BANGLADESH WATER DEVELOPMENT BOARD

NABAGANGA
INTEGRATED LAND & WATER USE STUDY

SEMI-DETAILED SOIL SURVEY

VOLUME II

SURVEY CARRIED OUT AND REPORT PREPARED BY
DEPARTMENT OF SOIL SURVEY
MINISTRY OF AGRICULTURE AND FORESTS
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

FEBRUARY 1981

Tippetts-Abbett-McCarthy-Stratton Consociates International Ltd.

(Project not approved as of 5/11/82.)

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P R E F A C E

The Department of Soil Survey, Ministry of Agriculture and Forests, Govt. of the People's Republic of Bangladesh, carried out the soil survey and prepared this report as an adjunct to the Nabaganga Integrated Land and Water Use Study, under the Bangladesh Water Development Board. This was undertaken as a consequence to the request made to the Ministry of Agriculture and Forests by the Chief Engineer, Planning-I, BWDB, as per advice of the Project Manager, Tippetts-Abbett-McCarthy-Stratton/Consociates International Limited, Consultants to the project.

All expenditure, concerning salary and allowances of the personnel, field equipments and soil analyses, were borne by Department of Soil Survey while the Consultants provided vehicles, bore costs of fuel for departmental vehicles, of other incidentals & publication of this report.

The report consists of two volumes. Vol-I comprises of information on the general environmental conditions of the survey area, general description of soils, description of soil mapping units, factors controlling agricultural use of soils, present land use and soil potentiality in terms of land capability and crop suitability.

The interpretative map, showing proposed land use at the end of the Vol-I, has been prepared by TAMS.

Vol-II includes a correlation of the soils with the U.S.D.A. soil classification system, technical description of individual soil series and chemical and physical analytical data with interpretation.

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A1. SOIL GENESIS & CLASSIFICATION

A1.1 Soil Genesis

All the soils of the survey area, except for minor areas of peat soils in the south, are developed in calcareous Ganges sediments deposited in different times of the recent geological age (29). Under the influence of the prevailing Tropical Monsoon climate with alternate pronounced wet and dry seasons, the rate of soil development is rather rapid.

The high temperatures and seasonal high rainfall, creating alternate oxidation and reduction conditions, in association with vigorous biotic activity enhance the rate of both chemical and biochemical weathering as well as mechanical homogenization of the loose alluvial surface deposits to form soils. Soils thus formed show different properties due to the differences in texture, mineralogy and age of the soil parent materials and drainage conditions as influenced by the topography.

Parent materials of varying ages, textures and drainage conditions occur in the somewhat complex landscapes of the both young and old Ganges meander floodplain areas.

The survey area, in general, is underlain by medium to fine textured, calcareous, loose Ganges alluvial sediments. Mainly highly silty, medium to moderately fine and some moderately coarse to coarse textured, moderately calcareous, fresh alluvial deposits occur on the young alluvial lands or charlands comprising narrow ridges, inter-ridge depressions and infilled channels and lying within and adjoining the active river channels. On somewhat older landscapes, silt loam and silty clay loam sediments predominate on ridges, while more clayey deposits occur in basins and infilled channels. On the old floodplain areas, most of the basins and infilled channels and large parts of the lower ridge sites and inter-ridge depressions are underlain by one to several feet thick layers of heavy clays. Sandy deposits sometimes underlie the older sediments rather at shallow depths, particularly around ridge areas and locally occur also at the surface occupying small areas on ridges.

Deep peat deposits locally occur in some of the old, broad cut-off meander loops in the extreme southwest. These organic deposits, mostly derived from aquatic grasses and reeds, are deposited in the closed and perennially wet deep depressions. They are usually highly calcareous as a result of secondary accumulation of carbonates washed down from the surface layers of old Ganges sediments occupying the ridges and shallower basins that drain into these closed depression sites.

Mineralogical analyses of the sand fractions* show that Ganges sediments in general contain, like other major floodplain deposits of the country, large amounts of weatherable minerals. They include large amounts of feldspars (both alkali and plagioclass varieties) and micas (both biotite and muscovite). Unlike other floodplain deposits, they also include considerable amounts of dolomite and calcite (9), which account for their calcareousness. The clay mineralogy of

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* Samples analysed were collected from areas lying outside the survey area (9).

Ganges sediments is also strikingly different from that of other floodplain deposits. In addition to a variable mixture of kaolinite, illite and chlorite, they usually have an important amount of montmorillonite. This explains for the exceptional extent of cracking in the Ganges clays when dry.

The young a-luvial lands are seasonally shallowly to moderately deeply flooded by river water. In the rest of the area, on the both young and old Ganges meander floodplains, at present, most part of the ridges remains above normal flood level and usually becomes intermittently wet or shallowly flooded in the monsoon season and droughty in the dry season. The lower ridge sites, inter-ridge depressions, basins and infilled channels are shallowly to moderately deeply and locally deeply flooded in the monsoon season and dry out in the dry season. The deeper basin and infilled channel sites often remain wet in the early part of the dry season. The basin depressions, seasonally moderately deeply to deeply flooded, remain wet or flooded for most part of the dry season.

The freshly deposited Ganges sediments are calcareous and have conspicuous alluvial stratification. Under continuous wet conditions, the alluvium remains unripened and reduced. Under seasonally flooded conditions, the raw alluvium ripens and becomes weakly oxidized to a depth of 1-2 feet within 2-5 years and then becomes fairly homogenized by biotic activities within about 10-20 years. In course of time, prismatic and blocky subsoil structure is developed in silts and clays through cracking and reswelling as caused by the alternate seasonal drying and wetting, and ped faces become thickly coated with materials washed down from the reduced topsoils during intermittent or seasonal flooding. Alternate seasonal reduction and oxidation of the topsoils affecting rapid leaching of the topsoil cause decalcification of calcareous material and subsequently acidification in noncalcareous material. The process of decalcification is effective in presence of excess water and organic matter (30). Under transplanted rice cultivation, topsoils are puddled and eventually a compact ploughpan is formed at their bases by the continuous pressure from the plough. Locally the topsoils have a secondary accumulation of salts deposited from the solution rising through capillary pores.

In the young and old meander floodplains, the sediments are usually oxidized to a variable depth down to a permanently gleyed layer indicating the lowest level of the groundwater table. ...e seasonally and intermittently flooded soils developed in these materials still show variable amounts of grey mottles and ped cutans or glevans in the subsoil. Nonflooded soils, however, are locally thoroughly oxidized upto a depth of 2-3 feet from the surface, showing better drainage conditions.

On the young Ganges meander floodplain, soils developed on ridges are calcareous and moderately oxidized and usually have weak to strong structure with ped cutans and no stratification within a foot or more from the surface, except in some locally occurring very young sediments. Evidence of decalcification is locally found mostly confined to the topsoils of basin and infilled channel clays. In the old sediments, soils developed on ridges are often relatively strongly oxidized and decalcified to a depth of 1-2 feet or more from the surface and have weak to strong structural development with ped cutans in the subsoil. On the higher ridge sites with better drainage (i.e. least extent of waterlogging), least organic matter accumulation and highest degrees of biotic disturbances, some of the loamy soils escaped decalcification. The basin clays with relatively high organic matter

contents and longer period of rainwater flooding, have been decalcified down to 1-3 feet or more from the surface. They often have strong prismatic, blocky or lenticular (wedge-shaped) structure with dark grey cutans along ped faces and pores in a fairly oxidized subsoil. In some areas of the old Ganges meander floodplain, soils developed in the oldest sediments on ridges and in basins have deeply to very deeply decalcified profiles. However, in most cases, the basin deposits might not be as old as the ridge deposits, but their higher contents of organic matter and longer period of seasonal submergence had set in a more intensive and rapid process of decalcification soon after their deposition (20).

The process of decalcification in case of these soils, mainly involves lateral washing of calcium carbonates. As suggested by Zonneveld (1960) and later illustrated by Brammer (1968) with local soils, decalcification takes place under reduced conditions during seasonal flooding (3,30). Decomposition of organic matter under reduced condition increases the partial pressure of CO2 in the soil (Ponnamperuma, 1966), as a result the carbonates are transformed into more soluble bicarbonates and lost by solution in the floodwater.

Secondary accumulation of soluble salts, mainly comprising bicarbonates locally occurs in some of the ridge soils during the dry season. These soils occur within the capillary fringe of groundwater containing dissolved salts, mainly bicarbonates, washed out from both ridge and basin soils. The excess salts precipitate at or near the surface of the soil as the solution rising upward by capillary movement becomes concentrated through evapotranspiration. During the dry season, some of these soils locally show patchy thin white surface incrustations, usually tasting caustic and giving effervescence with hydrochloric acid. Locally it may give strong alkaline reaction. The white surface incrustation might also locally result from the relative accumulation of silty materials as a result of loss of clay (dispersed by the sodium ions occupying exchange positions, in case of alkali soils) from the topsoils (20). These soils usually become waterlogged at ease and very soggy with poor permeability and aeration after heavy showers during the rainy season. Some of these soils usually with a significant amount of bicarbonates in the soluble salt fraction whow a tendency of becoming saline or nonsaline alkali soils (27). However, none of them, except for some of the very young alluvial deposits, as observed during the survey, has been found to have a reaction higher than pH 8.4 or an electrical conductivity value above 1 millimhos.

Downward leaching and subsequent deposition of carbonates have been found to occur in most of the old permeable ridge soils in the survey area. Their subsoil or substratum shows a considerable increase in carbonate content compared with the upper and lower layers, but available data show none to have enough accumulation of carbonates to qualify it as a calcic horizon (25). However, calcic horizons (25). However, calcic horizons may occur in some of these soils in the survey area.

Most of the basin soils and some of the lower ridge soils are heavy clays with large amounts of montmorillonite mixed with illite and other clay minerals. These clays expand or shrink considerably when wet or dry and have strongly developed fine and very fine blocky or lenticular peds and also pressure faces and slickensides. When dry, the soils crack widely in the top-and subsoil, but often not widely or deeply enough to quality them as the Vertisols (25).

Peat soils occupying small areas of depressions occur in some broad and deep cutoff channels and overlie Ganges sediments at a variable depth. They are developed in partly decomposed aquatic grasses and reeds under anaerobic conditions in perennially wet or flooded depressions. They are mainly mucky peats.

A1.2 Soil Classification

A provisional classification of the soils of the survey area is given in Table 23. This classification is tentative and subject to change, since it is not yet supported by adequate analytical data and also the existing classification system is still of provisional nature. In addition, some of the soils show features which have apparently not been reported so far outside Bangladesh, e.g. the prominent ped cutans observed in floodplain soils, and so are not taken into account in the existing classification system.

The soils have been classified in terms of the U.S.D.A. Soil Taxonomy (25). It may be mentioned that not all the soils fit satisfactorily within this classification system. Difficulties in placing particular soils will be commented on below.

Most of the topsoils have characteristics derived from continuous ploughing for rice and other crops and alternate seasonal wetting or flooding and drying out. The cultivated topsoils are usually firm to very firm massive or cloddy. Some of them are gleyed or show iron stains along root channels and at the base of the ploughpan, where puddling is a common practice for transplanted rice cultivation. Most of these soils, having a dark grey or paler moist matrix colour, are classified as the ochric epipedons. Some topsoils meet some of the requirements for mollic epipedons, but mostly have massive structure or hard peds. For the present, the aquic properties of this layer have been ignored in classifying the soils.

The identification of the subsoil has been given most of the attention in classifying these floodplain soils. Several of them show strong prismatic and/or blocky structure in the subsoil with prominent cutans (glevans) along the ped faces and pore walls. They usually have the same colour as the topsoil: mostly olive-grey, greyish brown, dark greyish brown or dark grey. They are generally thicker than true clay skins (argillans) and appear to develop very rapidly, as they are also observed in the young floodplain soils. Thin sections of similar soils from Dacca district showed that large amounts of particles of silt size occur in such cutans in which the clay particles also lack proper orientation. They mostly represent flows of topsoil materials that moved down along the cracks and pores with the floodwater. These 'flood cutans', usually gleyed and hence also known as the 'glevans' are not regarded as true clay skins or argillans.

Some of the old floodplain soils show a marked increase in clay contents in the subsoil compared to the topsoil and substratum. This may be due to the original differences in alluvial deposition. However, this phenomenon along with some cases of broken texture needs further investigation to confirm the evidence regarding any secondary clay accumulation by horizontal washing, or vertical translocation or insitu formation of clays.

Cambic B horizons are recognized on the evidence of destruction of alluvial stratification by biotic mixing, development of prismatic and/or blocky structure, usually with the ped coated by the gleyans or flood cutans and oxidation inside the peds.

The soils of the survey area having a cambic B horizon are classified as the Inceptisols and fall mainly within two great groups: Haplaquepts for the dominantly grey soils having aquic moisture regime and Ustochrepts for the dominantly brown soils having ustic moisture regime.

The Typic Haplaquepts include soils with more than 60 percent grey as the matrix colour. Soils with brown colours covering more than 40 percent of matrix are classified in the Aeric subgroup. The proportion of oxidation colour is variable in some soil series; where this proportion fluctuates on both sides of 40 percent, it is not practical to differentiate soils of Typic and Aeric subgroups in separate series.

Some floodplain soils classified as the Haplaquepts, have some properties common to all Vertisols. Some of the Batra, Benapol, Gangni, Ghior and Magura soils have 30 percent or more clay usually in all layers down to 20 inches and wedge-shaped structure or prominent slickensides, but often are not found to have cracks as wide as 1 cm at a depth of 20 inches below the surface. This is probably mainly due to the interference of thorough drying of the subsoil by the mulching effect of the ploughed topsoil. This prevents the development of sufficiently deep and wide cracks in these otherwise heavy clay soils to qualify them as Vertisols. Some of these soils having such deep and wide cracks may be regarded as Chromusterts or Pellusterts, depending on the matrix colour in the subsoil.

Haplaquepts having a thick surface (locally also including part of the sub-surface) horizon with very dark greyish brown or darker moist matrix colour and high base saturation ($\geq$ 50 percent) may be classified as the Mollic Haplaquepts. These soils, mostly being finely structured clays, usually have hard to extremely hard peds when dry.

The strongly oxidized, calcareous soils with moderately well drainage conditions lack aquick profile characteristics to be classified as Haplaquepts. These soils with an ochric epipedon and free lime in the profile, having an ustic moisture regime are classified as the Ustochrepts. The imperfectly drained soils having some grey mottles within 30 inches of the surface are regarded as the Aquick Ustochrepts, while the thoroughly decalcified soils as the Aquic Udic Ustochrepts.

Raw alluvia and very young soils of the young floodplain, usually stratified within 10 inches of the surface and any other soil, particularly some of the almost perennially wet soils, not sufficiently structured to be regarded as Inceptisols, are classified as Entisols. The fairly oxidized, moderately coarse to medium textured soils of the sandy and silty Ganges alluvia, Pangsa and Rayna series are classified as the Aeric Fluvaquents. The greyer soils should be Typic.

The organic soils of Satla and Rajair series have been classified as the Histols. These almost perennially wet, Partially decomposed peat soils may be classified with the Medihemists. The soils of Satla series with a water layer within the control section may be regarded as the Hydric Medihemists, other soils without the water layer are either Fibric or Sapric Medihemists, depending on the state of decomposition of the organic matter. The shallower peat soils of Rajair series are regarded as the Fibric or Sapric Terric Medihemists.

The soils of the survey area have also been correlated with the general soil types of Bangladesh (6). The very young stratified soils have been regarded as the Calcareous Alluvium. The older fine textured soils of Amjhupi, Gangni, Garuri, Ghior, Ishurdi, Kumarkhali, Mehendiganj, Pakuria and Ramdia series, having carbonates throughout the profile or at least in the substratum occuring within 48 inches of the surface and moderately to strongly developed prismatic and/or blocky structure in the subsoil with dark grey to dark greyish brown matrix or at least flood coating colours, are classified as the Calcareous Dark Grey Floodplain Soils. The similar soils of Baradi, Batra, Benapol, Magura and Mahespur series with thoroughly decalcified profiles are classified as the Noncalcareous Dark Grey Floodplain Soils. The more brown soils of Darsana, Gopalpur, Paksey and Sara soils, having carbonates throughout the profile or at least in the substratum are regarded as the Calcareous Brown Floodplain Soils, while the similar soils of Mominpur and Patkelpota series with noncalcareous profiles as the Noncalcareous Brown Floodplain Soils. The greyer, calcareous soils of Rasulpur series have tentatively been classified with a newly suggested unit for the general soil types - Calcareous Grey Floodplain Soils. The organic soils of Rajair and Satla series are Peat Soils.

FIGURE

Table 23

Correlation Of Soil Series And Land Types In The USDA Soil Taxonomy And The General Soil Types Of Bangladesh

Order	Suborder	Great groups	Sub-groups	Soil series, variants, land types	General soil types
Entisols	Aquents	Fluvaquents	Aeric Fluvaquents	Pangsa (1,2), Rayna, Sandy Ganges Alluvium (1,2), Silty Ganges Alluvium (1)	Calcareous Alluvium
Inceptisols	Aquepts	Haplaquepts	Typic Haplaquepts	Jhenida (3,4), Kasiani (3,4) Rasulpur (3)	Noncalcareous Dark Grey Floodplain Soils Calcareous Grey Floodplain Soils (11)
			Aeric Haplaquepts	Darsana (5), Gopalpur (5), Kumarkhali (6)	Calcareous Brown Floodplain Soils
				Amjhupi (6), Ganji (6,7), Garuri (6), Ghior (6,7), Ishurdi(6), Mehendiganj, Pakuria(6,7)	Calcareous Dark Grey Floodplain Soils
				Baradi (5), Batra (6,7), Benapol (6,7), Benapol, calcareous topsoil variant (6,7)	Noncalcareous Dark Grey Floodplain Soils
			Mollic Haplaquepts	Magura Mahespur (8), Ramdia (8)	Noncalcareous Dark Grey Floodplain Soils Calcareous Dark Grey Floodplain Soils
	Ochrepts	Ustochrepts	Typic Ustochrepts	Paksey	Calcareous Brown Floodplain Soils
			Aquic Ustochrepts	Mirpur, Sara, Sara, made land variant, Sara, noncalcareous topsoil variant	Calcareous Brown Floodplain Soils
			Aquic Udic Ustochrepts	Mominpur (9), Patkelpara	Noncalcareous Brown Floodplain Soils
Histosols	Hemists	Medihemists	Hydric Medihemists	Satla (10)	Peat Soils
			Fibric Terric Medihemists	Rajair	Peat Soils

Notes:
1. Greyer soils are Typic Fluvaquents.
2. Coarse-textured soils are Typic or Aeric Psammaquents.
3. Soils with browner subsoils are Aeric Haplaquepts. Browner Rasulpur soils are Calcareous Brown Floodplain Soils.
4. Soils with thick very dark grey or very dark greyish brown topsoils are Mollic Haplaquepts.
5. Browner soils are Aquic Ustochrepts.
6. Greyer soils are Typic Haplaquepts.
7. Soils cracking wider and deeper when dry may be regarded as the Vertisols. They are either Aquic Udic Chromusterts or Aquic Udic Pellusterts, depending on the matrix colour in the subsoil.
8. Soils with paler or thinner surface layer are Typic or Aeric Haplaquepts. Profiles with massive subsurface layer are Typic or Aeric Fluvaquents.
9. Soils with coarser textures may be Aquic Ustipsamments.
10. Soils without the layer of water within the control section are either Fibric or Sapric Medihemists, depending on the state of decomposition of the peat layer.
11. This unit was not recognized among the general soil types of Bangladesh (6).

