Srimangal series in their steep topography, generally lesser porosity and less deep profile.

Soil profile: Khadimnagar series

Location: site 14, photo Sylhet o/30. In Khadimnagar tea estate, Police Station Sylhet. Land use: forest being cleared for tea. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Khadimnagar tea estate, Police Station Sylhet.

Horizon	Depth	Description
A1	0-2"	Sandy loam; pale olive (5Y6/3 dry); moderate fine angular blocky structure, all wormcasts, with many fine pores; soft when dry; many fine and common medium roots; slightly acid; abrupt smooth boundary.
B1	2-5"	Sandy loam; pale yellow (2.5Y7/4 dry); weak fine and medium angular blocky structure with many fine pores; soft when dry, friable when moist; many fine and common medium roots; very strongly acid, abrupt smooth boundary.

Horizon	Depth	Description
B21	5-14"	Sandy loam, yellowish brown (10YR5/6 moist); single grain structure; very friable when moist; common fine and medium roots; very strongly acid; clear wavy boundary.
B22	14-36"	Loamy sand, yellowish brown (10YR5/6 moist), single grain structure; very friable when moist, common fine and few medium roots; very strongly acid, diffuse boundary.
B23	36-60"+	Loamy sand; yellowish brown (10YR5/6 moist), single grain structure; very friable when moist; very strongly acid.

Range in characteristics

An excessively drained variant consisting of pink sand occupies few very small patches. Depth of soil to bedded material may range from more than 6 feet to about 30 inches. Locally, a subsoil horizon may contain concretionary mottles.

Present land use

Most of this series is under forest, bamboo or forest plantation. Minor areas, mainly around the larger piedmont valleys, are used for tea cultivation. Except on southern and southwestern slopes, the tea survives well. For highest production sprinkler irrigation would be required in the late dry season, but access and maintenance are more difficult and expensive on these hills than on terraces or piedmont plains. Land capability subclass IVDe.

Khasgaon series

The Khasgaon series consists of poorly drained seasonally flooded, seasonally dry soils developed in subrecent to recent moderately fine textured basin sediments, deposited in the Surma-Kusiyara floodplain but derived from the rivers draining the hills north of the area. They occur in association with Phagu series found in the basins wherever no piedmont material was deposited, and with Pritimpasa series on the present or abandoned levees criss-crossing the basins.

These soils have a very dark greyish brown to dark grey friable clay loam topsoil, generally with strong angular blocky structure, medium to strongly acid, overlying an olive to dark grey friable silty clay loam to silty clay subsoil with coarse angular blocky structure, neutral to strongly acid. They are deeply and rapidly flooded after every heavy rain, and remain flooded for 5-8 months. They are wet or moist for more than 2 months in the dry season and become dry for a rather short period.

They differ from the associated Phagu series in the basin in their less fine texture and the weak development or absence of clay skins, from Pritimpasa soils on the adjoining levees and ridges in their lower position in the landscape and stronger structure; from the similar Kadipur series, occurring in the floodplain, by their different associated ridge soil: Pritimpasa instead of Kusiyara, their position near a major piedmont area, their more brownish or olive colours and their slightly greater apparent age.

Soil profile: Khasgaon series

Location: site 15, photo Sylhet 2/34. Near Kakai bil, Police Station Goyainghat. Land use: mainly thatching grass. Flooded up to 12-14 feet for about 5 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Khasgaon village, Police Station Goyainghat.

Horizon	Depth	Description
A1	0-4"	Clay loam; very dark greyish brown (10YR3/2 moist); moderate fine angular blocky structure with common fine tubular pores; friable when moist; many fine roots; strongly acid; abrupt smooth boundary.
A3	4-10"	Silty clay; dark grey (10YR4/1 moist) with many fine distinct dark brown mottles; strong coarse prismatic and angular blocky structure with common fine tubular pores and thin nearly continuous iron skins on vertical ped faces; friable when moist; common fine roots; strongly acid; abrupt smooth boundary.
B2	10-22"	Silty clay; dark greyish brown (10YR4/2 moist) with common medium distinct dark reddish brown mottles; moderate coarse angular blocky structure with common fine tubular pores; friable when moist; common fine roots; strongly acid; clear boundary.
C1	22-34"+	Silty clay; light olive grey (5Y6/2 wet) with common medium distinct yellowish brown and few fine distinct dark brown mottles; massive with common fine tubular pores; slightly plastic and nonsticky when wet; strongly acid.

Range in characteristics

Small patches of very poorly drained, massive, plastic and slightly sticky silty clay loam have been included in this series. Topsoil colours range from very dark greyish brown to dark grey, reaction from medium to strongly acid. Subsoil colours range from dark greyish brown to olive, structure from coarse prismatic to coarse angular blocky, reaction from neutral to strongly acid. Silt loam or silty clay horizons may be present, and an occasional thin band of very humous material.

Present land use

Khasgaon soils are used for grazing (unimproved grazing land), with areas of thatching grass, small patches of dry-season dry-land crops and little single cropped rice. Land capability subclass IVWd.

Kulaura series

The Kulaura series consists of generally steep, well drained soils developed in fine textured little consolidated folded probably Tertiary sediments. They occur on moderately to very steep topography, in strongly dissected anticlinal hill ranges and scattered hills, in association with Barlekha and some Khadimnagar and Beani Bazar series, and with the finer textured piedmont and piedmont terrace soils in the valleys and surrounding plains.

These soils have a yellowish brown to brown, friable when moist to hard when dry, sandy clay loam to silty clay topsoil with generally granular wormcast structure, (no crumbs), very strongly acid, overlying a yellowish brown to strong brown, friable when moist to slightly hard when dry, clay to clay loam subsoil with medium and fine angular blocky structure, very strongly acid. They are droughty in the late dry season.

They differ from Beani Bazar series in their better drainage and absence of mottling; from all other hill soils in their finer texture; and from Srimangal series in their steep topography, and generally less porous and less deep profile.

Soil profile: Kulaura series

Location: site 1, photo Sylhet 18/25. In Amrail tea estate, Police Station Srimangal. Land use: tea. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Kulaura village, Police Station Kulaura.

Horizon	Depth	Description
A1	0-4"	Very fine sandy clay loam; yellowish brown (10YR5/4 dry); strong coarse and medium granular wormcast structure with many fine and common medium tubular pores; hard when dry; common fine roots; very strongly acid, abrupt smooth boundary.
A3	4-13"	Very fine sandy clay loam; yellowish brown (10YR5/6 dry); strong coarse and medium angular blocky structure with many fine and common medium tubular pores; slightly hard when dry; common fine roots; very strongly acid; clear smooth boundary.
B21	13-26"	Clay loam; yellowish brown (10YR5/6 dry), strong medium angular blocky structure with many fine and common medium tubular pores; slightly hard when dry; common fine roots; very strongly acid, clear smooth boundary.
B22	26-41"	Clay loam; yellowish brown (10YR5/8 dry); strong medium angular blocky structure with many fine and common medium tubular pores; hard when dry; common fine roots; very strongly acid; clear wavy boundary.
B3	41-52"	Clay loam; brownish yellow (10YR6/8 moist) with common fine faint strong brown mottles; moderate medium angular blocky structure with many fine and common medium tubular pores; hard when dry; common fine roots; very strongly acid; clear smooth boundary.
C1	52-67"	Clay loam; pale olive (5Y6/3 moist) with common fine faint yellowish brown and few fine distinct dark brown mottles; strong medium subangular blocky structure with few fine tubular pores; hard when dry; very strongly acid; clear smooth boundary.
C2	67-73"+	Clay loam; greyish brown (2.5Y5/2 moist) with common medium distinct brownish yellow and yellowish brown mottles; strong medium subangular blocky structure with thin patchy manganese skins along vertical ped faces and pores; very hard when dry; very strongly acid.

Range in characteristics

The topsoil texture ranges from sandy clay loam to silty clay. Soil depth to partly disintegrated, broken rock ranges from more than 6 feet to about 24 inches. Locally, the subsoil may be finely mottled dark red to yellowish red, and in these cases the substratum has medium dark red to yellowish red mottles.

Present land use

Most of this series is under forest or bamboo, with smaller areas under scrub. Areas near piedmont terraces or piedmont valleys are often used for tea where slopes are favourable. Scattered hills of this series in piedmont or floodplain are generally used for homesteads, thatching grass and small orchards. Land capability subclass IVDe.

Kusiyara series

The Kusiyara series consists of poorly drained seasonally flooded, seasonally dry soils developed in recent floodplain alluvium of the Kusiyara river and its southern tributaries, occurring on generally gently undulating spill areas and levees of spill channels, in association with Kadipur and Phagu series in basins and with Goyainghat, Balaganj and some Kanairghat series on older levees.

These soils have a light brownish grey to olive friable loam to silty clay loam topsoil with massive to platy or moderate coarse angular blocky structure overlying a grey to olive friable loam to silty clay loam subsoil with evidence of stratification, slightly to strongly acid. They are generally flooded up to 3-5 feet for 2-5 months. They remain moist for a relatively long period and dry out late in the dry season.