A2. SOIL SERIES DESCRIPTION

The technical description of soil series and land types that follow contain an introductory statement regarding the major differentiating features of the soil, a detailed description of representative profile, available analytical data (given in tables in the next chapter of the Appendix A), statements regarding range in profile and environmental characteristics, mode of occurrence of the soil, its distribution and extent and how it differs from other similar soils.

The nomenclatures of U.S.D.A. Soil Survey Manual (24) have been used.

Drainage classes: Four drainage classes have been recognized in the survey area which are already described in section 2.3 of Part 2 of this report.

Horizon: The horizon designation given for the representative profiles must be regarded as tentative, especially in profiles which have only weakly developed diagnostic subsurface horizons. The B horizons are regarded as cambic, rather than argillic, despite the presence of ped cutans in most cases. These cutans are usually thicker than true clay skins and appear to include particle coarser than clay. They mainly represent thin flows of topsoil materials under flooded or puddled condition. The cutans have been discussed in more details in the chapter on soil genesis and classification.

Topsoil, subsoil and substratum: In the introductory paragraph and in the statements on range of characteristics, profiles have mostly been subdivided into three main layers: topsoil, subsoil and substratum. These terms have been explained in section 1.9 in Part I.

Colour: Colour notations have been used according to the Munsell soil colour charts (16). In horizons where two colours (usually a reduced colour with chroma 2 or less and an oxidation colour with chroma 3 or higher) are dominant, each occupying about half of the soil mass, the colours have been described as 'mixed' in the text and have been indicated with an 'and' in the detailed profile descriptions.

Soil reaction: All soil reactions (pH) given were determined on the dried laboratory sample, pH figures given within brackets were determined in the field on moist or wet samples using a Hellige-Truog test kit. The later data have been given mainly where they differ by more than 0.5 pH unit from the laboratory determination. Normally the topsoils or even subsoils become anaerobic when seasonally flooded or wet and become aerobic on drying. From nearly neutral reaction under anaerobic condition, the non-calcareous horizon containing appreciable amount of organic matter, turn somewhat acid and calcareous horizon turn somewhat alkaline on aeration. This seasonal fluctuation in reaction is mainly attributed to alternate reduction and oxidation of organic matter and compounds of iron, manganese and sulphur (18).

Phases and variant: Subdivisions of soil series into phase and variant have been made based on depth and/or mode of flooding, drainage, river-erosion hazard, presence or absence of lime in the topsoil, extent of human disturbance, etc. and the relevant terms have been explained in Part 2 of this report as well as in the glossary given in the Appendix C.

Location of the profiles described is indicated by a stop number followed by the number of the aerial photograph (contact or enlarged print) that covered the site of the profile.

The desciptions are given in alphabetical order of the series names.

Amjhupi Series

Amjhupi series comprises intermittently to seasonally shallowly flooded, imperfectly to poorly drained, silty clay soils developed in old Ganges alluvium. They have an mixed olive-brown and dark greyish brown subsoil having moderate to strong coarse to medium prismatic breaking into angular blocky structure and continuous to broken dark greyish brown cutans along ped faces and pores. Their subsoil is either entirely or in the upper part is decalcified, while the substratum is calcareous.

Typical profile: Amjhupi silty clay, medium highland phase

Location : Stop no. 15/70W-236. Vill. Arjya Narayanpur, P.S. Jhenida,Dt. Jessore

Topography : Lower slope of very gently undulating ridge

Land use : Aus-transplanted aman-fallow

Drainage : Poor. Flooded upto 1 foot for 1-2 months in the rainy season

Horizon	Depth in in.	Description
Ap1	0-2½	Greyish brown (2.5Y 5/2) moist, common fine distinct light olive-brown mottles; silty clay; massive; very hard dry, firm moist, sticky and plastic wet; many very fine and few fine tubular pores; noncalcareous; iron-staining along cracks and root channels; many very fine and few fine roots; pH 6.1 (6.0); abrupt smooth boundary
Ap2	2½-4	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; silty clay; massive; very firm moist, very sticky and very plastic wet; common very fine and few fine tubular pores; noncalcareous; many very fine roots; pH 6.5 (6.5); clear smooth boundary
B21	4-13	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; silty clay; strong coarse prismatic breaking into strong coarse to medium angular blocky; firm moist, very sticky and very plastic wet; continuous moderately thick dark greyish brown cutans along ped faces and pores; many very fine tubular pores; noncalcareous; common very fine roots; pH 6.6; clear smooth boundary
IIB2	13-17½	Olive-brown (2.5Y 4/4) moist, many fine distinct greyish brown, few fine distinct yellowish and dark brown mottles; silty clay loam; moderate coarse prismatic breaking into angular blocky; firm moist, sticky and platic wet; broken thin greyish brown cutans along ped faces and pores; common very fine tubular pores; noncalcareous; few very fine roots; pH 6.8 (7.5); abrupt smooth boundary
IIIB3	17½-25	Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown and few fine distinct dark brown mottles; silt loam; weak coarse prismatic; friable moist, slightly sticky and slightly plastic wet; patchy thin greyish brown cutans along ped faces; continous thin tubular pores; noncalcareous; few very fine roots; pH 7.1 (8.0); abrupt smooth boundary

IIIC1 25-40 Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown and few fine distinct dark yellowish brown mottles; silt loam; friable moist, slightly sticky and slightly plastic wet; many very fine tubular pores; moderately calcareous: few very fine roots; pH 7.7; abrupt smooth boundary

IVC2 40-44 Olive-brown (3.5Y 4/4) moist, many fine faint dark brown and few fine distinct greyish brown mottles; loamy sand; very friable moist, nonsticky and nonplastic wet; noncalcareous; pH 7.7

IVC3 44-50 Light grey (5Y 7/1), many fine distinct dark brown and few fine distinct light yellowish brown mottles; sand; loose moist, non-sticky and nonplastic wet; noncalcareous; pH 7.9.

Note: pH determined on dried soil samples in the laboratory. pH figures given in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil thickness varies from 3-5 inches, colour ranges from olive-brown to dark greyish brown, occasionally very dark greyish brown and texture is usually silty clay loam, some times silty clay or silt loam. Subsoil colour ranges usually from olive-brown to dark greyish brown, occasionally from light olive-brown to greyish brown. Structure ranges from moderate to strong, coarse to medium prismatic, breaking into angular blocky with usually continuous moderately thick to thick greyish brown to dark greyish brown cutans along ped faces and pores. Texture of the substratum ranges from medium to moderately fine but occasionally is moderately coarse or fine. Substratum and sometimes also the lower part of subsoil are calcareous.

b. Environmental characteristics. These soils are developed on middle or lower part of very gently undulating to nearly level ridges of the old Ganges meander floodplain Locally they also occur in somewhat irregular landscape. They are intermittently ver shallowly to shallowly flooded in the monsoon season and become droughty in the dry season.

Four phases have been recognized: Amjhupi, highland phase: Amjhupi, highland, irregular relief phase; Amjhupi, medium highland phase and Amjhupi, medium highland, irregular relief phase.

Distribution and extent

These soils occupy about 7,445 acres of land in the project area.

Similar soils

Amjhupi soils differ from Ishurdi soils in having noncalcareous subsoil and from Jhenida soils in being calcareous in the substratum within a depth of 4 feet.

Baradi Series

Baradi series includes intermittently and seasonally flooded, imperfectly to poorly drained soils developed in old Ganges alluvium. They are greyish brown to olive-brown, noncalcareous silty clay loams with moderate coarse and medium blocky structure in the B horizon. They are decalcified throughout the whole profile.

Typical profile: Baradi silt loam, highland phase

Location : 1/68E-15. Vill. Kusabari, P.S. Magura, Dist. Jessore

Topography : Middle part of very gently undulating ridge

Land use : Aus/jute-transplanted aman-rabi crops

Drainage : Poor. Flooded unto 4-6 inches for more than 15 days

Horizon	Depth in in.	Description
Ap1g	0-3	Light olive-brown (2.5Y 5/3) moist, common fine distinct dark yellowish brown and few fine distinct yellowish brown and grev mottles; silt loam; massive; friable moist, slightlv sticky and slightly plastic wet: many ver, fine, common fine and few medium tubular pores; noncalcareous; mary very fine and commor fine roots; pH 4.8 (7.0); abrupt smooth boundarv
Ap2g	3-5	Greyish brown (2.5Y 5/2) moist, common fine distinct dark brown and few fine distinct dark yellowish brown and grev mottles· clay loam; massive; slightly friable moist, slightly sticky and slightly plastic wet; common very fine tubular pores; noncalcareous, common very fine roots; pH 5.7 (7.5); abrupt smooth boundary
B21	5-11	Dark greyish brown (2.5Y 4.5/2) moist, many fine distinct dark yellowish brown and brown, common fine faint ligh' olive-brown and few fine distinct dark brown mottles: clay loam: moderate coarse to medium prismatic breaking into moderate coarse to medium angular blocky: firm moist, slightly sticky and slightly plastic wet; broken moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; noncalcareous: common very fine roots; pH 6.2(7.5); abrupt smcoth boundary
B22	11-17	Greyish brown (2.5Y 5/2) moist, many fine distinct yellowish brown and few fine distinct dark brown mottles; silty clay loam; moderate coarse prismatic breaking into angular blocky: firm moist, sticky and plastic wet; broken moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; noncalcareous: pH 6.2; abrupt smooth boundary
IIB3	17-28	Greyish brown (2.5Y 5/2) moist, common fine distinct dark yellowish brown, yellowish brown and dark brown mottles; silty clay; weak coarse prismatic breaking into angular blocky: firm moist, sticky and plastic wet;patchy thin greyish brown cutans along vertical and horizontal ped faces and pores; common very fine tubular pores: non-calcareous; few very fine roots; pH 6.9 (7.5); abrupt smooth boundary

IIIC1	28-40	Greyish brown (2.5Y 5/2) moist, common fine distinct dark yellowish brown, yellowish brown and dark brown mottles: silty clay loam: firm moist, sticky and plastic wet; common very fine tubular pores; noncalcareous; pH 7.0 (7.5); abrupt smooth boundary
IVC2	48-58	Light olive-brown (2.5Y 5/3) and greyish brown (2.5Y 5/2) moist, common fine distinct yellowish brown and very dark greyish brown mottles; silt loam; friable moist, slightly sticky and slightly plastic wet; noncalcareous; pH 6.9 (7.5)

Note: Sampled by auger below 40 inches; structure, cutans and pores not recorded below this depth. pH determined on dried soil samples in the laboratory. pH figures given in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from greyish brown to olive-brown, occasionally light brownish grey or grey. The subsoil colour ranges from greyish brown to olive-grey and the texture is silty clay loam occasionally clay loam or sandy clay loam. The substratum is usually medium textured to moderately fine textured, occasionally moderately coarse textured or fine textured.

b. Environmental characteristics. These soils are developed in old Ganges alluvium. They occupy summit to lower part of ridges, occasionally inter-ridge depressions in the old Ganges meander floodplain. They are intermittently to shallowly flooded in the rainy season and become droughty in the dry season.

Four phases have been recognized: Baradi, highland phase: Baradi, highland, irregular relief phase; Baradi, medium highland phase: and Baradi, medium highland, irregular relief phase.

Distribution and extent

These soils occupy about 2,073 acres in the survey area.

Similar soils

They differ from Gopalpur and Darsana soils in having thoroughly noncalcareous profile.

Batra Series

Batra series includes seasonally shallowly to deeply flooded, poorly drained soils developed in Old Ganges alluvium. The B horizon comprises dark greyish brown to olive-brown noncalcareous clay with fine to very fine angular blocky structure. They are decalcified throughout the profile.

Typical profile: Batra clay, medium lowland, slow draining phase

Location: Stop : 1/68E-13. Vill. Samaspur, P.S. Jhenida, Dist. Jessore

Topography : Basin bottom

Land use : Broadcast deepwater aman-fallow

Drainage : Poor. Flooded upto 3-4 feet for 6-7 months in the rainy season. Groundwater at 40" on 8th February, 1980.

Horizon	Depth in in.	Description
Ap1g	0-4	Very dark grey (10YR 3/1) most, few fine distinct yellowish brown mottles; clay; massive: firm moist, very sticky and very plastic wet; common very fine and few fine tubular pores; noncalcareous; yellowish brown and strong brown iron staining along cracks and root channels; many very fine and few fine roots; pH 5.2 (6.0); abrupt smooth boundary
Ap2g	4-5	Very dark grey (10YR 3/1) moist, common fine distinct yellowish brown mottles; clay; massive; very firm moist, very sticky and very plastic wet: common very fine tubular pores; noncalcareous; yellowish brown and strong brown iron staining along cracks and root channels; many very fine roots; pH 5.2 (6.5); abrupt smooth boundary
B21g	5-11½	Dark greyish brown (2.5Y 4/2) moist, many fine distinct yellowish brown and few fine prominent strong brown mottles; clay; strong coarse to medium prismatic breaking into strong medium to very fine angular blocky; firm moist, very sticky and very plastic wet; continuous thick to moderately thick very dark grey cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; common very fine roots; pH 6.2 (7.5); clear smooth boundary
B22g	11½-25	Dark grey (5Y 4/1) moist, common fine distinct yellowish brown and few fine prominent strong brown mottles; clay; strong very coarse to coarse prismatic breaking into strong medium to fine angular blocky; firm moist, very sticky and very plastic wet: continuous moderately thick to thick very dark grey to dark grey cutans along vertical and horizontal ped faces and pores; common very fine and few fine tubular pores; noncalcareous; common very fine roots; pH 6.3 (7.5); abrupt smooth boundary
IIC1g	25-35	Dark grey (10YR 4/1) moist, common fine distinct dark yellowish brown and few fine distinct strong brown mottles; sandy clay loam; firm moist, very sticky and very plastic moist; few very fine tubular pores; noncalcareous; few fine roots; pH 6.4 (8.0); abrupt smooth boundary
IIC2g	35-40	Grey (5Y 5/1) wet, few fine distinct dark brown mottles; sandy loam; slightly firm moist, slightly sticky and slightly plastic wet; noncalcareous; pH 6.6 (8.0); abrupt smooth boundary

IIIC3g 40-54 Grey (5Y 5/1) wet, few fine distinct dark brown mottles; sandy loam; friable moist, nonsticky and nonplastic wet; noncalcareous; pH 6.5 (8.0)

Note: pH figures in brackets determined on moist or wet soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour usually ranges from dark grey to dark greyish brown and rarely greyish brown to olive-brown. Subsoil colour ranges from dark greyish brown or dark grey to olive-brown. Structure is very fine to fine angular blocky with continuous thick dark grey to dark greyish brown cutans along vertical and horizontal ped faces and pores. Substratum is mainly moderately fine to fine textured, rarely moderately coarse to coarse textured.

b. Environmental characteristics. These soils are developed in Old Ganges alluvium and occupy basins and sometimes infilled channels of the Old Ganges meander floodplain. They are flooded upto 6 feet for 3 to 7 months during the rainy season. They are usually droughty in the dry season, occasionally remain wet in the early dry season and are affected by flood hazard due to early heavy monsoon rains.

Four phases have been recognized: Batra, medium highland phase: Batra, medium lowland, early draining phase; Batra, medium lowland, slow draining phase and Batra, lowland phase.

Distribution and extent

These soils occupy about 5,002 acres in the survey area.

Similar soils

The Batra soils differ from Magura series in overall paler colour, from Ghior series in having a throughly decalcified profile and from Kasiani series in relatively heavier clay texture, heavier consistence and finer structure in the B horizon usually with wedged-shaped peds, pressure faces and slickensides.

Benapol Series

Benapol series includes intermittently and seasonally shallowly flooded, imperfectly to poorly drained, dark greyish brown, noncalcareous, heavy clays developed in Old Ganges alluvium. These soils have coarse and medium prismatic and blocky structure breaking into fine and very fine blocky, sometimes with pressure faces, and continuous dark grey to dark greyish brown coatings in the B horizon. They are decalcified throughout the profile.

Typical profile: **Benapol clay, medium highland phase**

Location : Stop. 39/70W-234. Vill. Hazipur, P.S. Magura, Dist. Jessore

Topography : Middle slope of nearly level ridge

Land use : Jute-transplanted aman-rabi crops (lentil, gram, wheat, etc.)

Drainage : Poorly drained. Seasonally very shallowly flooded (upto a few inches) for about 15 or 20 days

Horizon	Depth in in.	Description
Ap1	0-3½	Dark greyish brown (10YR 4/2) moist, many fine distinct dark yellowish brown and strong brown mottles; clay; cloddy; very hard dry, very firm moist, very sticky and very plastic wet; common very fine to fine tubular pores; many very fine to fine and few medium roots; pH 5.6; abrupt smooth boundary
Ap2	3½-5½	Dark greyish brown 10YR 4/2) moist, many fine distinct dark yellowish brown and few fine distinct yellowish brown mottles; clay; massive; very firm moist, very sticky and very fine roots; pH 5.7 (7.0); abrupt smooth boundary
B21g	5½-17½	Dark greyish brown (2.5Y 4/2) moist, many fine distinct dark brown and few fine distinct dark yellowish brown mottles: clay; strong coarse and medium prismatic breaking into coarse and medium angular blocky; very firm moist, very sticky and very plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; pressure faces; common very fine roots; pH 6.4 (7.5); clear smooth boundary
B22g	17½-28	Dark greyish brown (10YR 4/2) moist, common fine distinct yellowish brown and few fine distinct dark brown mottles; clay; moderate very coarse and coarse prismatic breaking into moderate coarse and medium angular blocky; very firm moist, very sticky and very plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; few very fine roots pH 6.5 (8.0); abrupt smooth boundary
B3g	28-32	Dark greyish brown (2.5Y 4/2) moist, common fine distinct light olive-brown mottles; clay; moderate very coarse and coarse prismatic breaking into angular blocky; very firm moist, very sticky and very plastic wet; continuous moderately thick dark grey cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; pH 6.8 (8.0); abrupt smooth boundary
C1	32-42	Greyish brown (2.5Y 5/2) moist, common fine distinct light olive-brown and few fine distinct greyish brown mottles; clay; weak very coarse and coarse prismatic; firm moist, sticky and plastic wet; pH 6.9 (8.0)

C2	42-50	Greyish brown (2.5Y 5/2) and olive-brown (2.5Y 4/4) moist, common fine distinct yellowish brown and few fine distinct very dark greyish brown mottles; silty clay; firm moist, sticky and plastic wet; pH 6.5 (8.0)
IIC3	50-58+	Greyish brown (2.5Y 5/2) and olive-brown (2.5Y 4/4) moist, common fine distinct yellowish brown mottles; silty clay loam; firm moist, sticky and plastic wet; pH 6.5 (8.0)

Note: Sampled by auger below 42 inches. pH determined on dried sample in the laboratory. pH figures given in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. A typical topsoil is massive, greyish brown to dark greyish brown, mottled silty clay; other colours include dark grey, very dark grey, very dark greyish brown and olive-brown while texture ranges from silty clay loam to clay. This overlies a heavy clay subsoil, with strong coarse to medium prismatic and coarse to very fine angular blocky peds having continuous to nearly broken dark grehish brown, dark grey, very dark grey or greyish brown cutans. Subsoils are dark greyish brown, mottled with grey and dark grey to light olive-brown and yellowish brown. Pressure faces and wide cracks are commonly present. Textures in the substratum are medium to fine occasionally, moderately coarse; while matrix colours are mainly greyish brown, dark greyish brown or olive-brown. These soils are thoroughly decalcified.

b. Environmental characteristics. These soils occur on the Old Ganges meander floodplain occupying the upper to lower slopes of level to very gently sloping broad ridges and inter-ridge depressions. Locally they also occupy narrow ridges and inter-ridge depressions. They are either above flood level or shallowly flooded by rainwater in the rainy season.