They differ from the associated Kadipur soils in basin sites by their location, less fine texture, more brownish or olive colour, and their clear stratification from shallow depth; from Goyainghat series occurring on similar sites in the subrecent floodplain by their more undulating relief, the absence of coatings on ped faces and their more friable consistence. They differ from Pritimpasa series occurring on the piedmont plain in their seasonal flooding, their more undulating relief, more friable topsoil and more olive colour.

Soil profile: Kusiyara series

Location: site 5, photo Sylhet 6/36. Near village Barojoni Chelulbag, Police Station Zakiganj. Land use: double cropped rice (aus and transplanted aman). Flooded to shallow depth for about 4 months. According to local information more than 3 feet of new sediment deposited in the last few years. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Kusiyara river, Sylhet district.

Horizon	Depth	Description
Ap	0-6"	Fine sandy loam; grey (5Y6/1 dry); single grain structure; loose when dry; common fine roots; medium acid; abrupt smooth boundary.
C1	6-9"	Silt loam; olive brown (2.5Y4/4 moist) with common medium distinct strong brown mottles; massive breaking into cloddy structure with many fine and medium tubular pores and medium patchy dark red iron skins along vertical and horizontal ped faces and pores; friable when moist; common fine roots; medium acid; clear smooth boundary.
C2	9-18"	Loam; olive (5Y5/4 moist) with common medium distinct yellowish brown mottles; massive breaking into cloddy structure with common fine tubular pores, very friable when moist; few fine roots; medium acid; abrupt smooth boundary.
C3g	18-25"	Loam; dark greenish grey (5G4/1 moist); massive breaking into weak angular blocky structure with few fine and very fine tubular pores and thin patchy dark red iron skins along vertical and horizontal ped faces and pores; friable when moist; strongly acid; gradual smooth boundary.
C4	25-40"+	Loam; olive (5Y4/4 moist) with common fine faint yellowish brown mottles; weak medium subangular blocky structure with thin patchy dark red iron skins along ped faces; friable when moist; strongly acid.

Range in characteristics

The topsoil colour ranges from light brownish grey to grey or olive, texture from fine sandy loam to silty clay loam, structure from massive or platy to moderate coarse angular blocky. Reaction may be medium to very strongly acid. The subsoil colour ranges from greenish grey to olive, texture from loam to silty clay loam, structure is massive or platy, consistence friable when moist to plastic, nonsticky when wet. The reaction in topsoil and subsoil is slightly acid in reduced condition to strongly acid when oxidized.

Present land use

Kusiyara soils are generally used for double cropped rice (aus and transplanted aman) or locally unimproved grazing land. Scattered areas support a winter crop in addition. Land capability subclass IIIWr.

Lakhaichara series

The Lakhaichara series consists of well drained soils developed in old Holocene or late Pleistocene piedmont terrace deposits. They occur on deeply dissected, nearly level (normal phase) to steep (strongly dissected phase) terrace remnants, in association with larger areas of Srimangal series; with Itkhola, Manu and Pritimpasa series in most of the valleys; locally with Balisira series in some small valleys; and with Barlekha and Kulaura series on the hills.

These soils have a brown to dark brown, friable sandy loam topsoil with weak coarse angular blocky structure, very strongly acid, overlying a brown to yellowish brown, friable sandy loam to sandy clay loam subsoil with weak blocky to massive structure, very strongly acid. They are droughty in the late dry season.

They differ from the associated Srimangal series in their coarser textures; from all other piedmont soils in their better drainage and occurrence on high piedmont terrace remnants, and from the hill soils in their often nearly level topography, deeper profile, greater porosity and in the absence of rock fragments or bedding in the substratum.

Soil profile: Lakhaichara series

Location: site 1, photo Sylhet 16/23. In Baraura tea estate, Police Station Srimangal. Land use: tea. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Lakhaichara village, Police Station Srimangal.

Horizon	Depth	Description
A1	0-5"	Sandy loam; dark brown (10YR4/3 moist); weak coarse angular blocky structure with many fine tubular pores; friable when moist; many fine, few medium and coarse roots; very strongly acid; clear smooth boundary.
B1	5-14"	Sandy clay loam; brown (10YR5/3 moist); weak coarse angular blocky structure with many fine and medium tubular pores; friable when moist; many fine, few medium and coarse roots; very strongly acid; clear smooth boundary.
B2	14-29"	Sandy clay loam; yellowish brown (10YR5/4 moist); weak coarse angular blocky structure with many fine and medium tubular pores; friable when moist; common fine, few medium and coarse roots; very strongly acid; gradual boundary.
C1	29-40"	Sandy loam; yellowish brown (10YR5/8 moist); massive; very friable when moist; few medium and coarse roots; very strongly acid, gradual boundary.
C2	40-52"+	Sandy clay loam; olive yellow (2.5Y6/6 moist); massive; very friable when moist; few medium and coarse roots; very strongly acid.

Range in characteristics

On few occasions this series was observed. There is a very small range in the observed characteristics. Most of this series occurs on old Holocene terrace remnants, but it was also found in some small colluvial-alluvial subrecent valleys in the Khadimnagar association.

Present land use

Nearly all of the normal phase of this series is used for tea, most of the strongly dissected phase is covered with thatching grass. Land capability subclass of the normal phase: IID, of the strongly dissected phase: IIIDr.

Manu series

The Manu series consists of poorly drained intermittently flooded soils developed in subrecent piedmont deposits. They occur in wide nearly level piedmont plains, in association with Itkhola and Pritimpasa series, and bordering large areas of Kanairghat and Goyainghat series in the adjoining floodplain. The soils of the surrounding hill ranges are mainly Barlekha and Kulaura series.

These soils have a grey finely mottled, firm to hard clay loam to silty clay topsoil with massive or coarse cloddy structure, very strongly acid, overlying a grey mottled yellowish brown to strong brown firm clay to silty clay subsoil with strong coarse angular blocky structure and coatings, grading into very coarse prismatic structure with depth, strongly to medium acid. They are flooded up to 1-2 feet for a few days to a week after heavy rain. They remain moist for less than 2 months in the dry season and are dry for a relatively long period.

They differ from the associated Itkhola series in their stronger structure and the presence of coatings on all ped faces; from the Selapur series occurring in small basins by their less poor drainage, absence of organic remains in the profile and stronger structure; from the Pritimpasa series by their stronger structure and finer texture; and from the closely similar Kanairghat series, occurring in similar position in the floodplain, by the absence of seasonal flooding and their often slightly higher porosity.

Soil profile: Manu series

Location: site 1, photo Sylhet 14/31. Near village Mansurpur, Police Station Kulaura. Land use: double cropped rice (aus and transplanted aman). Intermittently flooded to shallow depth after heavy rain. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Manu river, a tributary of the Kusiyara in Moulvi Bazar subdivision.

Horizon	Depth	Description
Ap1	0-3"	Clay loam; grey (5Y6/1 dry) with common fine distinct yellow mottles mainly along root channels; strong very coarse angular cloddy structure with narrow hexagonal cracks and common fine and medium tubular pores; very hard when dry; many fine roots; very strongly acid; abrupt smooth boundary.
Ap2	3-6"	Clay loam; grey (5Y5/1 moist) with common fine distinct yellowish brown mottles mainly along root channels; strong very coarse, coarse and medium angular blocky structure with few fine and medium tubular pores and thin nearly continuous coatings and patchy light grey silt skins along vertical and horizontal ped faces; firm when moist; few fine roots; strongly acid; clear smooth boundary. This horizon is a plough pan.
B21	6-13"	Clay; grey (5Y5/1 moist) with common fine distinct strong brown mottles; strong coarse and medium angular blocky structure with many fine tubular pores and thin continuous coatings along vertical and horizontal ped faces; moderately firm when moist; few fine roots; strongly acid; abrupt wavy boundary.
B22	13-27"	Clay; greyish brown (2.5Y5/2 moist) with common fine distinct yellowish brown mottles; strong very coarse and coarse prismatic structure with many fine tubular pores and medium continuous coatings along vertical ped faces and pores, thin patchy coatings along horizontal ped faces and thin patchy light grey silt skins along vertical and horizontal ped faces; friable when moist; medium acid; gradual boundary.

Horizon	Depth	Description
B3	27-35"	Clay; grey (N5/ moist) with many fine distinct yellowish brown mottles and common coarse to fine concretions; moderate very coarse prismatic structure with medium continuous coatings along vertical ped faces; plastic and slightly sticky when moist; medium acid; gradual boundary.
C1g	35-54"+	Clay loam; greenish grey (5GY5/1 moist) with many fine distinct yellowish brown mottles and many fine distinct very dark greyish brown concretions; massive; plastic and slightly sticky when moist; medium acid.

Range in characteristics

The topsoil texture ranges from silty clay loam to silty clay, colour in few cases is pale olive; subsoil may have patchy silt skins over the coatings; substratum colour ranges from olive grey to greenish grey.

Present land use

Nearly all of this series is used for double cropped rice (aus and transplanted aman), with a small percentage under homesteads and villages. Scattered, very small patches near water are also used for dry-season dry-land crops. Land capability subclass IIDw.

Phagu series

The Phagu series consists of poorly drained seasonally flooded, seasonally dry clay soils, developed in subrecent alluvium of the Surma and Kusiyara rivers and their tributaries in most of the floodplain basins and basin margins.

These soils have a grey to dark grey, finely mottled, generally firm to very hard clay topsoil with strong angular blocky structure and very strongly acid reaction, overlying a grey mottled yellowish brown to strong brown, firm clay subsoil with strong angular blocky to prismatic structure and strongly acid reaction. The normal phase is flooded about 6-10 feet, the rapidly flooded phase about 8-15 feet for 5-8 months. They remain moist for a relatively short time and become dry before the middle of the dry season.

They differ from Tajpur soils occurring on similar topography in their lighter colour, less coarse structure and less firm consistence; from Techibari soils which occur in some basin depressions in their better drainage and stronger and deeper structure; from Kanairghat soils occurring on adjacent basin margins and levees in their clay texture throughout, the absence of a silty topsoil and their generally stronger acidity. They differ from Hakaluki soils in the absence of organic horizons in the profile, and from Khasgaon and Kadipur soils occurring in basins near piedmont edges and recent spill basins respectively in their lack of stratification, finer texture and stronger structure.

Soil profile: Phagu series

Location: site 4, photo Sylhet 5-37. Near village Bara Haor, Police Station Kanairghat. Vegetation: grazing and thatching grass. Flooded 10-12 feet for about 6 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Phagu village, Sadar subdivisions.

Horizon	Depth	Description
A1	0-4"	Clay; grey (N5/ dry) with few fine distinct strong brown mottles; strong very coarse, coarse and medium angular blocky structure with common fine tubular pores; very hard when dry; many fine roots; very strongly acid; abrupt wavy boundary.

Horizon	Depth	Description
A3	4-10"	Clay; dark grey (N4/ moist) with common fine distinct strong brown mottles; strong coarse and medium angular blocky structure with many medium and fine tubular pores and nearly continuous dark grey coatings along vertical and horizontal ped faces and root channels; very firm when moist; common fine roots; strongly acid; clear wavy boundary.
B21	10-28"	Clay; grey (N5/ moist) with many medium distinct strong brown and very dark grey mottles; strong medium and fine angular blocky structure with many medium and fine tubular pores and nearly continuous dark grey coatings along vertical and horizontal ped faces and root channels; firm when moist; common fine roots; strongly acid, clear wavy boundary.
B22	28-36"	Clay; dark grey (10YR4/1 moist) with few fine faint very dark grey and strong brown mottles; strong medium and fine angular blocky structure with few fine tubular pores and grey nearly continuous coatings along vertical and horizontal ped faces; friable when moist; few fine roots; medium acid; clear wavy boundary.
IIC1	36-48"	Silt loam; grey (N6/ moist) with many medium and coarse distinct strong brown and yellowish brown mottles; moderate medium and fine angular blocky structure with few fine tubular pores and nearly continuous coatings along ped faces; friable when moist; few fine roots; medium acid; gradual wavy boundary.
IIC2	48-52"+	Silt loam; grey (N6/ moist) with many coarse distinct dark brown mottles; weak medium and fine angular blocky structure with few fine tubular pores; very friable when moist; medium acid.

Range in characteristics

Colour of the A horizon ranges from grey to dark grey, and clay skins in the subsoil may be grey to dark grey. The topsoil may be silty clay, and in rare cases the subsoil is dark grey in colour. Topsoil structure under rice is massive or cloddy, under grass generally medium to fine angular blocky. Consistence may be friable to very hard, but is generally firm in the subsoil. In very few cases the substratum is silty clay loam to loam.

Land use

At present, Phagu series is used for cultivation of single cropped rice (broadcast aman or boro) or as unimproved grazing land where deeply and rapidly flooded. Thatching grass and reeds grow in few small areas. Land capability subclass for the normal phase: IIIWd; for the rapidly flooded phase: IVWd.

Pritimpasa series

The Pritimpasa series consists of poorly drained intermittently flooded soils developed in subrecent moderately fine textured piedmont deposits. They occur mainly in plains, but also in valleys and fans, on nearly level or very gently undulating topography. They are associated with Bijipur soils occurring in varying proportions, with Barlekha and other hill soils which may be scattered in the plain and which surround the valleys. Near the northern border they are associated with somewhat poorly drained piedmont soils on the higher parts of the piedmont fan, and with Khasgaon and some Phagu soils in the adjoining floodplain basins. Here the topography of Pritimpasa series is gently undulating ridges.

These soils have a grey finely mottled friable silty clay loam to fine sandy loam topsoil with massive, cloddy or moderate medium angular blocky structure, medium to strongly acid, overlying a grey mottled yellowish brown to dark greyish brown, friable silty clay loam to fine sandy clay loam subsoil with weak to moderate coarse angular blocky structure without or with thin patchy silt skins and coatings, medium to strongly acid. They are intermittently flooded after heavy rain. On most of the land water is ponded for rice cultivation. The soils are droughty in the late dry season.

They differ from Bijipur series in their finer texture, from the similar Kusiyara series in their weaker stratification, different physiographic location and absence of seasonal flooding; from other floodplain soils in the absence or weak development of structure and coatings. They differ from the somewhat poorly drained piedmont soils in their grey colours and mottling throughout the profile.

Soil profile: Pritimpasa series

Location: site 2, photo Sylhet 14/31. Near village Pritimpasa, Police Station Kulaura. Land use: double cropped rice (aus and transplanted aman). Flooded up to 1-2 feet for 2-3 days after heavy rain. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Pritimpasa village, Police Station Kulaura.

Horizon	Depth	Description
Ap1	0-4"	Loam; grey (5Y6/1 moist) with common fine distinct brownish yellow mottles; massive with many fine tubular pores; very friable when moist; many fine roots; strongly acid; abrupt smooth boundary.
Ap2	4-7"	Loam; grey (5Y6/1 moist) with many fine distinct dark reddish brown and few fine distinct strong brown mottles; weak coarse angular blocky structure with common fine tubular pores; friable when moist; common fine and very fine roots; medium acid; clear wavy boundary. This horizon is a plough pan.
B11	7-14"	Fine sandy clay loam; grey (5Y5/1 moist) with common fine distinct dark greyish brown mottles; weak coarse and very coarse angular blocky structure with many fine and very fine tubular pores and thin patchy silt skins; friable when moist; common fine and very fine roots; medium acid; clear wavy boundary.
B12	14-24"	Loam; grey (5Y5/1 moist) with few fine distinct yellowish brown and dark greyish brown mottles; weak coarse and very coarse angular blocky structure with many fine tubular pores and thin patchy silt skins; friable when moist; few fine roots, medium acid; gradual boundary.
B2	24-46"	Clay loam; grey (5Y5/1 moist) with many fine distinct yellowish brown mottles; weak coarse prismatic and very coarse angular blocky structure with many very fine and common fine tubular pores and thin patchy coatings; friable when moist; few very fine roots; medium acid; clear smooth boundary.
IIC1	46-54"+	Fine sandy loam; grey (5Y6/1 moist) with few fine distinct yellowish brown mottles and a 1" thick yellowish brown soft concretionary layer at 49"; weak medium and coarse angular blocky structure with few fine tubular pores; very friable when moist, strongly acid.

Note: B2 horizon split at 34 inches for sampling.

Range in characteristics

The topsoil texture ranges from fine sandy loam to silty clay loam; subsoil texture from fine sandy clay loam to silty clay loam and structure from weak to moderate, medium angular blocky to very coarse prismatic. Substratum textures generally are moderately fine, but may be fine sandy loam to silty clay. A very poorly drained variant occurs in very narrow strips, covering a negligible area.

Present land use

Most of the land is used for double cropped rice (aus and transplanted aman). Up to a quarter of the area may be occupied by homesteads, and small areas along creeks are triple cropped: two rice crops and a dry-season dry-land crop raised with traditional methods of irrigation. Land capability subclass IIDw.

Ratna series

The Ratna series consists of moderately well to somewhat poorly drained fine textured soils developed in subrecent piedmont materials. They occur in small patches on what is either a slightly dissected, somewhat older, 3-foot terrace or the higher gently undulating part of the subrecent piedmont valleys in a few hill areas in the south of Moulvi Bazar subdivision. They are associated with the Kulaura and Barlekha series on the surrounding hills, and locally with small areas of Srimangal and Lakhaichara series occurring on high terrace remnants.

They have a grey to light brownish grey, faintly mottled, friable clay loam to silty clay topsoil with coarse cloddy or subangular blocky structure, very strongly acid, overlying a pale olive to dark brown friable clay loam to silty clay subsoil with weak very coarse angular to strong medium subangular blocky structure with coatings, very strongly acid. The substratum is grey. The soils are subject to occasional flooding after heavy rain. The areas under tea have gravity drainage.

They differ from the associated Balisira series and from Jaflong series in their finer texture, from the Srimangal and Lakhaichara series in their poorer drainage, and from all other piedmont and floodplain soils in their better drainage and browner colour.

Soil profile: Ratna series

Location: site 1, photo Sylhet 13/40. In Ratna tea estate, Police Station Kulaura. Land use: tea. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Ratna tea estate, Police Station Kulaura.