Four phases and one variant have been recognized: Benapol, highland phase; Benapol, highland, irregular relief phase; Benapol, medium highland phase; and Benapol, medium highland, irregular relief phase and Benapol medium highland, calcareous topsoil variant

Distribution and extent

These soils occupy about 6,582 acres in the Old Ganges meander floodplain.

Similar soils

The Benapol soils differs from Pakuria and Gangni soils in being noncalcareous throughout the profile and from Jhenida soils in having finer texture and stronger structure in the subsoil.

Darsana Series

Darsana series comprises intermittently and seasonally shallowly flooded, imperfectly to poorly drained, moderately fine textured soils developed in old Gangetic alluvium. They have a noncalcareous or partly decalcified, olive-brown to greyish brown silty clay loam subsoil with moderate to strong, coarse to medium prismatic breaking into moderate to strong coarse to medium angular blocky structure, overlying usually medium textured calcareous substratum.

Typical profile: Darsana silty clay loam, medium highland phase

Location : 152/69W-43. Vill. Mirzapur, P.S. Magura, Dist. Jessore

Topography : Middle part of very gently undulating ridge

Land use : Aus-transplanted aman-rabi crops (wheat)

Drainage : Poor. Flooded upto one foot for about one month

Horizon	Depth in in.	Description
Ap1g	0-3	Light olive-brown (2.5Y 5/4) moist, common fine distinct grey and few fine distinct yellowish brown mottles; silty clay loam; cloddy; hard dry, sticky and plastic wet; many very fine and few fine tubular pores; noncalcareous; many very fine roots; pH 6.8; abrupt smooth boundary
Ap2g	3-5	Olive-brown (2.5Y 4/4) moist, common fine distinct grey, few fine distinct yellowish brown and few fine prominent strong brown mottles; silty clay loam; massive; firm moist; common very fine tubular pores; noncalcareous; common very fine roots; pH 6.9; abrupt smooth boundary
B21	5-13	Dark greyish brown (2.5Y 4/2) and olive-brown (2.5Y 4/4) moist, few fine distinct yellowish brown and dark brown mottles; silty clay loam; strong coarse and medium prismatic breaking into strong coarse angular blocky; friable moist, sticky and slightly plastic wet; continuous moderately thick dark greyish brown cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; few very fine roots; pH 6.4 (7.0); abrupt wavy boundary
B22	13-21	Olive-brown (2.5Y 4/4) and dark greyish brown (10YR 4/2) moist, few fine distinct yellowish brown mottles; silty clay loam; strong very coarse prismatic breaking into weak very coarse angular blocky; friable moist, sticky and slightly plastic wet; continuous moderately thick greyish brown cutans along vertical ped faces and pores; noncalcareous; few very fine roots; pH 6.6; clear smooth boundary
IIB3	21-30	Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown, few fine distinct dark yellowish brown and few fine prominent dark brown mottles; silty clay; moderate very coarse prismatic; friable moist, sticky and slightly plastic wet; continuous moderately thick greyish brown cutans along vertical ped faces and pores; many very fine tubular pores; calcareous; remnants of stratification in the lower part; few very fine roots; pH 7.9; clear smooth boundary
IIC1	30-43	Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown, common fine prominent dark brown and few fine distinct yellowish brow mottles; Silty clay; weak very coarse prismatic; moist, friable sticky and slightly plastic wet; broken moderately thick greyish brown cutans along vertical ped faces and pores; many very fine tubular pores; calcareous; remnants of stratification; few very fine roots; pH 8.0
IIC2	43-57	Olive-brown (2.5Y 4/4) moist, many fine distinct greyish brown, common fine distinct yellowish brown and few fine prominent dark brown mottles; silty clay loam; firm moist, sticky and slightly plastic wet; calcareous; pH 8.1

Note: 1 determined on dried soil samples in the laboratory. pH figure given in brackets obtained on moist soils in the field using a Hellige-Truog test kit

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from light olive-brown to dark greyish brown, occasionally light olive-brown to dark greyish brown or olive-grey and texture silt loam to silty clay loam and rarely silty clay. Subsoils are mottled with combinations of colours ranging from light olive-brown or olive-brown to greyish or dark greyish brown. Occasionally very dark greyish brown, grey or olive-grey colou was observed. Subsoil structure is prismatic breaking into angular blocky structure having grevish brown to dark greyish brown cutans on ped faces and pores and texture is silty clay loam. The substratum is mainly medium to fine textured and rarely moderately coarse textured.

b. Environmental characteristics. These soils are developed on the old Ganges meande floodplain occupying upper to lower parts of mainly very gently undulating and rarely undulating ridges and occasionally in inter-ridge depressions. They are either intermittently flooded by rainwater within the field bunds for a few hours to less than 15 days or seasonally very shallowly to shallowly flooded upto 3 feet for more than 15 da upto 3 months.

Four phases have been established; Darsana, highland phase; Darsana, highland, irregular relief phase: Darsana, medium highland phase; and Darsana, medium highland, irregular relief phase.

Distribution and extent

These soils occupy about 8,156 acres in the old Ganges meander floodplain.

Similar soils

They differ from Gopalpur series in having partly or completely decalcified subsoils a from Baradi series in having free lime either in the lower part of subsoil or at least in the substratum.

Gangni Series

Gangni series consists of intermittently and seasonally flooded, imperfectly to poorly drained, partially decalcified, fine textured soils developed in old Ganges alluvium. They have greyish brown or olive-brown to dark greyish brown subsoil with strong prisma tic and angular blocky structure having thick dark greyish brown cutans along ped faces and pores. Their subsoil is decalcified either entirely or in the upper part; while the substratum is calcareous.

Typical profile: Gangi clay, highland phase

Location : Stop no. 1/70W-234. Vill. Hazipur, Magura thana, Dist. Jessore

Topography : Very gently undulating ridge

Land use : Jute-rabi crops (mustard, gram, etc.)

Drainage : Imperfect. Above normal flood level

Horizon	Depth in in.	Description
Ap1	0-4	Dark brown (10YR 4/3) and dark greyish brown (2.5Y 4/2) moist, clay; cloddy; hard dry, firm moist, sticky and plastic wet; many very fine tubular pores; noncalcareous; many very fine and fine roots; pH 6.2 (7.0); abrupt smooth boundary
Ap2	4-5½	Dark greyish brown (2.5Y 4/2) moist, many fine distinct dark yellowish brown mottles; silty clay; massive; very firm moist, very sticky and very plastic wet; common very fine tubular pores; noncalcareous; many very fine and fine roots; pH 6.1 (7.0); abrupt smooth boundary
B21g	5½-11	Dark greyish brown (2.5Y 4/2) moist, many fine distinct dark yellowish brown and dark brown mottles; clay; strong coarse to medium angular blocky; very firm moist, very sticky and very plastic wet; many very fine tubular pores; continuous thick dark grey cutans along vertical ped faces and pores; noncalcareous; common very fine roots; pH 6.5 (7.5); abrupt smooth boundary
IIB22g	11-17	Dark greyish brown (2.5Y 4/2) moist, many fine distinct dark yellowish brown and yellowish brown mottles; silty clay loam; strong coarse to medium angular blocky; firm moist, sticky plastic wet; many very fine tubular pores; broken moderately thick dark grey cutans along vertical and horizontal ped faces and pores; noncalcareous; few very fine roots; pH 6.8 (7.5); abrupt smooth boundary
IIIC1	17-23	Mixed greyish brown (2.5Y 5/) and light olive-brown (2.5Y 5/4) moist silt loam; friable moist, slightly sticky and slightly plastic wet; many very fine and fine tubular pores; noncalcareous; few very fine roots; pH 7.1 (8.0); abrupt smooth boundary
IIIC2	23-32	Mixed light olive-brown (2.5Y 5/4) and yellowish brown (10YR 5/4) moist, silt loam; friable moist, sticky and plastic wet; many very fine and fine tubular pores; moderately calcareous; few very fine roots; pH 8.1; abrupt smooth boundary
IVC3	32-46	Greyish brown (2.5Y 5/2) moist, many fine distinct yellowish brown and dark brown mottles; silty clay; friable moist, sticky and plastic wet; many very fine and fine tubular pores; moderately calcareours; few very fine roots; pH 7.8
VC4	46-50	Dark greyish brown (2.5Y 4/2) moist, yellowish brown and dark yellowish brown mottles; clay laom; noncalcareous; pH 7.1 (8.0)

Note: Sampled by auger below 46 inches. pH figures given within brackets determined on moist soils in the field by using Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges usually from greyish brown to dark greyish brown, occasionally olive-brown or dark grey; texture from silty clay to clay or silty clay loam. Subsoil colour usually is greyish brown or olive-brown to dark greyish brown, rarely very dark greyish brown or dark grey; structure varies usually from strong coarse to medium angular blocky, occasionally moderate to strong coarse

to medium prismatic breaking into coarse to fine angular blocky with continuous thick dark greyish brown cutans along ped faces and pores. Locally, subsoil has pressure faces, earthworm activity and shell fragments. Colour of the calcareous substratum usually ranges from greyish brown to lightolive-brown, occasionally, olive-brown; texture ranges from silt loam to clay. A buried layer occurs in some of the profiles. Soils are calcareous in the lower part of the subsoil and/or substratum.

b. Environmental characteristics. These soils occupy upper to lower parts of nearly level to very gently undulating ridges and inter-ridge depressions in the old Ganges meander floodplain. They are usually flooded upto 3 feet for 1-5 months, but occasionally are also above flood level.

Four phases have been recognized: Gangni, highland phase; Gangni, highland, irregular relief phase; Gangni, medium highland phase and Gangni, medium highland, irregular relief phase.

Distribution and extent

These soils occupy about 4,195 acres of land in Jhenida-Magura Project area.

Similar soils

Gangni soils differ from Pakuria soils in having a decalcified subsoil, from Benapol soils in having a calcareous substratum and from Amjhupi soils in having finer texture and relatively stronger structure in the subsoil.

Garuri Series

Garuri series includes seasonally flooded, poorly drained, fine textured, partially calcareous soils developed in old Ganges alluvium. They have an olive-brown to dark greyish brown, clay to silty clay subsoil with strong coarse to medium and fine angular blocky structure, and continuous thick dark grey to dark greyish brown cutans along ped faces and pores. Their subsoil is decalcified either entirely or in the upper part; while the substratum is calcareous.

Typical profile: Garuri silty clay loam, medium lowland, slow draining phase

Location : Stop no. 16/70W-236. Vill. Huda Gopalpur, P.S. Jhenida, Dist. Jessor

Topography : Basin bottom

Land use : Broadcast deepwater aman-fallow

Drainage : Poor. Flooded upto 4 feet for about 6-7 months

Horizon	Depth in in.	Description
Apg	0-5	Dark grey (10YR 4/1) moist, few fine distinct dark brown and few fine distinct light olive-brown mottles; silty clay loam; massive; firm moist, sticky and plastic wet; common very fine and few fine tubular pores; noncalcareous; iron staining along cracks and root channels; many very fine and few fine roots; pH 5.2 (6.0); abrupt smooth boundary

B21g	5-11	Dark greyish brown (2.5Y 4/2) moist, many fine distinct olive-brown and common fine distinct yellowsh brown mottles; silty clay; strong coarse prismatic breaking into strong coarse to medium angular blocky; very firm moist, very sticky and very plastic wet; continuous moderately thick to thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; many very fine roots; pH 5.8 (7.0); abrupt smooth boundary
B22g	11-17½	Yellowish brown (10YR 5/6) moist, common fine distinct olive-brown and few fine distinct greyish brown mottles; silty clay; strong coarse prismatic breaking into weak coarse angular blocky; very firm moist, very sticky and very plastic wet; continuous to broken thick to moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; common very fine roots; pH 6.7 (8.0); abrupt smooth boundary
IIB3g	17½-22	Dark greyish brown (2.5Y 4/2), many fine distinct olive-brown and common fine distinct yellowish brown mottles; silty clay loam; moderate coarse prismatic breaking into angular blocky; friable moist, sticky and plastic wet; brocken moderately thick dark grey cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; noncalcareous; few very fine roots; pH (8.0); abrupt broken boundary
IIIC1	22-24	Greyish brown (2.5Y 5/2), many fine distinct dark brown and common fine distinct light olive-brown mottles; silty loam; remnants of stratification; very friable moist, nonsticky nonplastic wet; common very fine tubular pores; noncalcareous; few very fine roots; pH 6.9 (8.0); abrupt smooth boundary
IVC2	24-30	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2), yellowish brown mottles; silty clay loam; remnants of stratification; friable moist, slightly sticky and slightly plastic wet; few very fine tubular pores; noncalcareous; pH 7.0 (8.0); abrupt smooth boundary
VC3	30-39	Olive-brown (2.5Y 4/4), common fine distinct greyish brown, few fine distinct yellowish brown and dark brown mottles; silt loam; remnants of stratification; slightly sticky and slightly plastic wet; slightly plastic wet; slightly calcareous; pH 7.5 (8.0); abrupt smooth boundary
VIC4	39-44	Olive-brown (2.5Y 4/4), many fine distinct greyish brown and common fine distinct yellowish brown mottles; silty clay loam; remnants of stratification; sticky and plastic wet; moderately calcareous; pH 7.8
VIIC5	44-50	Greyish brown (2.5Y 5/2), common fine distinct olive-brown, dark brown and very dark greyish brown mottles; silty clay; very sticky and very plastic wet; moderately calcareous; pH 7.7
VIIC6	50-58	Olive-brown (2.5Y 4/4) moist, many fine distinct greyish brown and common fine distinct yellowish brown mottles; clay; very sticky and very plastic wet; noncalcareous; pH 7.4 (8.0)

Note: pH figures within brackets determined on moist soils in the field by using a Hellige-Truog test kit. Sampled by auger below 44" inches.

Range of characteristics

a. Profile characteristics. Thickness of topsoil usually ranges from 3" to 5". It's colour from greyish brown to dark greyish brown or dark grey and texture from clay to silty clay loam with silty clay being dominent. Thickness of the subsoil varies from 5 to 18 inches, rarely to 24 inches; subsoil colour usually is olive-brown or dark greyish brown, occasionally greyish brown or dark grey, structure is coarse to medium and fine angular blocky, sometimes strong very coarse to medium prismatic breaking into coarse to medium and fine angular blocky. Continuous thick dark grey to dark greyish brown cutans are normally present along ped faces and pores, ocassionally broken moderately thick dark grey to dark greyish brown cutans occurs. At least the upper part of the subsoil is noncalcareous and medium acid to neutral in reaction. Colour of the substratum usually is olive-brown or light olive-brown or greyish brown, rarely dark grey to dark greyish brown or neutral grey; texture varies from silt loam to clay with silt loam and silty clay loam being dominent, rarely silty clay or clay. At least, lower part of the substratum is calcareous.

b. Environmental characteristics. These soils are developed usually in floodplain basins, sometimes in infilled channel in the old Ganges meander floodplain. They are poorly drained and seasonally flooded upto 4' feet for 1 to 8 months.

Five phases have been recognized: Garuri, medium highland phase; Garuri, medium highland, irregular relief phase; Garuri, medium lowland, early draining phase, Garuri, medium lowland, slow draining phase; and Garuri, lowland phase.

Distribution and extent

These soils occupy about 3,477 acres of land in the project area.

Similar soils

Garuri series differs from Ghior series in having somewhat lighter clay texture, coarser structural peds and lighter consistence in the subsoil which totally lacks any wedge-shaped ped or slickenside, from Mehendiganj soils in having noncalcareous subsoil, from Gangni soils in having somewhat coarser peds with greyer cutans in the subsoil and also occurrence in basin sites, from Kasiani soils in having a calcareous substratum and from Batra soils in having relatively lighter clay texture, coarser peds and lighter consistence in the subsoil and a calcareous substratum.

Ghior Series

Ghior series includes seasonally flooded poorly drained soils developed in heavy clays of the old Ganges meander floodplain basins. The subsoil is generally has a mixed dark grey and olive-brown colour, strong angular blocky structure with wedge-shaped ped and pressure faces with prominent dark grey cutans in the upper part of the B horizon. The lower part of the B horizon is sometimes calcareous and the substratum is always calcareous.

Typical profile: Ghior clay, medium highland phase

Location : Stop no. B1/70W-232. Vill. Kasiadanga, P.S. Magura, Dist. Jessore

Topography : Basin margin

Land use : Broadcast deepwater aman-fallow/rabi crops (khesari and linseed)

Drainage : Flooded upto 2-2½ feet deep for 4-5 months

Horizon	Depth in in.	Description
Ap1	0-3	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown (10YR 4/4) and strong brown mottles: clay; massive; very firm moist, sticky and plastic wet; common very fine and fine tubular pores; noncalcareous; strong brown iron staining along root channels and pores; many very fine and fine and few medium roots; pH 5.7 (6.5); abrupt smooth boundary
Ap2	3-4½	Dark greyish brown (2.5Y 4/2) moist, common fine faint light olive-brown and few fine distinct dark yellowish brown mottles; clay; massive; firm moist, sticky and plastic wet; common very fine tubular pores; noncalcareous; common very fine roots; pH 5.5 (7.0); abrupt smooth boundary
B21g	4½-11	Dark grey (5Y 4/1) and olive-brown (2.5Y 4/4) moist, common fine distinct dark brown mottles; clay; strong coarse to medium angular blocky structure breaking to strong medium and fine angular blocky; firm moist, very sticky and plastic wet; continuous dark grey cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; noncalcareous; pressure faces present; common very fine roots; pH 6.3 (7.5); abrupt smooth boundary
B22g	11-22	Olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, common fine distinct yellowish brown mottles; silty clay; moderate coarse prismatic breaking to moderate coarse and medium angular blocky; firm moist, sticky and plastic wet; broken moderately thick grey cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; calcareous; presence of krotovina; few very fine roots; pH 7.8 (8.0); abrupt smooth boundary
C1	22-32	Olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, common fine distinct yellowish brown and dark brown mottles; silty clay; weak coarse prismatic breaking to angular blocky; slightly firm moist, sticky and plastic wet; patchy thin grey cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; moderately calcareous; few very fine roots; pH 7.8; abrupt smooth boundary
IIA1b	32-38	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; clay loam; firm moist, sticky and plastic wet; few very fine tubular pores; noncalcareous; pH 7.2 (8.0)

IIC2 38-50 Greyish brown (2.5Y 5/2) moist, many fine distinct yellowish brown and dark brown mottles; clay loam; slightly firm moist, sticky and plastic wet; noncalcareous; pH 7.4 (8.0)

Note: pH figures given in the bracket determined on moist soils in the field by using Hellige-Truog test kit. Below 38 inches, sampled by auger.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from dark grey to very dark greyish brown, rarely light olive-brown to olive-brown and texture ranges from clay to silty clay loam. Subsoil colour ranges from mainly dark grey to dark greyish brown occasionally light olive-brown or olive-brown and rarely very dark grey or very dark greyish brown. Structure is strongly developed medium to very fine angular blocky with dark grey to dark greyish brown cutans. Pressure faces and slickensides usually occur in the upper part of the subsoil. Depth to the calcareous layer varies from 12-40 inches. Texture of the substratum ranges from silty clay loam to silt loam occasionally clay and very rarely fine sandy loam and colour is mainly light olive-brown. Locally these soils include buried layers with dark grey to dark greyish brown colours.

b. Environmental characteristics. These soils are developed in the old Ganges meander floodplain and occupy mainly nearly level to very gently undulating basin margins and basin bottoms and also some infilled channels. They are seasonally flooded upto 1-8 feet deep for 1-8 months in the rainy season. The medium highland and medium lowland soils on basin margins are usually flooded upto 1-3 feet deep for 1-4 months and upto 3-5 feet deep for about 3-5 months respectively and basin bottoms are usually flooded upto 8 feet deep for about 5-8 months in the rainy season. The basin bottom soils are locally subject to occasional rapid rise of flood level and mostly remain wet in the early part of dry season.

Four phases have been recognized: Ghior, medium highland phase: Ghior, medium lowland, early draining phase; Ghior, medium lowland, slow draining phase: and Ghior, lowland phase.

Distribution and extent

Ghior soils occupy about 3,481 acres in the survey area.

Similar soils

Ghior soils differ from Batra soils by being calcareous within a depth of 48 inches, and from Garuri soils, in having relatively heavier clay texture, finer structure with wedge-shaped peds, pressure faces and slickensides and heavier consistence.

Gopalpur Series

Gopalpur series comprises intermittently to seasonally very shallowly to shallowly flooded, imperfectly to poorly drained soils developed in Ganges alluvium. They are light olive-brown to olive-brown, calcareous, silty clay loams with moderate to strong coarse prismatic breaking into moderate coarse to medium angular blocky structure in the B horizon.

Typical profile: Gopalpur silty clay loam, highland phase

Location : 36/70W-234. Vill. Dariapur, P.S. Magura, Dist. Jessore

Topography : Middle slope of gently sloping ridge

Land use : Aus or jute-rabi crops (barley)

Drainage : Imperfect. Above normal flood level. Intermittently flooded by rainwater with field bunds for a few hours to 2-3 days

Horizon	Depth in in.	Description
Ap	0-3½	Pale yellow (2.5Y 7/4) dry, light greyish brown mottles; silty clay loam; dry hard; many very fine tubular pores; moderately calcareous; many very fine and common fine roots; pH 7.5 (8.0); abrupt smooth boundary
B21	3½-8½	Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown and dark brown mottles; silty clay loam; weak coarse prismatic breaking into angular blocky; friable moist; patchy thin greyish brown cutans along vertical ped faces and pores; many very fine and fine and few medium pores; moderately calcareous; many very fine roots; pH 7.9; clear smooth boundary
B22	8½-17	Mixed greyish brown (2.5Y 5/2) and olive-brown (2.5Y 4/4) moist, common fine distinct dark yellowish brown mottles; silty clay loam; weak coarse prismatic breaking into coarse to medium angular blocky; friable moist; patchy thin greyish brown cutans; many very fine tubular pores, moderately calcareous; many very fine roots; pH 7.9; clear wavy boundary
B23	17-23	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, common fine distinct dark brown and very dark greyish brown mottles; silty clay loam; weak very coarse to coarse prismatic; friable moist; patchy thin greyish brown cutans; many very fine and fine and few medium tubular pores; moderately calcareous; many very fine roots; pH 7.9; clear smooth boundary
C1	23-32	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, silty clay loam; weak very coarse to coarse prismatic; friable moist; patchy thin greyish brown cutans; many very fine and fine and few medium tubular pores; moderately calcareous; pH 7.9; clear smooth boundary
C2	32-48	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, dark brown and very dark greyish brown mottles; silty clay loam; friable moist; many very fine tubular pores; moderately calcareous; few very fine roots; pH 7.9
IIC3	48-56+	Light olive-brown (2.5Y 5/4) moist, dark yellowish brown to dark brown mottles; silt loam; friable moist; moderately calcareous; pH 7.9

Note: Sampled by auger below 48 inches. pH determined on dried sample in the laboratory; pH figure in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from greyish brown to olive-brown, rarely dark grey to dark greyish brown and texture from silt loam to silty clay loam. On the older floodplains, topsoils are locally noncalcreous. Subsoil colour ranges from light olive-brown to olive-brown and occasionally greyish brown and texture is usually silty clay loam, rarely sandy clay loam. Structure is moderate to strong and occasionally weak very coarse to coarse and medium prismatic breaking into coarse to medium angular blocky usually with patchy to broken thin to moderately thick and also continuous thick grey to dark greyish brown cutans along vertical and horzontal ped faces and pores. Texture of the substratum usually occurring below 10-38 inches from the surface, ranges from silt loam to silty clay loam, rarely very fine sandy loam and silty clay or clay. In some profile stratification is present in the substratum and burried often noncalcareous topsoils can occur.

b. Environmental characteristics. These soils have developed in young and old Ganges meander floodplains occupying upper to lower part of usually nearly level to very gently undulating and occasionally gently undulating ridges and inter-ridge depressions. They are either above normal flood level or flooded upto 3 feet deep for 3-4 months in the rainy season. The highland soils are often intermittently flooded for a few hours to few days by rain water within field bunds and become droughty in the dry season.

Four phases have been recognized: Gopalpur, highland phase: Gopalpur, highland, irregular relief phase; Gopalpur, medium highland phase and Gopalpur, medium highland, irregular relief phase.

Distribution and extent

Gopalpur soils occupy about 2,902 acres in the project area.

Similar soils

The Gopalpur soils differ from Darsana and Baradi soils having a calcareous subsoils, from Ishurdi soils in having coarser texture, relatively weaker structure and lighter consistence in the subsoil, from Sara soils in having finer texture and stronger structure in the subsoil and from Rasulpur soils in having relatively browner colour in the subsoil and occurence on ridge sites with better drainage conditions.

Ishurdi Series

Ishurdi series comprises intermittently to seasonally very shallowly to shallowly flooded, imperfectly to poorly drained, light olive-brown to olive-brown, finely mottled, calcareous silty clays developed in Ganges alluvium. They have moderate to strong prismatic and angular blocky structure with greyish brown to dark greyish brown and occasionally dark grey cutans on ped faces in the B horizon.

Typical profile: Ishurdi silty clay, medium highland phase

Location : 37/70W-234. Vill. Darianur, P.S. Magura, Dist. Jessore

Topography :

Land use : Aus or jute-rabi crops

Drainage : Poor. Flooded upto 1 foot for more than 15 days within field bunds in the monsoon season

Horizon	Depth in in.	Description
Ap1	0-4½	Light olive-brown (2.5Y 5/4) moist, greyish brown mottles; silty clay; massive; hard dry; many very fine and fine and few medium tubular pores; calcareous; many very fine and fine and few medium roots; abrupt smooth boundary; pH 7.7
Ap2g	4½-5½	Greyish brown (2.5Y 5/2) moist, light olive-brown mottles; silty clay; massive; firm moist, common very fine tubular pores; moderately calcareous; common very fine roots; abrupt smooth boundary; pH 7.8
B21g	5½-14	Mixed light olive-brown (2.5Y 5/4) and greyish brown (2.5Y 5/2); silty clay; moderate coarse prismatic breaking into coarse to medium angular blocky; firm moist; broken moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; moderately calcareous; common very fine roots; clear smooth boundary; pH 7.9
IIB22g	14-19	Greyish brown (2.5Y 5/2), many fine distinct dark yellowish brown and dark brown mottles; silty clay loam; weak coarse prismatic breaking into angular blocky; friable moist; patchy thin greyish brown cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; moderately calcareous; common very fine roots; abrupt smooth boundary; pH 8.0
IIIC1	19-24	Mixed olive-brown (2.5Y 4/4) and dark yellowish brown (10 YR 4/4) moist, dark brown and very dark greyish brown mottles; silt loam; massive, partly stratified; friable moist; common very fine and fine tubular pores; moderately calcareous; few very fine roots; abrupt smooth boundary; pH 8.1
IVC2	24-32	Mixed olive-brown (2.5Y 4/4) and dark brown (10YR 4/3) moist, dark yellowish brown mottles; silty clay; firm moist; common very fine tubular pores; moderately calcareous; few very fine roots; clear smooth boundary; pH 7.9
VC3g	32-46	Light olive-brown (2.5Y 5/4) moist, common fine distinct greyish brown and dark yellowish brown mottles; silty clay loam; firm moist; common very fine and fine tubular pores; calcareous; few very fine roots; pH 7.7

VIC4g 46-52 Dark yellowish brown (10YR 4/4) moist, greyish brown and very dark greyish brown mottles: silty clay; firm moist; slightly calcareous; pH 7.6

Note: Sampled by auger below 46 inches. pH determined on dried sample in the laboratory; pH figures in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Thickness of the topsoils ranges from 4-6 inches. It's colour from olive-brown to dark greyish brown and texture generally from silty clay loam to silty clay and occasionally silt loam and clay. On the older floodplains, the topsoil is locally non-calcareous; subsoil colour ranges from light olive-brown to olive-brown, occasionally greyish brown to dark greyish brown. Structure varies from moderate to strong, coarse to medium prismatic breaking into moderate to strong coarse to fine angular blocky with broken to continuous moderately thick to thick grey to dark greyish brown cutans on ped faces and pores. The substratum is usually medium textured but occasionally moderately coarse, moderately fine or fine textured. Barried topsoil locally occurs in the substratum.

b. Environmental characteristics. These soils are developed on old and young Ganges meander floodplain occupying generally middle to lower parts and occasionally upper part of nearly level to gently undulating ridges and inter-ridge depressions. They are either above normal flood level and intermittently flooded by rain water or seasonally flooded upto 2½ feet deep by rainwater or by both rain and river water for ½ to 4 months. All soils become droughty in the dry season.

Three phases have been recognized: Ishurdi, hihgland phase; Ishurdi, highland, irregular relief phase; and Ishurdi, medium highland phase.

Distribution and extent

Ishurdi soils occupy about 930 acres in the survey area.

Similar soils

The Ishurdi soils differ from Amjhupi and Jhenida series in having a calcareous subsoil, from Pakuria soils in having relatively coarser texture, weaker structure and lighter consistence in the subsoil and from Gopalpur soils in having relatively finer texture, stronger structure and heavier consistence in the subsoil.

Jhenida Series

Jhenida series includes intermittently and seasonally very shallowly to shallowly flooded, imperfectly to poorly drained, fine textured, noncalcareous soils developed in old Ganges alluvium. They have dark greyish brown to olive-brown, silty clay subsoil with moderate to strong coarse to medium prismatic and blocky structure.

Typical profile: Jhenida silty clay loam, highland phase

Location : Stop no. 1/69W-47. Vill. Panditpur, P.S. Jhenida, Dist. Jessore

Topography : Middle part of nearly level ridge

Land use : Aus/jute-rabi crops (gram, linseed, mustard, lentil, etc.); on adjoining field: aus/jute-transplanted aman-fallow/rabi crops

Drainage : Imperfect. Above normal flood level. Intermittently flooded by rainwater within field bund for a few hours to less then 15 days during the monsoon season.

Horizon	Depth in in.	Description
Ap1	0-3	Greyish brown (2.5Y 5/2) moist, common fine distinct dark yellowish brown and few fine faint strong brown mottles; silty clay loam; massive; friable moist, slightly sticky and plastic wet; strong brown iron staining along root channel; many very fine roots; pH 5.6; clear smooth boundary
Ap2	3-5	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and few fine faint strong brown mottles; silty clay; massive (compact); slightly firm moist, sticky and plastic wet; common very fine tubular pores; common very fine roots; pH 6.1 (7.0); clear smooth boundary
B2g	5-15	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and few fine distinct strong brown and few fine faint yellowish red mottles; silty clay; moderate coarse and medium angular blocky; firm moist, very sticky and very plastic wet; continuous to broken moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine and few fine pores; few very fine r-ots; pH 6.5 (7.5); abrupt wavy boundary
IIB3	15-32	Greyish brown (2.5Y 5/2) moist, many fine distinct yellowish brown and few fine faint strong brown mottles; silty clay loam; weak very coarse prismatic; slightly firm moist, slightly sticky and plastic wet;patchy thin grey cutans along vertical ped faces; many very fine and few fine pores; few fine soft iron-manganese concreation; few very fine roots; pH 7.2 (8.0); clear smooth boundary
IIIC1	32-38	Greyish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) moist, few fine faint strong brown and few fine faint dark brown mottles; silt loam; friable moist; slightly sticky and slightly plastic wet: many very fine pores; few very fine roots; pH 7.2 (8.0)
IVC2	38-50	Greyish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) moist, few fine distinct dark reddish brown mottles; silty clay; firm moist, sticky and plastic wet; common very fine pores, pH 7.1 (8.0)
IVC3g	50-60	Grey (N5/) moist, many fine distinct dark yellowish brown and common fine distinct olive-brown mottles; silty clay; firm moist, sticky and plastic wet; pH 6.9 (8.0)

Note: Sampled by auger after 50 inches. pH determined on dried sample in laboratory; pH figures between brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from light olive-brown to dark greyish brown and texture is usually silty clay loam occasionally silt loam to silty clay. Subsoil colour is usually dark greyish brown occasionally greyish brown or olive-brown. Texture is silty clay but some sandy clay soils have been included as a variant. Substratum is usually medium to fine textured occasionally moderately coarse or coarse.

b. Environmental characteristics. These soils are developed in old Ganges meander floodplain occupying the upper to lower slopes of level to very gently sloping broad ridges and inter-ridge depression. They are mainly above normal flood level and intermittently flooded by rainwater with field bund for few hours to less than 15 days and occasionally very shallowly to shallowly flooded by rain water from few inches upto 3 feet for more than 15 days to three months in the rainy season.

Four phases have been recognized: Jhenida, highland phase; Jhenida, highland, irregular relief phase; Jhenida, medium highland phase and Jhenida, medium highland, irregular relief phase.

Distribution and extent

These soils occupy about 3,792 acres in the project area.

Similar soils

The Jhenida soils differ from Amjhupi and Ishurdi series in having a thoroughly decalcified profile, from Benapol soils in having relatively coarser texture, weaker structure and lighter consistence in the subsoil which totally lacks any wedge-shaped structure or slickenside and from Baradi soils in having relatively finer texture, stronger structure and heavier consistence in the subsoil.

Kasiani series

Kasiani series includes seasonally flooded poorly drained soils developed in the old Ganges basin alluvium. The B horizon comprises dark grey to dark greyish brown silty clay to clay with strong to moderate very c-arse to medium prismatic breaking into strong coarse to medium angular blocky structure. They are decalcified throughout the profile.

Typical profile: Kasiani clay, medium highland phase

Location	:	Stop no. 4/70W-236. Vill. Arjya Narayanpur, P.S. Jhenida, Dt. Jessore
Topography	:	Basin bottom
Land use	:	Broadcast deepwater aman-fallow or rabi crops (khesari) or transplanted aman-boro (with irrigation)
Drainage	:	Poor. Flooded up to 3 feet for 2-3 months in the rainy season.

Horizon	Depth in in.	Description
Apg	0-5	Dark grey (5Y 4/1) moist, few fine distinct dark brown mottles; clay; massive; very firm moist; very sticky and very plastic wet; common very fine and few fine tubular pores; noncalcareous; many very fine and common fine roots; iron staining along cracks and root channels; pH 5.7; abrupt smooth boundary
B2g	5-13	Dark grey (10YR 4/1) moist, common fine distinct dark yellowish brown mottles; clay; strong coarse to medium angular blocky; very firm moist; very sticky and very plastic wet; continuous thick to moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; many very fine roots; pH 6.1 (7.0); clear smooth boundary
B3g	13-19	Mixed dark grey (10YR 4/1) and dark yellowish brown (10YR 4/3) moist, common fine distinct yellowish brown mottles; silty clay; moderate coarse prismatic breaking into angular blocky; firm moist; sticky and plastic wet; continuous moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; noncalcareous; common very fine roots; pH 6.4 (7.5); abrupt smooth boundary
IIC1	19-27	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, dark brown mottles; silty clay loam; weak very coarse prismatic; friable moist; slightly sticky and slightly plastic wet; broken moderately thick dark grey cutans along vertical ped faces and pores; noncalcareous; few very fine roots; pH 7.1; abrupt smooth boundary
IIIC2	27-40	Greyish brown (2.5Y 5/2) moist, many fine distinct olive-brown and common fine distinct dark brown mottles; very fine sandy loam; very friable moist; slightly sticky and slightly plastic wet; noncalcareous; pH 6.9 (8.0); abrupt smooth boundary
IVC3	40-44	Mixed greyish brown (2.5Y 5/2) and olive-brown (2.5Y 4/4) moist, common fine distinct yellowish brown and dark brown mottles; silt loam; very friable moist; slightly sticky and slightly plastic wet; noncalcareous; pH 6.6 (8.0); abrupt smooth boundary
VC4	44-56+	Greyish brown (2.5Y 5/2) moist, common fine distinct light olive-brown and dark brown mottles; sandy loam; very friable moist, non-sticky and nonplastic wet; noncalcareous; pH 7.3 (8.0)

Note: pH figures in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour is greyish brown or dark greyish brown, occasionally dark grey or very dark grey. The colour of the suboil ranges from dark grey to dark greyish brown and texture from silty clay to clay with moderate to strong very coarse to medium prismatic breaking into strong coarse to medium angular blocky structure.

b. Environmental characteristics. These soils are developed in the old Ganges alluvium and occupy basins or infilled channels. Seasonal flooding ranges from 1-4 feet for about 1-5 months. These soils are usually droughty in the dry season and occasionally remain wet early in the dry season.

Three phases have been recognized: Kasiani, medium highland phase; Kasiani medium lowland, early draining phase and Kasiani, medium lowland, slow draining phase.

Distribution and extent

These soils occupy 313 acres in Magura and Jhenida thanas of Jessore district.