Horizon	Depth	Description
Ap	0-4"	Clay loam; grey (5Y5/1 dry) with many fine faint yellowish brown and few fine distinct strong brown mottles; very coarse and coarse cloddy structure with common fine and few medium tubular pores; very hard when dry and friable when moist; many fine roots; very strongly acid; clear smooth boundary.
B21	4-9"	Silty clay loam; dark brown (10YR4/3 moist); moderate coarse and very coarse angular blocky structure with many fine and few medium tubular pores and thin nearly continuous coatings along vertical and horizontal ped faces and pores; friable when moist, common very fine and fine roots; very strongly acid, clear smooth boundary.
B22	9-23"	Clay loam; dark brown (10YR4/3 moist); weak very coarse angular blocky structure with many very fine and fine and common medium tubular pores and thin nearly continuous coatings along vertical and horizontal ped faces and pores; friable when moist; many very fine and common fine roots; very strongly acid; gradual smooth boundary.

Horizon	Depth	Description
C1	23-30"	Clay loam, grey (5Y6/1 moist) with many medium distinct dark brown mottles; moderate coarse and medium angular blocky structure with many very fine and fine and few medium tubular pores and thin nearly continuous coatings along vertical ped faces and pores; friable and slightly plastic when moist, common fine roots; very strongly acid; gradual smooth boundary.
C2	30-50"+	Clay loam, grey (5Y6/1 moist) with common fine distinct brown mottles; moderate very coarse prismatic structure with many fine and very fine and few medium tubular pores and thin continuous coatings along vertical ped faces and pores; friable and slightly plastic when moist; very strongly acid.

Range in characteristics

The topsoil may become very hard when dry, but is generally hard. Topsoil and subsoil structure may consist almost entirely of compressed wormcasts. Substratum texture ranges from clay to fine sandy clay.

Present land use

The small patches occupied by this series are mostly either under tea or cleared for tea cultivation or establishment of tea seedling plots. A few of the areas are still under forest. Land capability subclass IIDw.

Selapur series

The Selapur series consists of very poorly drained seasonally flooded, permanently wet clay soils developed in subrecent piedmont material. They occur in small piedmont depressions, in association with Juri series in the deepest parts and with Manu or some Itkhola series on the higher basin margins, mainly in the Juri valley.

These soils have a grey to dark grey mottled plastic and sticky clay topsoil with massive to moderate very coarse prismatic structure, overlying a grey to dark grey mottled brown to dark grey plastic and sticky clay subsoil with massive to weak prismatic and angular blocky structure. The subsoil or substratum generally contains locally abundant partly decomposed organic remains or a peaty horizon. They are flooded up to 3-6 feet for 5 to 8 months. The subsoil generally remains wet for most or all of the year.

They differ from the Manu and Itkhola series by the presence of organic remains, less mottling, their position in depressions, plastic and sticky consistency throughout the profile, and their seasonal flooding; from the Juri series in having a mineral profile instead of peat. They differ from most floodplain basin soils in their physiographic position and the presence of organic remains, and from Hakaluki series in not having a clay-on-peat profile.

Soil profile: Selapur series

Location: site 5, photo Sylhet 12/39. Near village Katnarpara, Police Station Kulaura. Land use: single cropped rice (transplanted aman), and grazing grass at and near the pit. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Selapur village, Police Station Kulaura.

Horizon	Depth	Description
Ap	0-4"	Clay, grey (5Y5/1 moist) with few fine distinct strong brown mottles, mainly along root channels and pieces of rice straw; moderate very coarse prismatic structure with many fine tubular pores and thin nearly continuous pressure surfaces along vertical ped faces; plastic and slightly sticky when moist; many fine roots; very strongly acid; clear smooth boundary.

Horizon	Depth	Description
A3	4-9"	Clay; dark grey (5Y4/1 wet) with few fine distinct strong brown mottles; moderate very coarse prismatic structure with common very fine tubular pores and thin continuous coatings along vertical and horizontal ped faces; plastic and slightly sticky when wet; common fine and many very fine roots; very strongly acid; clear smooth boundary.
B2	9-15"	Mucky clay; dark grey (5Y4/1 wet) with few fine faint brown mottles along ped faces and pores; weak very coarse prismatic and moderate coarse and medium angular blocky structure with thin continuous coatings along vertical and horizontal ped faces and thin patchy iron skins along vertical ped faces; plastic and sticky when wet; many very fine and common fine roots; very strongly acid; clear smooth boundary.
C1	15-30"	Clay with scattered pieces of brown and black organic remains; dark grey (10YR4/1 wet) with few fine faint brown mottles; massive with few fine tubular pores; plastic and sticky when wet; few fine living and many fine dead roots; very strongly acid; clear smooth boundary.
C2	30-48"+	Clay with much bedded undecomposed brown and black organic matter; dark grey (5Y4/1 wet); massive with few fine and very fine tubular pores; plastic and sticky when wet; slightly acid.

Range in characteristics

Soil reaction throughout the profile ranges from very strongly acid to neutral, apparently depending on the state of oxidation in each horizon. A peat horizon may be present in the subsoil.

Present land use

More than half of this series is used for single cropped rice (transplanted aman, broadcast aman or boro, depending on availability of water and depth of flooding), and the rest for grazing. Land capability subclass IVWw.

Srimangal series

The Srimangal series consists of well drained soils developed in old Holocene or late Pleistocene piedmont terrace deposits. They occur on deeply dissected, nearly level (normal phase) to steep (strongly dissected phase) terrace remnants in association with small patches of Lakhaichara series; with Itkhola, Manu and Pritimpasa series in most of the valleys; locally with Balisira series in some small valleys; and with Barlekha and Kulaura series on the hills.

These soils have a brown to yellowish brown, very friable to friable fine sandy loam to sandy clay loam topsoil with subangular blocky to granular wormcast structure (no crumbs), very strongly acid, overlying a yellowish brown to brown faintly mottled yellowish red to dark brown, friable silty clay loam to sandy clay subsoil with subangular blocky and granular wormcast structure, very strongly acid. The substratum is a yellowish brown to strong brown friable clay with subangular to angular blocky structure. These soils are droughty in the late dry season.

They differ from the associated Lakhaichara series by their finer texture, from all other piedmont soils in their better drainage and occurrence on high piedmont terrace remnants; and from the hill soils in their often nearly level topography, deeper profile, greater porosity and in the absence of rock fragments or bedding in the substratum.

Soil profile: Srimangal series

Location: site 3, photo Sylhet 18/29. In Kurmah tea estate, Police Station Kamalganj. Land use: tea. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Srimangal town, Police Station Srimangal.

Horizon	Depth	Description
A1	0-4"	Loam; yellowish brown (10YR5/6 dry, 5/4 moist); moderate coarse, medium and fine subangular blocky and medium and fine granular structure, mostly wormcasts, with common fine and few medium tubular pores; very friable when moist; many fine roots; very strongly acid; abrupt smooth boundary.
A3	4-9"	Clay loam; yellowish brown (10YR5/4 moist); moderate coarse and medium subangular blocky structure, mostly wormcasts, with many fine and medium and few coarse tubular pores; friable when moist; many fine roots; very strongly acid; clear wavy boundary.
B1	9-19"	Clay loam; brown (7.5YR5/4 moist) with common fine faint reddish yellow and dark brown mottles; moderate coarse, medium and fine subangular blocky and fine granular structure, mostly wormcasts, with many fine and common medium and coarse tubular pores and medium nearly continuous coatings along pores; friable when moist; common fine and few medium and coarse roots; very strongly acid; gradual boundary.
B21	19-34"	Clay; brown (7.5YR5/4 moist) with common fine faint light yellowish brown mottles; moderate coarse and medium subangular blocky structure, mostly wormcasts, with many fine and common medium tubular pores; friable when moist; common fine and few medium and coarse roots; very strongly acid; gradual boundary.
B22	34-50"+	Clay; strong brown (7.5YR5/6 moist) with few fine faint yellowish brown and yellowish red mottles; moderate coarse subangular blocky structure, mostly wormcasts, with many fine and common medium tubular pores and thin patchy coatings along vertical and horizontal ped faces and pores; friable when moist; common fine and few medium and coarse roots; strongly acid.

Range in characteristics

Topsoil texture ranges from fine sandy loam to clay loam; subsoil is generally clay loam but may range to sandy clay; and substratum is sandy clay to clay, generally with subangular blocky wormcast structure, but locally with angular blocky structure.

Present land use

Almost all of the normal phase of this series is used for tea cultivation, the remainder being occupied by tea factory buildings and labourers' villages; most of the strongly dissected phase is under thatching grass. Land capability subclass of the normal phase: IID; of the strongly dissected phase: IIIDr.

Tajpur series

The Tajpur series consists of poorly drained seasonally flooded, seasonally dry clay soils developed in subrecent floodplain basin deposits of the Surma-Kusiyara river system, occurring in level or slightly depressed parts of basin areas, as inclusions in the Thagu series.

These soils have a grey silty clay to clay topsoil, very hard and massive but cracking into very coarse hexagonal clods when dry, and generally firmly attached to the next horizon, overlying a very dark grey to dark grey, mottled yellowish brown to strong brown, very firm clay subsoil with coarse prismatic and angular blocky structure, and generally with slickensides below the topsoil. They are flooded 6-10 feet for 6 to 8 months, remain moist for a short period and are dry for most of the dry season.

They differ from the associated Phagu series in their coarser structure, presence of slickensides, firmer and harder consistency and generally darker colour.