Similar soils

The Kasiani soils differ from Batra and Ghior series in having relatively lighter clay texture and coarser peds in the subsoil, totally lacking any wedge-shaped peds, pressure face or slickenside, from Magura soils in having paler colour and from Garuri and Mehendiganj soils in having a thoroughly decalcified profile.

Kumarkhali Series

Kumarkhali series includes seasonally moderately deeply to deeply flooded, almost perennially wet, very poorly drained, olive-brown, occasionally greyish brown to dark greyish brown mottled, calcareous, silty clays and clays. They are massive or to moderate prismatic in the subsoil.

Typical profile: Kumarkhali silty clay, medium lowland phase

Location : 47/68E-16. Vill. Abalpur, P.S. Magura, Dist. Jessore

Topography : Small basin depression

Land use : Broadcast deepwater aman-fallow

Drainage : Very poor. Flooded upto 3-4 feet for 9-10 months

Horizon	Depth in in.	Description
Apg	0-5	Very dark grey (5Y 3/1) moist, few fine distinct dark yellowish brown mottles; silty clay; massive; firm moist; sticky and plastic wet; common very fine and fine tubular pores; slightly calcareous; iron staining; many very fine roots; pH 7.6; abrupt smooth boundary
B2g	5-11	Mixed light olive-brown (2.5Y 5/4) and dark greyish brown (2.5Y 4/2) moist, common fine distinct olive-brown and few fine distinct dark brown mottles; silty clay; moderate very coarse to coarse prismatic; firm moist; sticky and plastic wet; broken moderately thick grey to dark grey cutans along vertical and horizontal ped faces and pores; slightly calcareous; common very fine roots; pH 7.7; abrupt smooth boundary

IIClg	11-17	Olive-brown (2.5Y 4/4) wet, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; silty clay loam; weak very coarse prismatic, with remnants of stratification inside peds; slightly sticky and slightly plastic wet; broken thin to moderately thick grey cutans along vertical and horizontal ped faces and pores; common very fine and few fine tubular pores; moderately calcareous; few very fine roots; pH 7.8; abrupt smooth boundary
IIIC2	17-30	Olive-brown (2.5Y 4/4) wet, few fine distinct greyish brown and dark yellowish brown mottles; very fine sandy loam; massive, stratified; nonsticky and nonplastic wet; common very fine and few fine tubular pores; moderately calcareous; few very fine roots; pH 8.0; abrupt smooth boundary
IIIC3g	30-42	Dark greenish grey (5GY 4/1) wet; silt loam; slightly sticky and slightly plastic wet; moderately calcareous; pH 7.8; abrupt smooth boundary
IVC4g	42-54	Dark greenish grey (5GY 4/1) wet; few fine distinct black mottles; silty clay loam; slightly sticky and slightly plastic wet; moderately calcareous; pH 7.6

Note: Sampled by auger below 30 inches. pH figures given in brackets obtained in moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. The topsoil colour ranges from neutral grey to neutral very dark grey, occasionally greenish grey and texture ranges from silty clay to clay, occasionally silty clay loam. The subsoil colour is olive-brown, occasionally greyish brown to dark greyish brown, rarely olive-grey; the texture is silty clay to clay, and the structure ranges from weak to moderate very coarse to coarse prismatic with broke to moderate dark grey to dark greyish brown ped cutans. The substratum is usually fine textured.

b. Environmental characteristics. These soils are developed in the basin depressions of the old Ganges meander floodplains. They are flooded upto 3-7 feet deep for about 4-10 months remaining saturated or under shallow water for part of the dry season. They are subject to rapid rise and/or flow of floodwater in the rainy season.

Four phases have been recognized: Kumarkhali, medium lowland phase; Kumarkhali, medium lowland, flood hazard phase; Kumarkhali, lowland phase and Kumarkhali, lowland, flood hazard phase.

Distribution and extent

These soils occupy about 821 acres in the survey area.

Similar soils

Kumarkhali series differs from Mahespur and Ramdia series by being calcareous in the subsoil and from Mehendiganj series in having weaker profile development and being almost perennially wet.

Magura Series

Magura series includes seasonally flooded, poorly drained, fine textured, noncalcareous soils developed in old Ganges basin clays. They have a very dark greyish brown to very dark grey subsoil with strong medium, fine and very fine angular blocky structure. They are decalcified throughout the profile.

Typical profile: Magura clay, medium lowland, slow draining phase

Location : Stop no. 2/68E-15. Vill. Teoharia, P.S. Magura, Dist. Jessore

Topography : Basin bottom

Land use : Broadcast deepwater aman-fallow

Drainage : Poor. Flooded upto 3-4 feet deep for about 6-7 months

Horizon	Depth in in.	Description
Apg	0-5	Grey (10YR 5/1) dry, very dark grey (10YR 3/1) moist, common fine distinct dark yellowish brown and few fine distinct strong brown mottles; clay; massive; very hard dry, firm moist, very sticky and very plastic wet; common fine tubular pores; few iron staining; many very fine and common fine roots; pH 4.6 (6.5); clear smooth boundary
A1g	5-10	Very dark greyish brown (10YR 3/2) moist, common fine distinct olive-brown and few fine distinct dark yellowish brown mottles; clay; strong medium, fine and very fine angular blocky; very sticky and very plastic wet; continuous thick very dark grey cutans along vertical and horizontal ped faces and pores; noncalcareous; pressure faces; common very fine roots; pH 5.8 (7.0); abrupt wavy boundary
B21g	10-15	Mixed olive-brown (2.5Y 4/4) and dark grey (10YR 4/1) moist, common fine distinct dark yellowish brown and few fine distinct black mottles; clay; strong medium and fine angular blocky; very sticky and very plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces and pores; common fine tubular pores; noncalcareous; pressure faces; pH 6.4 (8.0); abrupt wavy boundary
B22	15-24	Mixed dark greyish brown (10 YR 4/2) and dark brown (10YR 3/3) moist, few fine distinct yellowish brown and few fine distinct black mottles; clay; strong coarse and medium prismatic; very sticky and very plastic wet; continuous moderately thick dark greyish brown cutans along vertical ped faces and pores; few very fine tubular pores; noncalcareous; pH 6.6 (8.0); abrupt wavy boundary
B3g	24-38	Dark grey (10YR 4/1) moist, many fine distinct dark yellowish brown and few fine distinct dark brown mottles; clay; very sticky and very plastic wet; continuous thick dark grey cutans along vertical ped faces and pores; common very fine tubular pores; noncalcareous; sand pockets; pH 6.5 (8.0); abrupt wavy boundary

IIClg 38-48 Grey (5Y 6/1) moist, few fine distinct dark brown mottles; fine sandy loam; friable moist, nonsticky and nonplastic wet; noncalcareous; pH 6.8 (8.0)

IIC2g 48-60 Dark greenish grey (N5GY 4/1); fine sandy loam; stratified; pH 5.5

Note: Sampled by auger below 48 inches. pH determined on dried sample in the laboratory; pH figures given in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from very dark grey to very dark greyish brown, occasionally greyish brown, texture from silty clay to clay. Subsoil colour ranges from very dark grey to very dark greyish brown and texture is clay. Texture of the substratum ranges from fine to moderately coarse.

b. Environmental characteristics. These soils are developed in the old Ganges meander floodplain and occupy very gently sloping to nearly level basins. They are poorly drained and seasonally flooded upto 2-7 feet deep for 1-9 months in the rainy season.

Four phases have been recognized: Magura, medium highland phase; Magura, medium lowland, early draining phase; Magura, medium lowland, slow draining phase and Magura, lowland phase.

Distribution and extent

These soils occupy about 665 acres in the survey area.

Similar soils

They differ from Batra soils in having darker colour in the surface and subsurface horizons, from Ghior soils in having a thoroughly decalcified profile with darker surface and subsurface horizons, from Kasiani soils in having darker colour and usually having finer peds in the subsoil, from Mahespur soils in having stronger structure and better drainage as they occur on relatively higher sites in basins.

Mahespur Series

Mahespur series includes seasonally moderately deeply to deeply flooded, almost perennially wet, very poorly drained soils developed in old Ganges basin clays. They are dark grey to mixed dark grey and yellowish brown, massive to moderate prismatic, clays, with grey to dark grey cutans along pores, cracks and ped faces in the subsoil. They are noncalcareous throughout the profile.

Typical profile: Mahespur clay, medium lowland phase

Location : Stop no. 103/68E-16(S). Vill. Dafalia, P.S. Magura, Dist. Jessore

Parent material: Old Ganges alluvium

Topography : Edge of basin depression

Land use : Broadcast deepwater aman-fallow

Drainage : Very poor. Flooded for 3-4 feet deep for 9-10 months. Groundwater at the depth of 35 inches on 22nd March, 1980

Horizon	Depth in in.	Description
Ap1g	0-4	Very dark greyish brown (2.5Y 3/2) wet, common fine distinct dark brown and few medium distinct dark grey; clay; massive; sticky and plastic wet; many very fine and fine pores; noncalcareous; iron staining along root channels and pores; many very fine and few fine roots; pH 5.9 (6.0); abrupt smooth boundary
Ap2g	4-6	Very dark grey (10YR 3/1) moist, dark yellowish brown mottles; clay; massive; very sticky and very plastic wet; few very fine roots; noncalcareous; iron staining along root channels and pores; few very fine roots; pH 5.8 (7.0); abrupt smooth boundary
A1g	6-16	Dark grey (10YR 4/1) moist, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; clay; strong very coarse to coarse prismatic breaking to moderate very coarse to coarse angular blocky; very sticky and very plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces and pores; noncalcareous; iron staining along root channels and pores; ped interior is raw upto 10 inches and below 10 inches, structure is more developed; pH 6.6 (7.5); few very fine roots; clear smooth boundary
B21g	16-27	Dark greyish brown (2.5Y 4/2) moist, common fine distinct yellowish brown (10YR 5/4) and few fine distinct dark brown (10YR 3/2) mottles; clay; strong fine to very fine angular blocky; very sticky and very plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces; common very fine pores; noncalcareous; pressure faces; pH 7.6; clear smooth boundary
IIA1gb	27-37	Very dark grey (10YR 3/1) wet, common fine distinct dark yellowish brown (10YR 4/4) and few line distinct very dark greyish brown (10YR 3/2) mottles; clay; strong fine to very fine angular blocky structure very sticky and very plastic wet; continuous thick very dark grey cutans along vertical and horizontal ped faces and pores; noncalcareous pressure faces; pH 7.0 (8.0)
IIB2b	37-49	Very dark greyish brown (10YR 3/2) wet, common fine distinct dark yellowish brown (10YR 4/4) and common fine distinct very dark brown (10YR 2/2) mottles; clay; very sticky and very plastic wet; noncalcareous; pH 7.3 (8.0)
IIC1b	49-59	Mixed yellowish brown (10YR 5/6) and light olive-brown (2.5Y 5/4) wet, common fine distinct grevish brown (2.5Y 5/2) mottles; silty clay; very sticky and very plastic wet; noncalcareous; pH 7.2
IIIC2b	59-64	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) wet, few fine distinct dark yellowish brown mottles; silty clay loam; slightly sticky and slightly plastic wet; noncalcareous; pH 7.4

Note: pH figure in the brackets obtained on moist or wet soils in the field by using Hellige-Truog test kit. Below 36 inches sampled by auger.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from neutral grey to neutral dark grey, occasionally dark grey to very dark greyish brown. The subsoil colour ranges from dark grey to very dark grey, occasionally greyish brown. The substratum is usually fine textured, occasionally moderately fine to moderately coarse.

b. Environmental characteristics. These soils are developed in the old Ganges alluvium. They occupy middle part to bottom of the basin, occasionally infilled channels. They are seasonally moderately deeply to deeply flooded for about 5-9 months and remain wet for most part of the dry season. They are subject to rapid rise of flood level during heavy rainfalls in the monsoon season.

Four phases have been recognized: Mahespur, medium lowland phase: Mahespur, medium lowland, flood hazard phase; Mahespur, lowland phase and Mahespur, lowland, flood hazard phase.

Distribution and extent

These soils mainly occur in the low-lying basins of Magura and Jhenida thanas where they occupy about 707 acres.

Similar soils

They differ from Ramdia and Kumarkhali soils in being thoroughly noncalcareous and from Kumarkhali also in having darker subsoil.

Mehendiganj Series

Mehendiganj series comprises seasonally shallowly to moderately deeply flooded, poorly drained, fine textured soils developed in young Ganges alluvium. They have an olive-brown to dark greyish brown, finely mottled, firm, calcareous, silty clay to clay subsoil with moderate to strong, coarse to medium prismatic breaking into blocky structure with grey to dark greyish brown ped cutans.

Typical profile: Mehendiganj silty clay, medium highland phase

Location : B1/68E-17. Vill. Satyapur, P.S. Magura, Dist. Jesshore

Topography : Basin margin

Land use : Broadcast deepwater aman-fallow or rabi crops

Drainage : Poor. Flooded upto 1-2 feet deep for about 4-5 months during the monsoon season

Horizon	Depth in in.	Description
Ap	0-5	Greyish brown (2.5Y 5/2) moist, common fine distinct olive-brown mottles; silty clay; massive, firm moist, sticky and plastic wet; common very fine and few fine tubular pores; noncalcareous; strong

brown iron staining along root channel; many very fine and fine roots; pH 6.1 (7.0); abrupt smooth boundary

B21	5-16	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, common fine distinct dark brown mottles; silty clay; moderate to strong coarse prismatic breaking into moderate coarse to medium angular blocky; firm moist, sticky and plastic wet; broken moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine and fine and few medium tubular pores; calcareous; common very fine and fine roots; pH 7.7; abrupt smooth boundary
B22	16-24	Light olive-brown (2.5Y 5/4) moist, common fine distinct greyish brown and few fine distinct dark brown mottles; silty clay; weak to moderate coarse prismatic; firm moist, sticky and plastic wet; broken moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine to fine tubular pores; calcareous; few very fine roots; pH 7.8; abrupt smooth boundary
B3	24-32	Light olive-brown (2.5Y 5/4) moist, few fine distinct greyish brown and dark brown mottles; silty clay; weak very coarse prismatic; firm moist, sticy and plastic wet; patchy thin greyish brown cutans along vertical and horizontal ped faces and pores; common very fine tubular pores; calcareous; few very fine roots; pH 7.7; abrupt smooth boundar
IIA1gb	32-38	Very dark grey (10YR 3/1) moist, common fine distinct light olive-brown mottles; clay; very firm moist, very sticky and very plastic wet; common tubular pores; noncalcareous; pH 7.4 (8.0)
IIC1g	38-48	Grey (N4/) moist, common fine distinct olive-brown and few fine distinct yellowish brown mottles; clay; very firm moist, very sticky and very plastic wet; noncalareous; pH 7.3 (8.0)
IIC2	48-60	Olive-brown (2.5Y 4/4), many fine distinct yellowish brown mottles; clay; very firm moist, very sticky and very plastic wet; noncalcareous; pH 7.6

Note: Sampled by auger below 38 inches; structure, cutans and pores not recorded below this depth. pH figures in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristcs. Topsoil colour ranges from olive-grey to olive-brown; the texture from silty clay loam to clay, rarely silt loam. The subsoil colour ranges from olive-grey to olive-brown; the structure from moderate to strong prismatic and blocky; occasionally weak; the texture from silty clay to clay. The substratum is usually moderately fine to fine textured, occasionally medium textured.

b. Enviornmental characteristics. These soils are developed on the young Ganges meander floodplain. They occupy infilled channels and basins, occasionally inter-ridge depressions. They are seasonally flooded upto 1 to 6 feet deep for about 1 to 8 months in the monsoon season.

Four phases have been recognized: Mehendiganj, medium highland phase; Mehendiganj, medium highland, irregular relief phase; Mehendiganj, medium lowland, early draining phase and Mehendiganj, medium lowland, slow draining phase.

Distribution and extent

These soils occupy about 1,427 acres mainly on the young Ganges meander floodplain in Magura and locally in Jhenida and Sripur thanas.

Similar soils

The Mehendiganj soils differ from Pasulpur soils mainly in having finer texture and more strongly developed structure in the subsoil, from Kumarkhali soils in having stronger structure and usually browner colour in the subsoil and occupying higher sites in basins lacking very poor drainage condition, from Ishurdi and Pakuria soils in having greyer ped cutans in the subsoil and also by occupying basin sites with poorer drainage condition, and from Garuri and Kasiani soils being thoroughly calcareous profile.

Mirpur Series

Mirpur series comprises seasonally intermittently to very shallowly flooded, imperfectly to poorly drained, medium textured soils developed in old Ganges alluvium. They have a light olive-brown to olive-brown, noncalcareous, friable silt loam subsoil overlying a calcareous substratum at a variable depth.

Typical profile: Mirpur silt loam, highland phase

Location : 37/70W-236. Vill. Kala, P.S. Jhenida, Dist. Jessore

Topography : Nearly level to very gently undulating ridge

Land use : Aus/jute-rabi crops

Drainage : Imperfect. Above normal flood level. Intermittently flooded by rainwater within field bunds for few hours to 2-3 days in the monsoon season.

Horizon	Depth in in.	Description
Ap1	0-4	Light olive-brown (2.5Y 5/4), few fine faint greyish brown mottles; silt loam; very friable moist; common very fine and few fine tubular pores; noncalcareous; pH 6.4; abrupt smooth boundary
Ap2	4-5½	Light olive-brown (2.5Y 5/4), common fine distinct greyish brown mottles; silt loam; massive; friable moist; common very fine and few fine tubular pores; noncalcareous; pH 6.5 (7.0); abrupt wavy boundary

B21	5½-13	Olive-brown (2.5Y 4/4), many fine distinct greyish brown and few dark brown mottles; silt loam; moderate coarse prismatic breaking into coarse to medium angular blocky; friable moist; broken moderately thick greyish brown along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; noncalcareous; common very fine roots; pH 6.6 (7.5); clear smooth boundary
B3	13-21	Olive-brown (2.5Y 4/4), many fine distinct greyish brown mottles; silt loam; weak very coarse prismatic structure; friable moist; patchy thin greyish brown cutans along vertical ped faces and pores; noncalcareous; few very fine roots; pH 6.4 (7.5); abrupt smooth boundary
C1	21-28	Olive-brown (2.5Y 4/4), many fine distinct greyish brown and few fine distinct dark brown mottles; silt loam; very friable moist; many very fine and few fine tubular pores; moderately calcareous; few large and small calcium carbonate nodules; few very fine roots; pH 7.8; abrupt smooth boundary
IIC2	28-41	Mixed olive-brown (2.5Y 4/4) and greyish brown (2.5Y 5/2) moist, few fine distinct yellowish brown mottles; very fine sandy loam; very friable moist; many very fine and few fine tubular pores; moderately calcareous; remnants of stratification and few calcium carbonate nodules; pH 8.1; abrupt smooth boundary
IIIC3	41-50	Light grey (5Y 7/2), many fine distinct dark brown and few fine distinct light olive-brown mottles; sandy loam; moderately calcareous; pH 7.1 (8.0); abrupt smooth boundary
IVC4	50-60+	Mixed greyish brown (2.5Y 5/2) and olive-brown (2.5Y 4/4) moist, few fine distinct yellowish brown and dark brown mottles; silt loam; moderately calcareous; pH 7.6

Note: Sampled by auger below 41 inches. pH determined on dried sample in the laboratory; pH figures in brackets obtained on moist soil in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour is usually light olive-brown to olive-brown, but occasionally greyish brown and texture is silt loam. The subsoil colour usually varies from light olive-brown to olive-brown and is occasionally greyish brown with dark brown to yellowish brown mottles. They have noncalcareous friable silt loam subsoil with weak to moderate very coarse to coarse prismatic breaking into weak to moderate coarse to medium angular blocky structure. Substratum is generally medium textured but occasionally moderately coarse or moderately fine textured.

b. Environmental characteristics. These soils are developed in mixed young and old Ganges alluvium. They occupy upper to middle part of nearly level to very gently undulating and occasionally undulating ridges. They are intermittently to very shallowly flooded by rain water within field bunds for few hours to upto 2 months in the monsoon season and become slightly droughty in the dry season.