Soil profile: Tajpur series

Location: site 4, photo Sylhet 10/27. Near village Bhagalpur, Police Station Balaganj. Land use: single cropped rice (aman or boro). Deeply flooded for 6-8 months. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Tajpur village, Balaganj Police Station.

Horizon	Depth	Description
Ap1	0-3"	Silty clay; grey (N6/ dry) with common fine distinct yellowish brown mottles; massive breaking into strong very coarse hexagonal clods with many fine and medium tubular pores; medium patchy yellowish brown iron skins along vertical and horizontal ped faces and pores; very hard when dry; common fine roots; very strongly acid; abrupt smooth boundary.
Ap2	3-6"	Clay; grey (5Y6/1 dry) with common fine distinct yellowish brown mottles; moderate very coarse angular blocky structure with few fine tubular pores and thin nearly continuous coatings along ped faces and pores; very hard when dry; common very fine roots; strongly acid; abrupt wavy boundary. This horizon is a plough pan.
B21	6-15"	Clay; dark grey (5Y4/1 moist) with common fine distinct dark brown mottles; strong coarse and medium angular blocky structure with many fine tubular pores and thick continuous dark grey coatings along vertical and horizontal ped faces, firm and very firm when moist; few very fine roots; strongly acid; clear wavy boundary.
B22	15-22"	Clay; grey (5Y6/1 moist) with common medium distinct yellowish brown mottles; strong very coarse and coarse angular blocky structure with many very fine tubular pores and thick continuous dark grey coatings along vertical and horizontal ped faces; very firm when moist; few very fine roots; strongly acid; clear wavy boundary.
B3	22-46"+	Clay; grey (5Y6/1 wet) with common medium distinct yellowish brown mottles; strong very coarse and coarse angular blocky structure with many very fine tubular pores and thick continuous dark grey coatings on vertical and horizontal ped faces; plastic and nonsticky when wet; strongly acid.

N.B. Slickensides are present just below Ap1 layer. Hexagonal surface cracks are about 1 inch wide in the dry season.

Range in characteristics

Topsoil colour ranges from grey to dark grey, texture from clay to silty clay. Subsoil colour may be very dark grey to dark grey, mottled yellowish brown to strong brown. Subsoil reaction may be strongly acid to slightly acid, probably depending on the state of reduction or oxidation. Unlike under broadcast aman rice, slickensides are less prominent or absent under grass.

Land use

The small areas which these soils occupy is used as rough grazing land, or for rice cultivation (broadcast aman or boro), depending on availability of water and on the use of the surrounding land. The poor physical properties of this soil severely limit the ploughing depth and time available for cultivation by traditional implements. Land capability subclass IVWd.

Tamabil series

The Tamabil series consists of sloping to very steep, excessively drained stony and very shallow soils over mixed shale and sandstone of possibly Tertiary age, occurring on a number of generally low hill ranges along and near the northern border of Sadar subdivision. They are associated with inclusions of deeper soils: generally Barlekha series but occasionally Khadimnagar; and with Jaflong, Balisira, Pritimpasa and Bijipur series in the valleys and surrounding piedmont plains.

They have a pale brown, soft gravelly sandy loam to clay loam topsoil with granular and subangular blocky structure, very strongly acid, overlying either bedded mixed sandstone and shale, or a very stony sandy loam to clay loam subsoil. Soil material in this case has granular or subangular blocky structure. Substratum is consolidated sandstone or shale, generally interbedded and almost everywhere dipping south to south-southwest. The soils are very droughty in most of the dry season.

They differ from all other hill soils in their shallow depth to rock or very stony material, and their excessive drainage.

Soil profile: Tamabil series

Location: site 9, photo Sylhet 2/34. Near Sripur tea estate, Police Station Jaintiapur. Vegetation: forest. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Tamabil border outpost, Police Station Goyainghat.

Horizon	Depth	Description
A1	0-5"	Gravelly sandy clay loam, gravel consists of pebbles and fragments of sandstone, pale brown (10YR6/3 dry); strong coarse granular and moderate fine subangular blocky structure with many fine and medium tubular pores; soft when dry; many medium and fine roots; very strongly acid; clear wavy boundary.
AC	5-23"	Very stony sandy clay loam, stones are boulders and fragments of sandstone, light yellowish brown (2.5Y6/4 dry); soil material strong coarse granular; sandstone massive breaking into very coarse platy structure; soft when dry, sandstone very hard; many medium and fine roots; very strongly acid; clear smooth boundary.
C1	23-38"+	Rock (clay loam on analysis); light yellowish brown (2.5Y6/4 dry) with light grey mottles, massive breaking into very coarse platy structure, stratified; very hard when dry; many medium and fine roots; very strongly acid.

Range in characteristics

Topsoil texture ranges from sandy loam to clay loam; depth to rock is from less than 12 to about 24 inches, but in the deeper soils the subsoil is very stony.

Present land use

Most of this series is under forest and is either not used, or used for firewood; some areas produce bamboo, and small patches are under tea, citrus, pineapples, homesteads or grass. Only on inclusions of deeper soils do the perennial crops do well at all, but even there they suffer from dry-season drought. Land capability subclass VDe.

Terchibari series

The Terchibari series consists of very poorly drained seasonally flooded, permanently wet clay soils developed in subrecent floodplain basin sediments of the Surma and Kusiyara rivers and their tributaries, occurring in generally small closed basin depressions as inclusions in Phagu series.

These soils have a dark greenish grey to very dark grey, generally plastic and sticky clay topsoil with generally cloddy structure, strongly acid, overlying a grey to greenish grey, generally finely mottled, plastic and sticky clay subsoil with massive or angular blocky structure. This soil is generally flooded up to a depth of 10 to 15 feet for 8 months to nearly all year.

They differ from the associated Phagu series and from Tajpur series in their plastic and sticky consistency and less mottling; from Hakaluki series in the absence of peat layers in the profile; from Selapur and Juri series, occurring in depressions in the piedmont area, in their location in the floodplain, and in the absence of peaty material in the soil, and from Khasgaon series occurring in floodplain basins and infilled channels near piedmont areas, in their finer texture.

Soil profile: Terchibari series

Location: site 2, photo Sylhet 5/37. Near village Bara Haor, Police Station Kanairghat. Land use: single cropped rice (boro). Seasonally deeply flooded. Ground water at 7" depth in January. Series set up in soil survey of Sadar and Moulvi Bazar subdivisions, Sylhet district, 1965. Source of name: Terchibari village, Goyainghat Police Station.

Horizon	Depth	Description
Apg	0-4"	Clay; dark greenish grey (5GY4/1 wet) with common fine distinct yellowish red mottles; moderate medium angular cloddy structure; slightly plastic and slightly sticky when wet; many fine roots; strongly acid; clear wavy boundary.
A3g	4-10"	Clay; dark greenish grey (5GB4/1 wet) with few fine distinct yellowish red mottles; strong medium and fine angular blocky structure; plastic and sticky when wet; many fine roots; neutral; abrupt smooth boundary.
B2	10-26"	Clay; grey (N6/ wet) with common fine distinct brownish yellow mottles; strong medium angular blocky structure; plastic and very sticky when wet; common fine roots; very strongly acid; clear wavy boundary.
C1	26-36"	Clay, dark grey (10YR4/1 wet) with common fine distinct reddish brown mottles; strong medium subangular blocky structure; plastic and sticky when wet; strongly acid; clear wavy boundary.
IIC2	36-40"	Clay; very dark grey (5YR3/1 wet); weak medium and fine angular blocky structure; slightly plastic and slightly sticky when wet; strongly acid; clear wavy boundary.
IIC3	40-52"+	Clay; very dark grey (N3/ wet); strong medium and fine prismatic and angular blocky structure; plastic and sticky when wet; strongly acid.

Range in characteristics

The topsoil colour ranges from dark greenish grey to very dark grey, the reaction from very strongly to medium acid, probably depending on the state of oxidation and reduction, the structure from massive to coarse angular blocky. Subsoil reaction is strongly acid to neutral. Locally the substratum is dark coloured and very humous.

Land use and vegetation

Vegetation in uncultivated areas is aquatic grasses and water lily. Most of this soil is used for cultivation of boro rice, for which sufficient dry-season water is available. Land capability subclass IVWw.

ANALYTICAL DATA

Analytical Methods

Texture After destruction of organic matter where necessary and dispersion by Calgon, texture was determined by the hydrometer method. The results generally are not corrected for organic matter percentage which thus shows up as an excess in the sand fractions. Only where the carbon percentage exceeds 3 have textures been corrected. US sand (>50mu), International sand (>20mu), US silt (50-2mu), Int. silt (20-2mu) and clay (<2mu) percentages are given.

Cation Exchange

Cation Exchange Capacity After saturation with sodium at pH 8.2 and three washings with ethanol the index ion was exchanged by three additions of ammonium acetate and determined by flame photometer.

Exchangeable Calcium and Magnesium After centrifuge extraction with ammonium acetate at pH 7, exchangeable calcium and calcium plus magnesium were titrated with EDTA using solochrome dark blue and eriochrome black-T indicators respectively. Since soluble salts were very low, no correction was made for soluble Ca and Mg.

Exchangeable Potassium and Sodium After centrifuge extraction with ammonium acetate at pH 7, exchangeable K and Na were determined by flame photometer.

Exchangeable Hydrogen After centrifuge extraction with barium acetate at pH 8.2, exchange acidity was found by titration with sodium hydroxide using phenolphthalein as indicator.

Total Exchangeable Cations The total exchangeable cations were obtained by addition of ex. Ca, Mg, K, Na and H, and the total exchangeable bases (TEB) by addition of ex. Ca, Mg, K and Na.

Base Saturation Percentage The BSP was calculated as 100.TEB/Total. Since the cation exchange capacity was determined by Na acetate on few samples only, these figures were not used for the calculation of BSP.

pH Soil reaction was determined on a saturated soil paste using a Beckman Zeromatic pH meter with glass electrode.

Conductivity (EC. 103) Electrical conductivity was determined on a saturation extract using a Solu bridge; the results are expressed in millimhos/cm.

Soluble Salts A figure for total soluble salts was calculated from the conductivity using an approximate average line we have drawn in Figure 3, p.11 of Saline and Alkali Soils (9).

Saturation Percentage The water content of saturated soil paste was determined by oven-drying and the SP calculated as 100. weight of water/weight of dry soil.

Organic Carbon The carbon percentage was determined by the Walkley-Black method, the result being multiplied by 1.33 to arrive at a total carbon figure assuming 75% efficiency.

Nitrogen Total nitrogen was determined by the semi-micro Kjeldahl method using a selenium/copper catalyst.

C/N Ratio The carbon-nitrogen ratio was calculated from the N and corrected C percentages.

Tabulated data, river waters and soil series

The following tables show chemical analyses of river waters, quoted from the Master Plan (3), and available analytical data of all soil series described in this report.

Table 10. Chemical analyses of river waters*

	Kusiyara river near mouth of Manu river, December 31, 1961	Manu river near Moulvi Bazar, January 15, 1961
pH	8.2	8.6
ECx10^3 (mmho/cm, 25°C	0.173	0.198
SAR	0.9	0.8
Total salts, ppm (measured)	150	174
(calculated from EC)	about 100	about 100
Ions, me/L		
Ca	0.52	0.76
Mg	0.51	0.46
Na	0.63	0.65
Soluble Fe	0.01	0.04
CO_3	0.07	0.24
HCO_3	1.61	1.84
SO_4	0.33	0.11
Cl	0.08	0.08
NO_3	0.00	0.01
total cations	1.67	1.91
total anions (including CO_3 and HCO_3)	2.09	2.28
molar Ca/Mg ratio	1.0	1.6
calculated ESP	less than 1	less than 1

* Data derived from table in Master Plan (3), quoting analyses by Ralph M. Parsons Co.

Table 11. Analytical data of soil series

Balaganj series, location: 1/Sylhet 6/22

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
1414	0-5	37	16	39	60	24		4.9	2.7	0.04	0.55	5.3	13.5	8.2	61	5.4	0.10	120	77	1.07	0.12	9
15	5-10	33	13	41	61	26										6.3			63	0.67	0.08	8
16	10-18	41	15	32	58	27		6.3	3.3	0.13	0.49	3.6	13.8	10.2	74	6.1			64	0.53	0.09	6
17	18-25	54	17	20	57	26										6.1	0.15	<100	60			
18	25-35	58	34	23	47	19		5.8	2.8	0.08	0.49	2.8	12.0	9.2	76	6.1			55			
19	35-45	41	15	30	56	29										6.1			59			
20	45-56	34	14	39	59	27		7.6	3.4	0.04	0.54	3.6	15.2	11.6	76	6.2	0.16	<100	58			

Balisira series, location: 1/Sylhet 13/34

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
2855	0-6	58	37	22	43	20										5.0				0.57	0.04	14
56	6-17	51	34	19	36	30		-2.38-		0.02	0.08	7.4	9.9	2.48	25	5.0				0.49	0.05	10
57	17-37	63	48	15	30	22										5.0				0.24	0.02	12
58	37-50	74	54	12	32	14										5.2	0.08	<100				
59	50-76	49	33	24	40	27										5.2						
60	76-86	77	62	11	26	12										5.2						
61	86-104	49	29	22	42	29		6.1	2.4	0.02	0.08	3.9	12.5	8.6	69	5.1	0.18	100				
62	104-109	32	12	35	55	33										4.9				0.25	0.03	8
63	109-130	44	20	29	53	27										4.8	0.36	220		0.28	0.05	6

Barlekha series, location: 2/Sylhet 8/37

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Exchangeable cations me/100g Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
2756	0-3	79	73	9	15	12		3.2	1.0	0.32	0.54	4.5	9.6	5.1	53	5.8	0.45	300		3.11	0.16	19
57	3-11	71	65	11	17	18	7.3	0.9	0.8	0.28	0.44	5.5	7.9	2.4	30	5.1	0.21	120		1.06	0.09	11
58	11-22	52	48	13	17	35		0.6	0.8	0.15	0.62	7.7	9.9	2.2	22	5.3	0.16	<100		0.91	0.07	13
59	22-42	48	45	15	18	37	13.5	0.6	0.6	0.12	0.53	8.1	9.9	1.8	18	5.1	0.17	<100		0.71	0.05	14

Beani Bazar series, location: 2/Sylhet 10/13

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Exchangeable cations me/100g Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
2845	0-5	41	27	25	39	34										4.2				2.20	0.15	15
46	5-20	34	23	24	35	42										4.5				1.38	0.10	14
47	20-36	23	14	22	31	55										5.2				0.81	0.06	13
48	36-51	27	16	23	34	50										5.1						
49	51-67	35	22	23	36	42										5.2	0.18	100		0.33	0.03	11

Bijipur series, location: 20/Sylhet 6/30

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
1208	0-4	61	50	25	36	14										5.8	0.24	180		1.11	0.10	11
09	4-6	65	49	23	39	12	4.9	1.5	0.12	0.77	3.3	10.6	7.3	69		5.9	0.20	120		0.88	0.08	11
10	6-11	75	61	15	29	10										6.5	0.20	120		0.15	0.02	8
11	11-16	84	76	8	16	8										6.7	0.25	150				
12	16-26	82	52	4	34	14	6.4	1.2	0.09	0.65	0.6	8.9	8.3	93		6.4	0.18	100				
13	26-48	59	47	17	29	24										6.8	0.25	150				
							3.0	1.7	0.08	0.44	1.8	7.0	5.2	74								

Goyainghat series, location: 8/Sylhet 9/28

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
1198	0-5	64	37	21	48	15	1.3	1.6	0.19	0.53	3.9	7.5	3.6	48		5.4	0.24	150	51	1.13	0.07	16
99	5-9	43	10	22	55	35	6.9	4.7	0.15	0.44	2.2	14.4	12.2	85		6.9	0.32	200	68	1.20	0.10	12
1200	9-18	48	23	19	44	33										7.0	0.35	220	63	1.17	0.07	17
01	18-26	58	20	15	53	27										6.8	0.32	200	50	0.36	0.03	12
02	26-41	38	17	35	56	27										6.7	0.20	120	47	0.37	0.03	12
03	41-54	17	7	47	57	36	9.8	6.1	0.20	0.54	2.8	19.4	16.6	86		6.6	0.20	120	51	0.49	0.05	10

Hakaluki series, location: 3/Sylhet 11/32

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g Exchangeable cations me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
2772	0-5	8	4	12	16	80										4.3				3.57	0.27	13
73	5-14	21	11	23	33	56										4.5				23.8	1.04	23
74	14-22	6	1	23	28	71										5.0	1.9	1300		9.6	0.57	17
75	22-35	35	26	15	24	50														36.1	0.83	45
76	35-40	40	33	20	27	40															0.42	

Itkhola series, location: 1/Sylhet 18/29

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g Exchangeable cations me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
2313	0-4	27	16	38	49	35										4.6				0.61	0.07	9
14	4-10	44	15	17	46	39										4.1	4.0	2500		0.75	0.07	11
15	10-21	25	13	32	44	43										4.9				0.61	0.07	9
16	21-31	28	16	27	39	45										4.8						
17	31-46	33	17	26	42	41										5.0						
18	46-57	19	11	29	37	52										5.3	0.7	450				

Jaflong series, location: 7/Sylhet 5/33

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1421	0-4	78	70	10	18	12										5.0			37	1.27	0.11	12
22	4-10	80	69	9	20	11	6.3	- 0.74 -		0.01	0.05	4.7	5.5	0.80	14	5.0			30	0.61	0.05	12
23	10-18	81	72	9	18	10										5.0			33	0.24	0.02	12
24	18-25	77	61	11	27	12	7.2	- 1.16 -		0.01	0.04	4.1	5.3	1.21	23	5.3			40			
25	25-50	88	86	4	6	8										5.4			27			
26	50-57	89	84	3	8	8	4.4	- 0.80 -		0.01	0.04	2.9	3.8	0.85	23	5.2	0.11	<100	26			

Juri series, location: 3/Sylhet 11/34

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2769	0-4	19	9	35	45	46										5.8	0.7	450		7.4	0.45	16
70	4-20	24	18	21	27	55										5.3				22.0	0.79	28
71	20-48	49	43	22	28	29										5.3	0.8	500		16.0	0.61	26