Four phases have been recognized: Mirpur, highland phase; Mirpur, highland, irregular relief phase; Mirpur, medium highland phase and Mirpur, medium highland, irregular relief phase.

Distribution and extent

They occupy about 4,437 acres in the old Ganges meander floodplain in the project area.

Similar soils

Mirpur soils differ from Sara series in lacking free lime in the subsoil, from Patkelpota series in being calcareous in the substratum and from Darsana soils in having coarse texture and weaker structure in the subsoil.

Mominpur Series

Mominpur series comprises seasonally intermittently wet, imperfectly drained, noncalcareous, moderately coarse textured soils developed in old Ganges alluvium. These soils have a light yellowish brown to dark yellowish brown weakly mottled grey, friable, sandy loam to fine sandy loam subsoil with weak, very coarse, coarse and medium subangular blocky structure. They are decalcified throughout the profile.

Typical profile: Mominpur sandy loam

Location : Stop no. 3/68F-15. Vill. Basudebpur, P.S. Magura, Dist. Jessore

Topography : Summit of very gently undulating ridge

Land use : Aus/mesta-rabi crops (mustard)

Drainage : Imperfect. Above normal flood level. Remains moist in the rainy season.

Horizon	Depth in in.	Description
Ap	0-4	Light grey (2.5Y 7/2) dry, light olive-brown (2.5Y 5/4) moist, few fine distinct yellowish brown mottles; sandy loam; massive; loose dry, friable moist, nonsticky and nonplastic wet; noncalcareous; common very fine roots; pH 5.1; abrupt smooth boundary
B21g	4-11	Dark yellowish brown (10YR 4/4) moist, many fine distinct dark brown and common fine distinct grey and few fine distinct yellowish brown mottles; fine sandy loam; weak very coarse and coarse subangular blocky; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; patchy thin greyish brown cutans along vertical and horizontal ped faces; many very fine tubular pores; noncalcareous; common very fine roots; pH 5.3; clear smooth boundary

B22g	11-20	Dark yellowish brown (10YR 4/4) moist, common fine distinct dark brown and common fine distinct grey and few fine distinct dark yellowish brown mottles; fine sandy loam; weak very coarse and coarse subangular blocky; slightly hard dry, friable moist, slightly sticky and plastic wet; patchy thin greyish brown cutans along vertical and horizontal ped faces; many very fine and few fine tubular pores; noncalcareous; few very fine roots; pH 5.8; abrupt wavy boundary
C1	20-31	Dark yellowish brown (10YR 4/6) moist; sandy loam; massive; very friable moist, nonsticky and nonplastic wet; few very fine tubular pores; few very fine roots; pH 5.8 (6.5); clear smooth boundary
IIC2	31-40	Yellowish brown (10YR 5/6) moist, few fine distinct light grey mottles; loamy sand; single grain, very friable moist; nonsticky and nonplastic wet; pH 6.4 (7.0); clear smooth boundary
IIC3	40-48+	Yellowish brown (10YR 5/6) moist, common fine distinct light grey mottles; loamy sand; single grain; very friable moist; nonsticky and nonplastic wet; noncalcareous; pH 6.5 (7.0)

Note: pH determined on dried sample in the laboratory; pH figures given in brackets obtained on moist soils in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from light olive-brown to olive-brown and texture is generally sandy loam but sometimes fine sandy loam. Subsoil colour ranges from light yellowish brown to dark yellowish brown, occasionally light olive-brown and texture from sandy loam to fine sandy loam. Substratum texture is generally coarse.

b. Environmental characteristics. These soils occur on the old Ganges meander floodplain, occupying summits of very gently and gently undulating ridges. They are intermittently to very shallowly flooded in the rainy season and become droughty in the dry season.

Distribution and extent

These soils occupy about 129 acres in the project area.

Similar soils

They differ from Patapota soils in having finer texture in the subsoil.

Paksey Series

Paksey series comprises moderately well drained, olive-brown to light olive-brown, calcareous, medium textured soils developed in Ganges alluvium. They have weak to moderate prismatic structure with greyish brown cutans on ped faces in the B horizon overlying a medium to moderately fine textured substratum.

Typical profile: Paksey loam

Location : 152/69W-43. Vill. Ichchhakhada, P.S. Magura, Dist. Jessore

Topography : Summit of gently undulating ridge

Land use : a) fallow at the time of sampling
b) other years: aus/mesta-fallow/rabi crops

Drainage : Moderately well. Remains unsaturated for most part of the year

Horizon	Depth in in.	Description
Ap	0-4	Olive-brown (2.5Y 4/4) moist; loam; massive; friable moist, slightly sticky and nonplastic wet; common very fine and fine tubular pores; calcareous; many very fine and few fine roots; pH 7.8; abrupt smooth boundary
B2	4-20	Olive-brown (2.5Y 4/4) moist; loam; weak to moderate very coarse to coarse prismatic breaking into subangular blocky; friable moist, slightly sticky and slightly plastic wet; broken thin to moderately thick pale olive cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; calcareous; common very fine and few fine roots; pH 8.0; abrupt wavy boundary
B3	20-27	Light olive-brown (2.5Y 5/4) moist, few fine distinct pale yellow mottles; silt loam; weak very coarse to coarse prismatic; friable moist, slightly sticky and slightly plastic wet; broken thin to moderately thick olive-brown cutans along vertical ped faces; many very fine and few fine tubular pores; calcareous; pale yellow pockets of sandy materials are present within soil mass; common very fine and few fine roots; pH 8.2; abrupt smooth boundary
C1	27-31	Light olive-brown (2.5Y 5/4) moist, common fine distinct pale yellow mottles; loam; massive; very friable moist, slightly sticky and nonplastic wet; common very fine and few fine tubular pores; calcareous; pale yellow silt patches within soil mass; few fine roots; pH 7.8; abrupt smooth boundary
C2	31-38	Olive-brown (2.5Y 4/4) moist, few fine distinct dark yellowish brown mottles; silt loam; moderate coarse to medium subangular blocky; friable moist, slightly sticky and slightly plastic wet; broken thin to moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine and few fine tubular pores; calcareous; few fine roots; pH 8.1; clear smooth boundary
C3	38-50	Olive-brown (2.5Y 4/4) moist, common fine distinct greyish brown mottles; silt loam; moderate coarse to medium subangular and angular blocky; friable moist, slightly sticky and slightly plastic wet; broken thin to moderately thick greyish brown cutans along vertical and horizontal ped faces and pores; many very fine and common fine tubular pores; calcareous; light grey silty patches within the soil mass; few fine roots; pH 8.1

Note: pH determined on dried samples in the laboratory.

Range of characteristics

a. Profile characteristics. Depth of the substratum ranges from 12 to 32 inches. Topsoil colour is mainly olive-brown, rarely light olive-brown and texture is silt loam. Subangular colour is olive-brown to light olive-brown, sometimes dark yellowish brown, and texture is silt loam. The substratum is mainly medium to moderately fine textured and rarely moderately coarse textured.

b. Environmental characteristics. These soils are developed on the young and old Ganges meander floodplains occupying the summit of very gently to gently undulating ridges. They are only intermittently saturated in the rainy season during heavy rainfall and dry out early in the dry season. They become severely droughty in the late dry season.

Distribution and extent

These soils occupy minor area on the young and old Ganges meander floodplain in the project area.

Similar soils

The Paksey soils differ from Sara soils in their lacking grey mottles in the subsoil and being moderately well drained, from Mirpur and Patkelpota soils in being thoroughly calcareous and moderately well drained.

Pakuria Series

Pakuria series comprises intermittently to seasonally shallowly to very shallowly flooded, imperfectly to poorly drained, dark greynish brown to olive, calcareous clays. They have strong coarse to medium prismatic to blocky structure with continuous thick dark grayish brown cutans on ped faces and pores in the B horizon.

Typical profile: Pakuria clay(*)

Location	:	Stop no. 17/PAF 23A7. Vill. Samaspur, P.S. Khoksha, Dist. Kushtia
Topography	:	Lower slope of very gently sloping floodplain ridge
Land use	:	Mixed jute and broadcast deepwater aman-rabi crops; sugarcane
Drainage	:	Poorly drained. Flooded upto 1½ to 3 feet deep for about 1-1½ months in the monsoon season. Remains unsaturated for about 7 months in the dry season.

(*) Taken from the Reconnaissance Soil Survey Report of Kushtia district, Department of Soil Survey, Dacca.

Horizon	Depth in in.	Description
Ap1	0-4	Olive-brown (2.5Y 4/4) moist to greyish brown (2.5Y 5/2) dry; clay; cloddy; very hard dry; common fine tubular pores; noncalcareous; pH 7.6; abrupt smooth boundary
Ap2g	4-6	Dark greyish brown (2.5Y 4/2) moist; clay; moderate coarse breaking to fine to very fine subangular blocky; firm moist; broken thin to moderately thick grey cutans on vertical and horizontal ped faces and continuous thick along pores; noncalcareous; pH 7.7; abrupt smooth boundary
B21	6-15	Dark greyish brown to olive-brown (2.5Y 4/3) moist, common fine distinct dark yellowish brown and few fine distinct dark brown mottles; clay; strong coarse prismatic breaking to coarse, medium and fine subangular and angular blocky; firm moist; continuous thick dark greyish brown cutans along vertical and horizontal ped faces and pores; upper part slightly calcareous, lower part below 12 inches moderately calcareous; pH 7.9; abrupt smooth boundary
B3g	15-20	Olive-grey (5Y 5/2) and olive-brown (2.5Y 4/4) moist, few fine distinct dark brown mottles; silty clay; strong coarse prismatic breaking to strong coarse angular blocky; slightly firm moist; continuous thick dark greyish brown cutans along vertical and horizontal ped faces and pores; moderately calcareous; pH 7.9; abrupt smooth boundary
IIC1	20-45	Olive (5Y 5/3) moist, many fine distinct light olive-brown mottles; silty clay loam; massive; friable moist; moderately calcareous; pH 8.2; clear smooth boundary
IIC2	45+	Olive-grey (5Y 5/2) moist, common fine prominent strong brown and dark brown mottles; clay; massive; moderately calcareous; pH 8.0

Note: No analytical sample collected below 45 inches. pH figures given in brackets recorded in the field on moist soil using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour is generally olive-brown but occasionally dark grey or olive-grey and texture ranges from silty clay loam to clay. The topsoil is locally noncalcareous. Subsoil colour is generally olive-brown and occasionally greyish brown or dark greyish brown with olive-brown mottles and texture is clay. Structure is strong coarse to medium prismatic and angular blocky and occasionally very coarse and fine prismatic and angular blocky with continuous thick dark greyish brown and occasionally broken moderately thick dar greyish brown to grey cutans along ped faces and pores. The substratum is usually medium to moderately fine textured and occasionally older with noncalcareous fine textured materials.

b. Environmental characteristics. These soils are mainly developed in young Ganges meander floodplain occupying middle to lower parts of nearly level to very gently undulating ridges. They are generally seasonally very shallowly flooded by rain water for 2 weeks to 3 months in the rainy season and usually become very droughty in the late dry season.

Distribution and extent

These soils occupy minor area mainly in Magura thana.

Similar soils

The Pakuria soils differ from Gangni and Benapol series in being calcareous in the subsoil, from Ishurdi soils in having finer texture and stronger structure and from Mehendiganj soils in having clays with finer peds and browner coatings in the subsoil and also in occurence on ridge sites with relatively better drainage.

Pangsa Series

Pangsa series includes intermittently flooded, imperfectly drained, calcareous, moderately coarse textured, stratified soils developed in young Ganges alluvium.

Typical profile: Pangsa silt loam

Location : Stop no. 33/66E-17. Vill. Barakhari, Magura thana, Dist. Jessore

Topography : Upper part of ridge

Land use : Aus/mesta-rabi crops; sugarcane; chilli-rabi crops

Drainage : Imperfect. Intermittently flooded by rainwater within field bunds for a few hours after heavy showers in the monsoon season.

Horizon	Depth in in.	Description
Ap	0-4	Olive (5Y 5/4) moist, few fine distinct yellowish brown mottles; silt loam; massive; hard dry, firm moist, sticky and plastic wet; many very fine and few fine tubular pores; moderately calcareous; many very fine roots; pH (7.5); abrupt smooth boundary
C1	4-7	Light olive-brown (2.5Y 5/4) moist, few fine distinct yellowish brown mottles; silt loam; massive; dry hard, firm moist, sticky and plastic wet; many very fine and common fine tubular pores; moderately calcareous; common very fine roots: pH (8.0); abrupt smooth boundary
IIC2g	7-13	Mixed olive (5Y 5/4) and light grey (5Y 7/1) moist, few fine distinct olive-brown mottles: fine sandy loam; stratified; loose moist, nonsticky and nonplastic wet; moderately calcareous; pH (8.0); clear smooth boundary
IIC3	13-22	Olive (5Y 5/4) moist, few fine distinct yellowish brown mottles; fine sandy loam; stratified; nonsticky and nonplastic wet; pH (8.0)
IIC4	22-48	Light olive-brown (2.5Y 5/4) moist, common fine distinct yellowish brown and few medium prominent very dark greyish brown mottles; silt loam; pH (8.0)

Note: Sampled by auger below 36 inches. pH figures given brackets obtained on moist soils in the field using a Hellige-Truog test kit. As the Pangsa soils occupy small areas in the project area, typical profile was not described from regular pit and routine analytical samples not collected. Here the profile has been described from a short soil description recorded during the regular field observation.

Range of characteristics

a. Profile characteristics. Topsoil is usually medium textured and colour is mainly olive. Subsoil is a stratified light grey, occasionally olive, fine sandy loam. Texture of the substratum ranges from fine sandy loam to very fine sandy loam.

b. Environmental characteristics. These soils are developed in the young Ganges sediments and occupy usually nearly level to very gently undulating ridges on the young Ganges meander floodplain. They are above normal flood level and intermittently flooded by rainwater within field bunds for few hours to less than 15 days in the monsoon season.

Distribution and extent

These soils occupy minor area in the survey area.

Similar soils

They differ from sandy Ganges alluvium in lacking strong stratification and being more oxidized, and from Rayna soils in having coarser texture below the topsoil.

Patkelpota Series

The Patkelpota series includes intermittently wet to seasonally flooded, imperfectly to poorly drained, medium textured, noncalcareous soils developed in old Ganges alluvium. These soils have a greyish brown to olive-brown subsoil with weak to moderate structure. They are decalcified throughout the profile.

Typical profile: Patkelpota silt loam, highland, shallow phase

Location : Stop no. 18/70W-242. Vill. Gopinathpur, P.S. Jhenida, Dt. Jessore

Topography : Upper part of very gently undulating ridge

Land use : Aus/jute-rabi crops (gram, lentil, wheat, onion, tobacco, etc.)

Drainage : Imperfect. Above normal flood level. Intermittently very shallowly flooded in rainy season.

Horizon	Depth in in.	Description
Ap	0-3½	Light grey (2.5Y 7/2) dry, light olive-brown (2.5Y 5/4) moist, few fine faint greyish brown mottles; silt loam; massive; nonsticky and nonplastic wet; many very fine tubular pores; noncalcareous; many very fine and few fine roots; pH 6.5; abrupt smooth boundary
B21	3½-14	Olive-brown (2.5Y 4/4) moist, common fine distinct dark brown and common fine distinct greyish brown mottles; silt loam; weak very coarse and coarse prismatic; slightly sticky and nonplastic wet; patchy and broken thin greyish brown cutans along vertical ped faces and pores; common very fine and few fine tubular pores; noncalcareous; common very fine roots; pH 6.0 (6.5); abrupt smooth boundary

B22	14-20	Olive-brown (2.5Y 4/4) moist, common fine distinct dark brown and common fine distinct greyish brown and few fine faint light olive-brown mottles; silt loam; weak very coarse and coarse prismatic nonsticky and nonplastic wet; common very fine tubular pores; non-calcareous; few very fine roots; pH 5.9 (7.0); clear wavy boundary
IIC1	20-28	Light yellowish brown (2.5Y 6/3) and pale olive (5Y 6/3) moist; fine sandy loam; nonsticky and nonplastic wet; common very fine tubular pores; noncalcareous; pH 7.0; abrupt smooth boundary
IIC2g	28-51	Light olive-grey (5Y 6/2) and pale olive (5Y 6/3) moist, few fine distinct dark brown mottles; fine sandy loam; nonsticky and non-plastic wet; few very fine tubular pores; noncalcareous; pH 7.1
IIC3g	51-59	Light olive-grey (5Y 6/2) and light grey (2.5Y 7/2) moist, few fine distinct dark brown mottles; fine sandy loam; nonsticky and nonplastic; slightly calcareous; pH 8.3

Note: Sampled by auger below 51 inches. pH determined on dried sample in the laboratory. pH figures given in brackets obtained on moist soil in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from light olive-brown to olive-brown, occasionally greyish brown, texture is usually silt loam. Subsoil colour ranges from greyish brown to olive-brown, occasionally dark brown, texture is usually silt loam, rarely loam. Texture of substratum is ranges from moderately coarse textured to moderately fine textured.

b. Environmental characteristics. These soils are developed on the old Ganges meander floodplain and occupy upper to middle parts of nearly level to gently undulating ridges. They are either intermittently wet or very shallowly flooded in the rainy season and become droughty in the dry season.

Three phases have been recognized: Patkelpota, highland phase; Patkelpota, highland, irregular relief phase and Patkelpota, medium highland phase

Distribution and extent

These soils occupy about 580 acres in the project area.

Similar soils

The Patkelpota soils differ from Sara and Mirpur soils or in having thoroughly decalcified profiles, from Baradi soils in having coarser texture and weaker structure in the subsoil and from Mominpur soils in having finer texture and better developed structure in the subsoil.

Rajair Series

Rajair series includes seasonally to almost perennially flooded, very poorly drained, very dark greyish brown to very dark grey organic soils. They have less than 10 inches of mineral matter overlying peaty or mucky layers, which are less than 20 inches thick.