Kadipur series, location: 1/Sylhet 9/36

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
2909	0-8	10	5	33	38	57										5.0				1.44	0.14	10
10	8-15	6	5	13	14	81										4.6				1.48	0.17	9
11	15-28	3	1	15	17	82										4.3				1.24	0.15	8
12	28-32	6	6	16	16	78										4.2						
13	32-48	5	4	17	18	78										4.4	0.17	100				

Kanairghat series, location: 1/Sylhet 9/26

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
1171	0-4	28	13	42	57	30		1.6	1.2	0.12	0.81	6.3	10.0	3.7	37	4.9				1.60	0.14	11
72	4-6	18	10	33	41	49	14.8	5.8	3.3	0.08	0.86	3.1	13.2	10.1	77	5.8				0.68	0.09	8
73	6-17	15	11	31	35	54	18.0	5.9	4.9	0.08	0.99	3.0	14.9	11.9	80	5.9				0.59	0.06	10
74	17-32	18	13	31	36	51		6.0	6.2	0.08	0.90	4.2	17.4	13.2	78	5.3						
75	32-48	12	8	32	36	56	21.9	8.4	6.8	0.08	0.82	3.6	19.7	16.1	82	5.8						
76	48-63	14	12	37	39	49		10.3	7.1	0.09	0.81	2.4	20.7	18.3	88	6.5				0.53	0.06	9
77	63-72	9	7	17	19	74		6.7	8.3	0.13	0.84	4.5	20.5	16.0	78	5.7	0.35	220		0.60	0.08	8

Khadimnagar series, location: 14/Sylhet 6/30

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1184	0-2	79	75	11	15	10		2.7	1.9	0.27	0.43	3.3	8.6	5.3	62	6.2	0.25	150	40	2.69	0.15	18
85	2-5	78	73	9	14	13										5.7	0.15	<100	31	1.07	0.06	18
86	5-9	83	78	6	11	11		2.7	1.9	0.12	0.45	2.7	7.9	5.2	66	5.8	0.10	<100	27	0.80	0.04	20
87	9-14	81	78	7	10	12		1.13	0.16	0.10	0.40	3.1	4.9	1.8	37	5.7	0.10	<100	27	0.60	0.03	20
90	24-30	87	81	4	10	9										5.6						
92	36-42	88	82	6	12	6		0.16	0.81	0.15	0.26	2.4	3.8	1.4	37	5.9			32	0.32	0.02	16
93	42-48	89	83	5	11	6										5.7						
95	54-60	91	85	4	10	5										5.6	0.05	<100				

Khasgaon series, location: 15/Sylhet 2/34

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2195	0-4	37	25	29	41	34										4.7				3.50	0.26	13
96	4-10	21	12	36	45	43										4.6				3.44	0.28	12
97	10-22	15	11	36	40	49										4.6				2.60	0.22	12
98	22-34	18	12	35	41	47										4.7	0.16	<100		1.44	0.10	14

Kulaura series, location: 1/Sylhet 18/25

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2833	0-4	55	44	16	27	29		2.7	0.43	0.03	0.05	8.3	11.5	3.2	28	4.6				0.83	0.05	17
34	4-13	53	45	18	26	29										4.6				1.52	0.11	14
35	13-26	52	43	18	27	30										4.7				1.08	0.08	14
36	26-41	52	43	17	26	31		- 3.0 -		0.01	0.05	7.2	10.3	3.1	30	4.7						
37	41-52	52	45	19	26	29										5.0						
38	52-67	50	43	19	26	31										5.1				0.71	0.05	14
39	67-73	50	43	19	26	31										5.4	0.6	400				

Kusiyara series, location: 5/Sylhet 6/36

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1455	0-6		71		24	5		3.3	1.7	0.08	0.63	1.6	7.3	5.7	78	6.9	0.34	210		0.16	0.01	16
56	6-9		30		53	17										6.9				0.81	0.06	14
57	9-18		33		47	20		6.3	3.5	0.08	0.63	3.6	14.1	10.5	66	6.2				0.81	0.07	12
58	18-25		26		49	25										6.1						
59	25-40		27		44	29		7.5	4.5	0.17	0.58	4.0	16.8	12.8	76	6.1	0.37	240				

Lakhaichara series, location: 1/Sylhet 16/23

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g Exchangeable cations me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2805	0-5	76	72	7	11	17										4.0				1.53	0.10	15
06	5-14	71	67	7	11	22										4.1				1.41	0.09	16
07	14-29	72	67	6	11	22										4.2				1.25	0.06	21
08	29-40	76	71	5	10	19										4.2						
09	40-52	74	65	3	12	23										4.2	0.5	300				

Manu series, location: 1/Sylhet 14/31

Lab no	Depth in.	% sand Int.	% sand US	% silt Int.	% silt US	% clay	me/100g Exchangeable cations me/100g CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2864	0-3	42	30	31	43	27										4.9				1.88	0.14	13
65	3-6	38	30	30	38	32	14.55	-	7.1	-	0.01	0.08	5.5	12.7	7.2	57	5.0				1.57	0.13	12
66	6-13	39	30	21	30	40	15.81	4.0	2.9	0.01	0.07	6.6	13.6	7.0	51	5.1				0.87	0.08	11
67	13-27	29	23	27	33	44										5.4				0.76	0.06	13
68	27-35	32	29	28	31	40	22.76	7.0	9.3	0.01	0.09	4.0	20.4	16.4	80	6.0						
69	35-54	35	29	26	32	39										6.1	0.26	160				

Phagu series, location: 4/Sylhet 5/37

lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
1396	0-4	10	7	15	18	75		9.0	3.3	0.38	0.49	13.0	26.1	13.1	50	4.8	0.20	120		2.35	0.19	12
97	4-10		7		16	77		8.0	4.8	0.27	0.53	13.9	27.5	13.6	50	4.8				1.93	0.19	10
98	10-28	10	6	10	14	80		7.2	6.4	0.31	0.94	13.6	28.5	14.9	52	5.2				0.91	0.10	9
99	28-36	35	17	17	35	48										6.0	0.15	<100	72	0.43	0.05	9
1400	36-48	41	11	37	67	22										6.8			82	0.33	0.02	16
01	48-52	51	14	29	66	20		6.4	5.5	0.18	0.82	2.3	15.2	12.9	85	6.6	0.28	180	64	0.20	0.02	10

Pritimpasa series, location: 2/Sylhet 14/31

lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC, 10^3	Salts ppm	SP	%C	%N	C/N
2289	0-4	71	42	21	50	8										4.8				0.64	0.07	9
90	4-7	64	37	22	49	14	9.1	5.1	1.3	0.01	0.08	3.1	9.6	6.5	68	5.3	1.6			0.32	0.04	8
91	7-14	56	53	24	27	20										5.6	0.4	250		0.32	0.05	6
92	14-24	51	32	24	43	25	15.7	5.2	4.4	0.01	0.19	3.5	13.3	9.8	74	5.0						
93	24-34	46	25	27	48	27										5.3						
94	34-46	52	32	23	43	25	15.7	7.3	4.3	0.03	0.09	3.1	14.8	11.7	79	5.4						
95	46-54	73	54	13	32	14										5.5	0.60	400				

Ratna series, location: 1/Sylhet 13/40

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
2822	0-4	46	24	26	48	28										4.5				1.38	0.10	14
23	4-9	30	15	33	48	37										4.5	0.30	180		1.45	0.11	13
24	9-23	41	23	27	45	32										4.5				0.77	0.08	10
25	23-30	42	25	27	44	31										4.5				0.71	0.04	18
26	30-50	51	38	23	36	26										4.8	1.6	1100		0.63	0.04	16

Selapur series, location: 5/Sylhet 12/39

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC_3 10^3	Salts ppm	SP	%C	%N	C/N
2764	0-4	26	3	13	36	61										4.9				8.6	0.50	17
65	4-9	35	16	18	37	47										4.5	0.7	450		34.1	1.26	27
66	9-15	16	14	16	18	68										4.8	2.6	1800		4.4	0.51	9
67	15-30	8	2	23	29	69										4.8				8.0	0.52	15
68	30-48	4	0	21	25	75										4.6	2.9	2000		9.4	0.49	19

Srimangal series, location: 3/Sylhet 18/29

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
2301	0-4	53	38	25	40	22	17.8	-	1.31	-	0.02	0.06	11.1	12.5	1.4	11	3.9				2.25	0.17	13
02	4-9	49	35	22	36	29											4.0				1.48	0.11	13
03	9-19	43	28	23	38	34	17.2	-	0.83	-	0.02	0.06	10.5	11.4	0.9	8	4.0				1.29	0.11	12
04	19-34	36	26	19	29	45											4.4				1.09	0.07	16
05	34-50	36	24	18	30	46		1.23	0.63	0.01	0.06	9.1	11.0	1.9	18		4.9	0.20	120		0.76	0.05	15

Tajpur series, location: 4/Sylhet 10/27

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g CEC	Exchangeable cations Ca	Mg	K	Na	H	me/100g total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1481	0-3	23	4	26	45	51											4.8				2.45	0.22	11
82	3-6	16	4	16	28	68		6.8	6.5	0.02	0.06	11.9	25.3	13.4	53		4.6	0.17	<100		1.75	0.16	11
83	6-15	10	7	20	23	70		8.0	7.8	0.02	0.06	12.6	28.5	15.9	56		4.7				1.84	0.18	10
84	15-22	9	1	12	20	79											5.1						
85	22-46	6	2	4	8	90		9.9	10.7	0.02	0.07	6.3	27.0	20.7	77		5.4	0.16	<100				

Tamabil series, location: 9/Sylhet 2/34

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1407	0-5	69	61	10	18	21		0.0	0.8	0.17	0.56	7.8	9.3	1.5	16	5.1	0.15	<100	39	1.64	0.15	11
08	5-23	55	45	13	23	32		0.0	0.8	0.12	0.62	8.8	10.3	1.5	15	5.1	0.10	<100	44	1.07	0.12	9
09	23-38	47	38	19	28	34		0.0	0.7	0.08	0.45	6.5	7.7	1.2	16	5.3	0.10	<100	40	0.48	0.06	8

Terchibari series, location: 2/Sylhet 5/37

Lab no	Depth in.	% sand Int.	US	% silt Int.	US	% clay	me/100g Exchangeable cations CEC	Ca	Mg	K	Na	H	total	TEB	BSP	pH	EC. 10^3	Salts ppm	SP	%C	%N	C/N
1431	0-4	9	7	16	18	75										4.7				2.93	0.25	12
32	4-10	5	3	17	19	78										4.8	0.15	<100		2.80	0.19	15
33	10-26	6	4	12	14	82										4.7	0.18	100		0.67	0.10	7
34	26-36	6	2	11	15	83										4.7				3.20	0.18	18
35	36-40	8	6	11	13	81										4.9				7.4	0.55	13
36	40-52	9	4	23	28	68										4.8	2.0	1400		5.2	0.50	10

Summary and interpretation

Texture In a plot of available texture data in the USDA texture triangle, more than 90 percent of the points fall within a relatively narrow band, curving from loamy sand through silt loam and the edge of loam into the silty side of clay. This would indicate the possibility that all sediments, from the floodplain to the hills, might come from a common source.

CEC The cation exchange capacities determined by Na acetate saturation are about 1.15 times the total of the exchangeable cations. Most of the data are within 2 me/100g from this average relationship.

The cation exchange capacities by Na acetate are about 4 + 0.28 x clay percentage, and by total cations about 4.5 + 0.26 x clay percentage. Here, too, most of the data are within 2 me/100g from these average relationships. These results suggest that the clay fraction might have an exchange capacity of about 27 me/100g, and the (silt + sand) fraction of about 5 me/100g* in most of the soils in the area.

Exchangeable bases The molar Ca/Mg ratio generally ranges between 1 and 2. Exchangeable Na generally ranges from 0.4 to 1 me/100g, and from 3 to 10 percent of exchange capacity, exchangeable K from 0.1 to 0.3 me/100g, and from 0.5 to 2 percent of exchange capacity.

BSP and pH Base saturation percentages range from 15 to 93, reaction from pH 4.5 to 7. Between pH 4.5 and 6, base saturation percentage may vary between 15 and 80, with little if any correlation apparent between the two variables. Above pH 6, base saturation is between 62 and 93 percent, and shows a weak increasing trend with increasing pH. (Similar results are shown in work by R.B. Cate, on some thousands of samples during the Govt. of British Guiana-United Nations Soil Survey, 1961-'64).

EC. 10^3 and salts Salt concentration as estimated from electrical conductivity measurements ranges from less than 100 to 300 ppm in most soils, safe even for sensitive crops. In some soils and soil horizons, salt concentration is much higher and may exceed 2000 ppm. Part of these high concentrations may be explained by the continued high dry-season evapotranspiration over some depression soils, where water is supplied by seepage almost throughout the year. Others, like in the upper subsoil of Itkhola, await further data on more horizons or more soil profiles.

%C, %N, C/N Carbon percentages in the topsoils throughout the area generally range from 1 to 2, or up to 3 in some basin soils, and decrease with depth, to 0.2 - 0.7 in many subsoils. Some peaty or very humous horizons have high carbon percentages, higher than 30 locally in some piedmont depressions and floodplain basins. The cultivated floodplain and piedmont soils have a mean C/N ratio of about 11, generally decreasing slightly with depth, except for the soils and soil horizons with more than 3 percent C which have C/N ratios ranging from less than 10 to over 40. The high piedmont terrace and hill soils, which for the most part are under tea or forest, have a mean C/N ratio of about 15, individual values ranging from less than 10 to 20.

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* A. Karim and A. Islam (Soil Sci. 82, 5, p.433, 1956) found exchange capacities of silt around 10 me/100g for samples in other parts of East Pakistan. "A study of ion-exchange properties of silt"

Data on river waters The Ca/Mg ratios and the salt concentration of Kusiyara and Manu river waters (table 9) agree well with data from soil samples, but exchangeable Na is 3 to 10 times the figure estimated from the analyses of river waters, and the pH of river water in the dry season is roughly two units higher than that of most soils.

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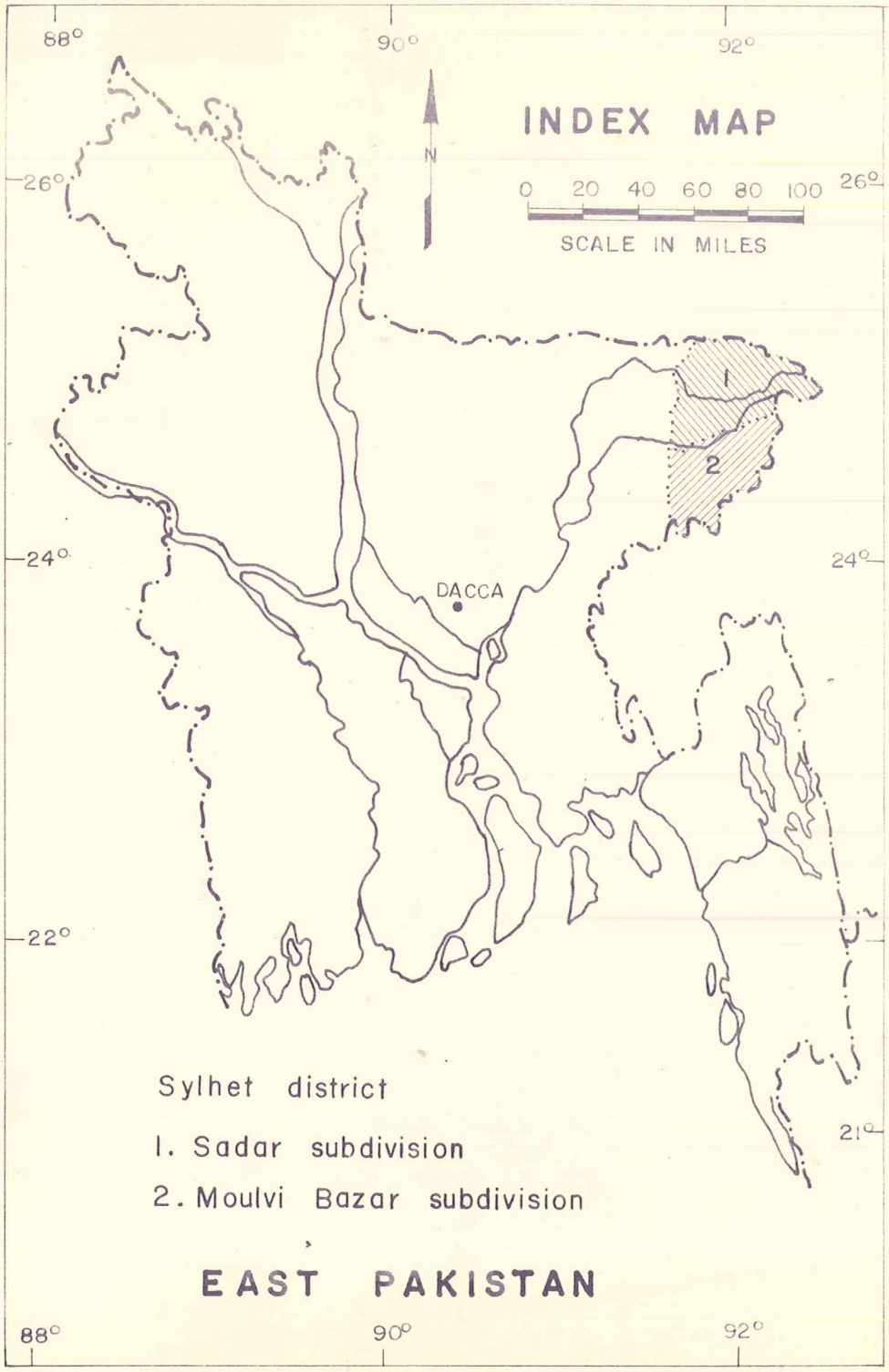
88°
90°
92°
INDEX MAP
N
0 20 40 60 80 100
SCALE IN MILES
26°
24°
22°
21°
1
2
DACCA
Sylhet district
1. Sadar subdivision
2. Moulvi Bazar subdivision
EAST PAKISTAN