Typical profile: Rajair mucky clay

Location : 126/69W-47. Vill. Panditpur, P.S. Jhenida, Dist. Jessore

Topography : Basin depression

Land use : Aus-fallow

Drainage : Very poor. Flooded upto 5 feet for more than 9 months. Remains unsaturated for about 1-2 months in the late dry season. Groundwater was found at 8 inches depth on 25th March, 1980

Horizon	Depth in in.	Description
Ap	0-6	Very dark grey (10YR 3/1) moist; mucky clay; massive; friable moist, sticky plastic wet; many very fine pores; calcareous; remnants of shells; many very fine and fine roots; pH 7.6; abrupt smooth boundary
IIO	6-15	Very dark greyish brown (10YR 3/2) wet; mucky peat; massive; when squeezed in the hand, liquid removed is turbid and only the total mass passes between the fingers; nonsticky and nonplastic wet; many very fine and fine pores; calcareous; (fibrous and porous); many very fine and fine roots; pH 8.4
IIIC1g	15-22	Grey (5Y 5/1) wet; mucky loam; when squeezed in hand, liquid removed in turbid and a large portion of the material ooze between the fingers; slightly sticky and slightly plastic wet; many very fine and fine pores; calcareous; many very fine and fine roots; pH 7.6
IIIC2g	22-36	Grey (5Y 5/1) wet; silt loam; slightly sticky and slightly plastic; calcareous; pH 7.5 (8.0)
IIIC3g	36-48	Greenish grey (5GY 5/1) wet; silty clay loam; very sticky and plastic wet; calcareous; pH 7.8

Note: pH determined on dried samples in the laboratory. pH figure given in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Thickness of the organic layer overlying the gleyed mineral substratum ranges from 10-20 inches. Topsoil thickness varies from 4-8 inches. The peat layer and the underlying mineral materials are usually calcareous and contain undecomposed shell fragments.

b. Environmental characteristics. These soils occur in the very poorly drained depressed parts of basin sites in the old Ganges meander floodplain. These soils are flooded upto 6 feet for about 8-10 months in the monsoon season and remain wet or flooded for most part of the dry season.

Distribution and extent

These soils occupy about 285 acres in Jhenida thana in the southern part of the project.

Similar soils

They differ from the peat soils of Satla series in having thinner organic layer (less than 20 inches thick) and from the mineral soils of Kumarkhali series in having a dark coloured peaty subsoil.

Ramdia Series

Ramdia series includes seasonally moderately deeply to deeply flooded, almost perennially wet very poorly drained soils developed in the old Ganges basin clays. They are mottled greenish grey to very dark grey, massive or weak to moderate prismatic and angular blocky with dark grey to very dark grey cutans on ped faces and along pores and cracks in the subsoil. They are calcareous in the substratum.

Typical profile: Ramdia clay, medium lowland, flood hazard phase

Location : Stop no. B1/68E-15. Vill. Paka Kanchanpur, P.S. Magura, Dt. Jessore

Topography : Basin depression

Land use : Broadcast deepwater aman-fallow

Drainage : Very poor. Flooded upto 5-6 feet for 9 months (the soil has risk of sudden rise of flood water). Groundwater at 50 inches depth on 22nd March, 1980

Horizon	Depth in in.	Description
Apg	0-5	Dark grey (10YR 4/1) dry; very dark grey (10YR 3/1) moist, common fine distinct dark yellowish brown (10YR 4/4) mottles; clay; massive; very hard dry; firm moist; very sticky and very plastic wet; many very fine tubular pores; noncalcareous; common very fine roots; pH 6.0; abrupt wavy boundary
Alg	5-8	Very dark grey (10YR 3/1) moist, common fine distinct dark yellowish brown and few fine distinct strong brown mottles; clay; moderate coarse to medium angular blocky; firm moist, very sticky and plastic wet; few very fine tubular pores; continuous thick very dark grey cutans along pores and vertical and horizontal ped faces; noncalcareous; strong brown iron staining; few very fine roots; pH 6.1 abrupt wavy boundary

B2g	8-15	Dark grey (5Y 4/1) moist, common fine distinct olive-brown and dark yellowish brown (10YR 5/6) mottles; clay; moderate coarse to medium prismatic breaking into moderate coarse angular blocky; very sticky and plastic wet; continuous thick dark grey cutans along vertical and horizontal ped faces and pores; few very fine tubular pores; noncalcareous; few very fine roots; pH 7.1 (8.0); abrupt wavy boundary
IIB3g	15-21	Mixed greyish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) moist, common medium distinct dark yellowish brown and few fine distinct dark brown mottles; silty clay loam; weak very coarse prismatic; sticky and slightly plastic wet; broken moderately thick dark grey cutans along vertical ped faces; common very fine tubular pores; calcareous; few Krotovinas present; few very fine roots; pH 7.1 (8.0); abrupt wavy boundary
IIC1	21-30	Greyish brown (2.5Y 5/2) moist, common fine distinct yellowish brown and few fine distinct dark brown mottoles; silty clay loam; massive; sticky and slightly plastic wet; patchy thin dark grey cutans along cracks and pores; few very fine tubular pores; calcareous; remnants of stratification; pH 8.0; abrupt wavy boundary
IIC2	30-42	Greyish brown (2.5Y 5/2) moist, common medium distinct dark brown and few fine distinct dark yellowish brown mottles; silty clay; sticky and slightly plastic wet; patchy thin dark grey cutans along pores; few very fine tubular pores; calcareous; remnants of stratification; pH 7.9; abrupt wavy boundary
IIIC3g	42-50	Dark grey (N4/), common medium distinct dark brown and few medium distinct dark yellowish brown mottles; clay; very sticky and plastic wet; calcareous; pH 7.6

Note: pH figures in the brackets obtained on moist soils in the field by using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from grey to dark grey or rarely greenish grey and texture from clay to silty clay. Subsoil colour ranges from dark grey to very dark grey and rarely olive-brown to dark greyish brown. Substratum is slightly calcareous to calcareous and colour ranges from light olive-brown to dark greyish brown and texture from clay to silty clay loam. Buried soil occurs in some profile.

b. Environmental characteristics. These soils are developed in the old Ganges alluvium and occupy basin depressions in the old Ganges meander floodplain. They are flooded upto 3-8 feet deep for 6-10 months in the rainy and part of the dry season. The medium lowland soils are flooded upto 3-5 feet deep for 6-9 months and lowland soils are flooded upto 6-8 feet deep for 9-10 months.

Four phases have been recognized: Ramdia, medium lowland phase; Ramdia, lowland phase; Ramdia, medium lowland, flood hazard phase and Ramdia, lowland, flood hazard phase

Distribution and extent

These soils occupy about 654 acres in the survey area

Similar soils

They differ from Ghior soils in having weaker structure in the subsoil and also in occurence in basin depressions with very poor drainage, from Mahespur soils in being calcareous in the substratum and from Kumarkhali soils in having a noncalcareous subsoil.

Rasulpur Series

The Rasulpur series includes seasonally flooded, poorly drained, calcareous, moderately fine textured soils developed in the young Ganges alluvium. These soils have an olive-grey or dark grey to dark greyish brown or olive-brown silty clay loam subsoil with moderate to strong coarse to medium angular blocky structure and thin to moderately thick dark grey to dark greyish brown cutans along ped faces and pores.

Typical profile: Rasulput silty clay, medium highland phase

Location : Stop no. 38/70W-236. Vill. Hat Gopalpur, P.S. Jhenida, Dist. Jessore

Topograph : Basin margin

Land use : Broadcast deepwater aman-fallow/rabi crops (khesari)

Drainage : Poor. Flooding upto 2-3 feet deep for about 4-5 months. The soil becomes droughty in the dry season

Horizon	Depth in in.	Description
Ap1	0-2½	Dark greyish brown (2.5Y 4/2) moist, common fine distinct dark yellowish brown and light olive-brown mottles; silty clay; clody; very firm moist, sticky and plastic wet; common very fine tubular pores; noncalcareous; iron staining along root channels; many very fine roots; pH 6.8 (7.5); abrupt smooth boundary
Ap2	2½-4½	Dark greyish brown (2.5Y 4/2) moist, common fine distinct light olive-brown and few fine distinct yellowish brown mottles; silty clay; massive; very firm moist, sticky and plastic wet; common very fine tubular pores; noncalcareous; iron staining along root channel; many very fine roots; pH 7.1 (8.0); abrupt smooth boundary
B21g	4½-10½	Dark greyish brown (2.5Y 4/2) moist, common fine distinct olive-brown and few fine distinct dark brown; silty clay loam; strong coarse prismatic breaking into strong coarse to medium angular blocky; firm moist, sticky and plastic; continuous moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; slightly calcareous; common very fine roots; pH 7.8; abrupt smooth boundary

B22g	10½-20	Greyish brown (2.5Y 5/2) moist, many fine distinct olive-brown and few fine distinct dark brown mottles; silty clay loam; strong very coarse to coarse prismatic breaking into moderate coarse to medium angular blocky; firm moist, sticky and plastic wet; continuous moderately thick dark grey cutans along vertical and horizontal ped faces and pores; many very fine tubular pores; moderately calcareous; common very fine roots; pH 7.9; clear smooth boundary
B3g	20-31	Greyish brown (2.5Y 5/2) moist, common fine distinct olive-brown and common fine distinct yellowish brown; silty clay loam; weak very coarse to coarse prismatic; firm moist, sticky and plastic wet; broken to continuous moderately thick greyish brown cutans along vertical ped faces; many very fine tubular pores; moderately calcareous; few very fine roots; pH 8.0; abrupt smooth boundary
C1	31-41	Greyish brown (2.5Y 5/2) moist, many fine distinct olive-brown; few fine distinct dark brown and light olive-brown mottles; silt loam; massive; firm moist; slightly sticky and slightly plastic wet; many very fine tubular pores; moderately calcareous; pH 8.0; clear smooth boundary
C2	41-52	Greyish brown (2.5Y 5/2) moist, many fine distinct light olive-brown; few fine distinct dark yellowish brown and olive-brown mottles; silt loam, firm moist, sticky and plastic wet; many very fine tubular pores; moderately calcareous; pH 8.1; abrupt smooth boundary
IIC3g	52-62	Grey (N5/) wet, few fine distinct black mottles; clay; very sticky and very plastic wet; slightly calcareous; pH 7.8
IIA1gb	62-80+	Black (5Y 2.5/1) moist, few fine faint very dark grey mottles; clay; very sticky and very plastic; noncalcareous; well decomposed organic matter; pH 7.3 (8.0)

Note: Sampled by auger below 52 inches. pH within brackets determined on moist soils in the field by using Helliqe-Truog test kit.

Range of characteristics

a. Profile characteristics. Thickness of the topsoil usually ranges from 3 to 5 inches; colour from olive-grey to dark grey or dark greyish brown and texture from silt loam to silty clay loam, rarely silty clay. The subsoil colour varies from olive-grey to dark grey and sometimes olive-brown or light olive-brown. Structure is moderate to strong prismatic and angular blocky with broken to patchy thin dark grey to dark greyish brown cutans. Texture of the substratum is usually medium, occasionally moderately fine to fine.

b. Enviornmental characteristics. These soils are developed in the young and, locally, also in the old Ganges meander floodplain occupying basins and infilled channels. They are seasonally shallowly to moderately deeply flooded for 1-7 months in the rainy season.

Four phases have been recognized: Rasulpur, medium highland phase; Rasulpur, medium highland, irregular relief phase; Rasulpur, medium lowland, early draining phase and Rasulpur, medium lowland, slow draining phase.

Distribution and extent

These soils occupy about 832 acres of land in the project area.

Similar soils

Rasulpur sereis differs from Gopalpur series in being greyer in the subsoil and in occupying basin or infilled channel sites having poorer drainage and from Mehendiganj soils in having coarser texture and weaker structure in the subsoil.

Rayana Series

Rayna series comprises intermittently and seasonally very shallowly to shallowly flooded, imperfectly to poorly drained, light olive-brown to olive-brown, finely mottled, calcareous silt loams. They are usually finely stratified below the top-soil. Locally, the Rayna series includes stratified very fine sandy loams.

Typical profile: Rayna silt loam, highland phase

Location : 49/69W-41. Vill. Nandoali, P.S. Magura, Dist. Jessore

Topography : Summit of very gently undulating ridge

Land use : Jute-rabi crops

Drainage : Imperfect. Above normal flood level. The soil become droughty in the late dry season.

Horizon	Depth in in.	Description
Ap	0-5	Light olive-brown (2.5Y 5/4); silt loam; massive; common very fine and few fine tubular pores; moderately calcareous; many very fine roots; pH 7.6; abrupt smooth boundary
C1	5-12	Olive-brown (2.5Y 4/3) moist, common fine distinct dark yellowish brown and few fine distinct grey mottles; silty loam; remnants of stratification; slightly firm moist; common very fine and few fine tubular pores; moderately calcareous; common very fine roots; pH 8.1; clear smooth boundary
C2	12-19	Olive-brown (2.5Y 4/4) moist, few fine distinct dark yellowish brown mottles; silt loam; finely stratified; slightly firm moist; common very fine and few fine tubular pores; moderately calcareous; common very fine roots; pH 8.1; abrupt smooth boundary
C3	19-22	Mixed light grey (5Y 7/2) and olive-brown (2.5Y 4/4) moist; very vine sandy loam; finely stratified; very friable moist; common very fine and few fine tubular pores; moderately calcareous; few very fine roots; pH 8.0; abrupt smooth boundary
C4	22-25	Olive-brown (2.5Y 4/4) moist; few fine distinct dark yellowish brown mottles; silt loam; finely stratified; slightly firm moist; common very fine and few fine tubular pores; moderately calcareous; few very fine roots; pH 8.0; abrupt smooth boundary

IIC5	25-30	Light grey (5Y 7/2) moist; fine sandy loam; stratified; very friable moist; moderately calcareous; dark brown minerals within the stratified layers; pH 8.0; abrupt smooth boundary
IIIC6	30-33	Mixed olive-brown (2.5Y 4/4) and light grey (5Y 5/2) fine sandy loam patches; silt loam; stratified; friable moist; few very fine tubular pores; moderately calcareous; pH 8.1; clear smooth boundary
IIIC7	33-37	Olive-brown (2.5Y 4/4) moist; silt loam; friable moist; moderately calcareous; finely stratified; pH 8.1; clear smooth boundary
IIIC8	37-50	Olive-brown (2.5Y 4/4) moist; common fine distinct dark yellowish and few fine distinct dark brown mottles; silt loam; moderately calcareous; pH 8.0; abrupt smooth boundary
IIIC9	50-62	Olive-brown (2.5Y 4/4) moist; few fine distinct dark yellowish brown mottles; very fine sandy loam; moderately calcareous; pH 8.2

Note: pH determined on dried sample in the laboratory

Range of characteristics

a. Profile characteristics. Topsoil colour generally ranges from light olive-brown to olive-brown and, occasionally, grey to olive. Texture generally is silt loam but can range from fine sandy loam to silty clay. Subsoil colour ranges from light olive-brown to olive and occasionally is greyish brown or pale olive and texture from very fine sandy loam to silt loam. The subsoil is usually finely stratified, but local it includes only remnants of stratification. Substratum is normally medium textured but layers of fine sandy loam can be present.

b. Environmental characterisitcs. These soils are developed in young deposits of the Ganges alluvium occupying generally upper to middle part of nearly level to very gently undulating ridges and occasionally gently undualting ridges and inter-ridge depressions. They are mainly non-flooded but some are intermittently to very shallowly flooded.

Five phases have been recognized: Rayna, highland phase; Rayna, highland, irregular relief phase; Rayana, highland, river erosion hazard phase; Rayna, medium highland phase and Rayna, medium highland, irregular relief phase.

Distribution and extent

The occupy about 1,403 acres in the young Ganges meander floodplain in Magura and Sripur thanas.

Similar soils

Rayna series differs from Sara series in having alluvial stratification in the subsoil, from Pangsa in having finer texture in the subsoil and from the silty Ganges alluvium in having relatively more oxidized and partly homogenized subsoil with somewhat broken stratification.

Sandy Ganges Alluvium

This land type includes intermittently and seasonally very shallowly to moderately deeply flooded, imperfectly to poorly drained, mixed light grey and olive-brown, stratified, calcareous, sandy loams to fine sandy loams.

Typical profile: Sandy Ganges alluvium, highland phase

Location : Stop no. 50/69W-39. Vill. Arpara, P.S. Magura, Dist. Jessore
Topography : Upper part of gently undulating ridge
Land use : Mesta-fallow/rabi crops
Drainage : Imperfect. Above flood level. Intermittently very shallowly flooded for a few hours to 1-2 days in the rainy season

Horizon	Depth in in.	Description
Ap	0-7	Light grey (5Y 7/2) dry, olive (5Y 5/3) moist, few fine distinct strong brown mottles; sandy loam; single grained, loose dry, very friable moist, nonsticky and nonplastic wet; calcareous; many very fine and fine roots; pH 7.9 (8.5); abrupt wavy boundary
C1	7-14	Light grey (5Y 6.5/1) and dark brown (10YR 4/3) moist; very thin alternating layers of fine sandy loam; and loamy sand, mixing into olive (5Y 5/3) sandy loam; stratified; loose dry, very friable moist, nonsticky and nonplastic wet; common very fine and few fine tubular pores; calcareous; common very fine and few fine roots; pH 8.9 (8.0); abrupt wavy boundary
C2	14-19	Light grey (5Y 6.5/1) and dark brown (10YR 4/3) moist; very thin alternating layers of loamy fine sand and fine sandy loam, mixing into olive (5Y 5/3) fine sandy loam; stratified; nonsticky and nonplastic wet; common very fine and few fine tubular pores; calcareous; few very fine roots; pH 9.0; clear smooth boundary
C3	19-26	Light grey (5Y 6.5/1) and dark brown (4YR 4/3) moist; very thin alternating layers of loamy fine sand and very fine sandy loam, mixing into olive (5Y 5/3) very fine sandy loam; stratified; nonsticky and nonplastic; few very fine tubular pores; calcareous; pH 8.8; abrupt smooth boundary
IIC4	26-35	Olive (5Y 4/3) moist, common fine distinct dark yellowish brown and few fine faint yellowish red mottles; silt loam; stratified; slightly sticky and slightly plastic wet; common very fine tubular pores; calcareous; pH 8.3; abrupt smooth boundary
IIC5	35-40	Olive (5Y 4/3) moist, common fine distinct light olive brown, few fine faint red brown and few fine faint dark yellowish brown mottles; silt loam; massive; slightly sticky and slightly plastic wet; common very fine and few fine tubular pores; calcareous; few very fine roots; pH 8.4; abrupt smooth boundary
IIC6	40-48	Olive (5Y 4/3) moist, many fine distinct olive-brown and few fine distinct dark yellowish brown mottles; silt loam; slightly sticky and slightly plastic wet; common very fine and few fine tubular pores; calcareous; iron staining along ped faces; few very fine roots; pH 8.3; abrupt smooth boundary
IIIC7g	48-56	Greenish grey (5GY 5/1) moist; silty clay loam; sticky and plastic wet; calcareous pH 8.0
IVC8	56-65+	Dark greyish brown (2.5Y 4/2) moist, many fine distinct olive-brown and few fine distinct dark yellowish brown mottles: clay: very sticky and very plastic wet; calcareous; pH 7.9

Note: Sampled by auger below 48 inches. pH determined on dried sample in the laboratory. pH figures given in brackets obtained on moist soil in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil texture varies from sandy loam to silt loam. Subsoil colour (usually mixed colour i.e. light grey and olive-brown) ranges from light grey to olive-brown and texture from sandy loam to fine sandy loam. Soils are stratified from below the topsoil.

b. Enviornmental characteristics. These soils are developed in the young Ganges alluvium and occupy very gently to gently undulating ridges of young alluvial lands or along the banks of the active river channels in the young Ganges meander floodplain They are either above normal flood level or flooded by river water upto 3-4 feet for about 2-5 months in the rainy season. They become severely droughty during the dry season and in areas along the active river channels the soils have moderate risk of river erosion and/or burial by fresh alluvial deposits in the monsoon season.

Three phases have been recognized are: Sandy Ganges alluvium, highland phase; Sandy Ganges alluvium, highland, river-erosion hazard phase and Sandy Ganges alluvium, medium lowland phase.

Distribution and extent

These soils occupy about 161 acres in the young Ganges meander floodplain in Magura and Sripur thanas.

Similar soils

They differ from Pangsa soils developed in relatively older sediments, in having poorer drainage and raw nature of parent material and from the silty Ganges alluvium in having coarser texture.

Sara Series

The Sara series comprises intermittently and seasonally very shallowly flooded, imperfectly to poorly drained, calcareous, medium textured soils developed mainly in the young Ganges alluvium. These soils usually have an olive-brown, silt loam subsoil with weak to moderate coarse prismatic and angular blocky structure.

Typical profile: Sara silt loam, highland phase

Location : Stop no. 156/68F-15. Vill. Abalpur, P.S. Magura, Dist. Jessore

Topography : Upper part of nearly level ridge

Land use : Aus/jute-rabi crops (gram, mustard, lentil, chillis, onion, etc.

Drainage : Imperfect. Above normal flood level. Intermittently very shallowly flooded for a few hours within field bunds during the rainy season.

Horizon	Depth in in.	Description
Ap	0-4	Light olive-brown (2.5Y 6/4) moist; common fine distinct greyish brown and few fine distinct dark brown mottles; silt loam; massive; friable moist, slightly sticky and slightly plastic wet; moderately calcareous; many very fine and fine roots; pH 7.9; abrupt smooth boundary
B2	4-12½	Mixed olive-brown (2.5Y 4/4) and dark brown (10YR 4/3) moist, dark yellowish brown mottles; silt loam; weak very coarse to coarse prismatic breaking into coarse medium angular blocky; friable moist, slightly sticky and slightly plastic wet; many very fine and fine tubular pores; patchy thin greyish brown cutans along vertical ped faces; moderately calcareous; earthworm casts present; common very fine roots; pH 8.1; abrupt wavy boundary
C1g	12½-16	Mixed olive-brown (2.5Y 4/4) and dark yellowish brown (10YR 4/4) moist, light grey mottles; silt loam; massive; friable moist; nonplastic, nonsticky; few very fine tubular pores; moderately calcareous; earthworm casts present; few very fine tubular pores; few very fine roots; pH 8.1; abrupt smooth boundary
C2	16-26	Mixed olive-brown (2.5Y 4/4) and dark yellowish brown (10YR 4/6) moist, greyish brown and very dark greyish brown mottles; silt massive; friable moist, sticky and slightly plastic wet; many very fine and fine tubular pores; moderately calcareous; earthworm casts present; few very fine roots; pH 7.9; abrupt smooth boundary
C3	26-31	Mixed olive-brown (2.5Y 4/4) and dark brown (10YR 4/3) moist, dark yellowish brown and greyish brown mottles; silt loam; massive; friable moist, slightly sticky and slightly plastic wet; common very fine and fine tubular pores; moderately calcareous, earthworm casts present; few very fine roots; pH 8.0; abrupt smooth boundary
C4	31-46	Mixed greyish brown (2.5Y 5/2) and dark yellowsh brown (10YR 4/6), olive-brown and very dark greyish brown mottles; silt loam; massive; friable moist, slightly sticky and slightly plastic wet; many very fine tubular pores; moderately calcareous; earthworm casts present; few very fine roots; pH 7.9
IIA1b	46-52+	Greyish brown (2.5Y 5/2) moist, many fine distinct dark yellowish brown and dark brown mottles; silty clay; massive; slightly firm moist, sticky and plastic wet; few very fine tubular pores; moderately calcareous; plastic; few very fine tubular pores; moderately calcareous; pH 7.7

Note: Sampled by auger below 48 inches. pH determined on dried samples in the laboratory.

Range of characteristics

a. Profile characteristics. Thickness of the topsoil varies from 3 to 5 inches, rarely upto 7 inches. Colour is olive or olive-brown, sometimes greyish brown and texture is usually silt loam. Locally, the topsoil is noncalcareous. The subsoil comprises a friable olive-brown to light olive-brown, olive or greyish brown silt loam with weak to moderate very coarse to coarse prismatic, occasionally strong coarse to medium prismatic breaking into angular blocky structure. Patchy, sometimes broken, thin grey to greyish brown cutans are present along vertical ped faces and pore walls. Texture of the substratum ranges from fine sandy loam to silty clay loam but usually is fine sandy loam or silt loam. Colour varies from light grey to light olive-brown.

b. Environmental characteristics. These soils occur on the young and old Ganges meander floodplains usually occupying higher parts of ridges. They are mainly above normal flood level and become intermittently very shallowly flooded by rainwater within field bunds for few hours to less than 15 days and locally very shallowly flooded by rainwater for more than 15 days during the monsoon season.

Four phases and two variants have been recognized: Sara, highland phase; Sara, highland, irregular relief phase; Sara, medium highland phase; Sara, medium highland, irregular relief phase and Sara, made land variant and Sara, noncalcareous topsoil variant.

Distribution and extent

These soils occupy about 5,877 acres of land, mainly on the young Ganges meander floodplain ridges.

Similar soils

Sara soils differ from Mirpur and Patkelpota soils, in being calcareous throughout the profile and from Rayna soils, in having structured subsoil.

Sara, Made Land Varient

Sara, made land soils include nonflooded imperfectly drained olive to olive-brown, calcareous silt loams with weak very coarse prismatic structure in the B horizon. Usually these soils have broken potteeries in part or throughout the profile.

Typical profile: Sara silt loam, made land variant

Location	:	Stop no. 31/69W-41. Vill. Nij Nandoali, P.S. Magura, Dt. Jessore
Topography	:	Upper part of made land ridge
Land use	:	Jute-rabi crops
Drainage	:	Imperfect. Above normal flood level. Remains unsaturated for most part of the year

Horizon	Depth in in.	Description
Ap	0-4	Greyish brown (2.5Y 5/2) moist and light brownish grey (2.5Y 6/2) dry, common fine distinct light olive-brown mottles; silty loam; massive; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; calcareous; many very fine and fine roots; pH 7.9; abrupt smooth boundary
Blg	4-8	Olive-brown (2.5Y 4/4) moist, common fine distinct light grey and common fine faint greyish brown mottles; silt loam; weak very coarse prismatic; friable moist, slightly sticky and slightly plastic wet; patchy thin greyish brown cutans along vertical ped faces and pores; many very fine and fine tubular pores; few broken potteries present; many very fine roots; pH 8.1; abrupt smooth boundary
B21	8-15	Dark greyish brown (10YR 4/2) moist, common fine to medium yellowish brown and few fine prominent dark yellowish brown mottles; silt loam; weak very coarse prismatic; friable moist, slightly sticky and slightly plastic wet; patchy thin dark greyish brown cutans along vertical ped faces and pores; many very fine and common fine tubular pores; calcareous; few broken potteries present; few very fine roots; pH 8.0; clear smooth boundary
IIAlg	15-30	Dark grey (10YR 4/1) moist, few fine distinct yellowish brown and very dark greyish brown mottles; silt loam; weak very coarse prismatic; friable moist, slightly sticky and slightly plastic wet; many very fine and few fine tubular pores; calcareous; broken potteries; krotovina and biotic activities evident; few fine roots; pH 8.0; abrupt wavy boundary
IIC1	30-46	Olive-brown (2.5Y 4/4) moist, common fine distinct light yellowish brown, few fine prominent dark yellowish brown and few fine distinct dark brown mottles; silt loam: massive; very friable moist, slightly sticky and slightly plastic wet; many very fine pores; calcareous; pH 8.2
IIC2	46-60	Greyish brown (2.5Y 5/2) moist, common fine distinct olive-brown and few fine distinct dark yellowish brown mottles; silt loam; very friable moist; calcareous; pH 8.2

Note: pH determined on dried soil samples in the laboratory.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from greyish brown to dark greyish brown and texture from silt loam to silty clay loam. Subsoil colour ranges from greyish brown dark greyish brown or locally olive-brown and texture loam to silt loam, locally very fine sandy loam or silty clay loam. They contain a variable amount of broken pieces of potteries of different depths of the profile.

b. Environmental characterisitcs. These highly disturbed soils are mainly developed in calcareous Ganges sediments of the very gently to gently undulating made land ridges, adjoining the homesteads.

Distribution and extent

They occupy large areas adjoining the homesteads and are mostly mapped as settlements.

Similar soils

They differ from Sara series in having dirty appearance with greyish brown or dark greyish brown colour in the subsoil.

Satla Series

Satla series includes seasonally to almost perennially flooded, very poorly drained, very dark greyish brown/very dark grey, organic soils with more than 20 inches thick mucky peat. The peaty layer locally has a less than 10 inches thick mineral topsoil. These peat soils are mainly calcareous in the sruvey area.

Typical profile: Satla mucky peat

Location : Stop no. 125/69W-47. Vill. Panditpur, P.S. Jhenida, Dist. Jessore

Topography : Basin depression

Land use : Aus-fallow

Drainage : Very poor. Flooded upto 6 feet for 9-10 months. Groundwater was found at 4 inches depth on the 25th March, 1980

Horizon	Depth in in.	Description
Oe1	0-5	Very dark grey (10YR 3/1) moist, few fine prominent black mottles; mucky peat; massive; nonsticky and nonplastic wet; many very fine to fine tubular pores; calcareous; many very fine and fine roots; pH 7.4 (8.0)
Oe2	5-19	Very dark greyish brown (10YR 3/2) wet; peat; when squeezed in the hand little materials ooze between fingers; massive; nonsticky and nonplastic wet; many very fine to fine tubular pores; slightly calcareous; many very fine and fine roots; pH 7.6
Oe3	19-23	Dark grey (5Y 4/1) wet, common fine distinct dark greyish brown mottles; peat; when squeezed in the hand little materials ooze between fingers; massive; nonsticky and nonplastic wet; many very fine pores; slightly calcareous; many very fine roots; pH 7.7
Oe4	23-36	Dark grey (5Y 4/1) wet, mucky peat; when squeezed in the hand more than ½ materials ooze between fingers; massive; nonsticky and nonplastic; calcareous; many very fine roots; pH 7.6
IIcg	36-48	Greenish grey (5GY 4/1) wet, silty clay; very sticky and very plastic wet; calcareous; pH 7.6

Note: pH determined on dried sample in the laboratory. pH figure given in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characterisitcs. Topsoil thickness ranges from 4 to 9 inches. The organic layers of mucks, mucky peats or peaty mucks, starting from a depth within 10 inches of the surface, usually vary in thickness from about 2 to 5 feet or more and, in colour, from very dark greyish brown to very dark grev. They are usually calcareous.

b. Environmental characteristics. These soils are developed in organic materials derived from decomposed swamp grasses and reeds in the low-lying basin depressions in the old Ganges meander floodplain.

They are subject to flooding upto 6-8 feet during the monsoon season and remain flooded or wet for most of the dry season.

Distribution and extent

They occupy about 356 acres in basin depressions near Panditpur village in Jhenida thana occuring in soil mapping unit 28.

Similar soils

They differ from Rajair soils, developed in similar peaty materials, in having thicker organic layer (thicker than 20 inches).

Silty Ganges Alluvium

The silty Ganges alluvium includes intermittently and seasonally flooded, imperfectly to poorly drained, very young, raw alluvial deposits. They are olive to light olive-brown, calcareous, medium textured Ganges sediments, stratified below the cultivated topsoil.

Typical profile: Silty alluvium, highland phase

Location : Stop no. 34/70W-228. Vill. Bara Kasundi, P.S. Magura, Dist. Jessore

Topography : Upper part of very gently undulating ridge

Land use : Aus/mesta-rabi crops

Drainage : Imperfect. Above normal flood level. Intermittently flooded by rainwater within field bunds for a few hours to less than a week in the monsoon season.

Horizon	Depth in in.	Description
Ap	0-5	Olive (5Y 5/4) moist, light grey (5Y 7/2) dry; silt loam; massive; loose dry, very friable moist, nonsticky and nonplastic wet; calcareous; common very fine and few fine roots; pH 7.8; clear wavy boundary

C1	5-10	Olive (5Y 5/3) moist, dark greyish brown in bands and common fine and medium distinct dark yellowish brown mottles; silt loam; finely stratified; slightly sticky and nonplastic wet; common very fine and few fine tubular pores; calcareous; common very fine and few fine roots; pH 8.2; abrupt wavy boundary
C2	10-15	Light olive-brown (2.5Y 5/4) moist, common fine faint olive-brown, common fine distinct dark yellowish brown and few fine prominent dark brown mottles; silt loam; remnant of stratification, friable moist, slightly sticky and nonplastic wet; many very fine tubular pores; calcareous; few very fine roots; pH 8.2; clear smooth boundary
IIC3	15-31	Olive-brown (2.5Y 4/4) moist, common fine faint greyish brown, few fine distinct dark yellowish brown and few fine prominent dark brown mottles; silt loam; massive; slightly firm moist; sticky and plastic wet; many very fine and common fine tubular pores; calcareous; biotic activity present; pH 8.5 (8.0); clear wavy boundary
IIC4g	31-37	Greyish brown (2.5Y 5/2) moist, with many fine distinct olive-brown, few fine distinct dark yellowish brown and few fine prominent dark brown mottles; silt loam; massive, friable moist, slightly sticky and plastic wet; many very fine and few fine tubular pores; calcareous; pH 8.6(8.0); clear wavy boundary
IIC5g	37-42	Olive-brown (2.5Y 4/4) moist, common fine faint dark greyish brown, few fine distinct dark yellowish brown, few fine distinct dark brown mottles; silt loam; massive; friable moist; sticky and plastic wet; many very fine and few fine tubular pores; calcareous; biotic activity present; pH 8.2; clear smooth boundary
IIIC6g	42-46	Light grey (5Y 7/1) moist, dark olive-grey in bands and few fine distinct dark brown mottles; sandy loam; very friable moist, nonsticky and nonplastic wet; calcareous; pH 8.5 (8.0)
IVC7g	46-55	Olive-brown (2.5Y 4/4) moist, many fine faint greyish brown and few fine distinct dark yellowish brown mottles; silt loam; friable moist, nonsticky and nonplastic wet; calcareous; pH 8.7 (8.0)

Note: Sampled by auger below 42 inches. pH figures given in brackets recorded in the field using a Hellige-Truog test kit.

Range of characteristics

a. Profile characteristics. Topsoil colour ranges from olive to olive-brown and texture ranges from silt loam to very fine sandy loam. The stratified silt loam subsoil usually varies in colour from light grey to olive rarely light olive grey. Texture of the substratum is usually silt loam, rarely very fine sandy loam to fine sandy loam.

b. Environmental characteristics. The silty Ganges alluvium, comprising medium textured, stratified raw Ganges alluvial deposits, occupies nearly level to undulating ridges along the banks of the Kumar and Madhumati rivers. They are either above normal flood level or seasonally moderately deeply flooded by river water for 2-4 months during the monsoon season. They are unsuitable for long term development due to the risk of river erosion or burial by fresh alluvial deposits caused by abnormal floods in the rainy season

Three phases have been recognized: Silty Ganges alluvium, highland phase; silty Ganges alluvium, highland, river erosion hazard phase; and Silty Ganges alluvium, medium lowland phase.

Distribution and extent

These silty Ganges alluvium occupy about 204 acres in areas along the banks of the Madhumati and Kumar rivers in Magura thana.

Similar soils

Silty Ganges alluvia differ from sandy Ganges alluvial in having finer texture and from Rayna soils in having more prominent alluvial stratification and lacking biotic activity in the layer below topsoil and in over all raw state of the deposits.

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Stratified	In layers, like the pages of a book or a pile of books; applied to alluvial/rock layers.
Subsoil	The layer below the topsoil. It has been changed from its original state (of rock or alluvium) by soil forming processes.
Substratum	The layer of the soil that has not been altered by soil forming processes, usually occurring below the subsoil or sometimes below the topsoil in very shallow soils.
Texture (soil)	The relative proportion of different particle sizes within the soil which determine whether it is sandy, loamy, clayey, etc.
Tripple crop	Three successive crops grown in a year.
Topsoil	The surface layer of the soil, usually the plough layer disturbed by cultivation, including the ploughpan.
Wetland crop	A crop such as rice or jute which can grow in a wet or flooded soil.

A3. ANALYTICAL DATA

3.1 Analytical Methods

A total of 271 samples were collected from 38 soil pits which were dug at representative sites for important soil series in the survey area. Samples were send to the laboratory for determination of the following characteristics:

Cation Exchange Capacity (CEC). After saturation with $BaCl_2$ Tri-ethanolamine and one washing with water, the soil was shaken with a known amount of MgSO4 and centrifuged. The remaining Mg in an aliquot of the supernatant liquid was titrated with EDTA using eriochrome black-T indicator, and substracted from a blank determination for calculation of CEC.

Exchangeable Calcium and Magnesium. After centrifuge extraction with ammonium acetate at pH 7, exchangeable Ca and Mg were titrated with EDTA using solochrome dark blue and eriochrome black-T indicator respectively.

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

Conductivity ($EC \times 10^3$). Electrical conductivity was determined on a saturation extract using a Solu-bridge. The results are expressed in mmhos/cm.

Total Soluble Salts. A figure for total soluble salts was calculated from the conductivity data using an approximate average line drawn in Figure 3, p. 11 of Saline and alkali soils (27), adjusted for saturation percentage.

Individual soluble cations and anions were determined on 2 samples from 1 profile containing significant amounts of soluble salts. On the saturation extract, soluble Ca and Mg were determined by the methods indicated for exchangeable Ca++ and Mg++. CO3 and HCO3 were determined by titration with 0.1 N sulphuric acid and Cl by titration with silver nitrate. SO4 was determined by precipitation with $BaCl_2$ as BaSO4.

Organic Carbon. The carbon percentage was determined by the Walkely-Black method, the result being multiplied by 1.33 to arrive at a total carbon 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 corrected carbon and nitrogen percentage.

Exchangeable Hydrogen. Exchangeable H (exchange acidity) was obtained by measuring the change in pH when the soil was leached with normal ammonium acetate of pH exactly 7.00.

A3.2 Summary And Interpretation Of Analytical Data

Texture. Figure 4 indicates the very distinct distribution of all textural data in the USDA texture triangle. Nearly all the samples, independent of their geographical location within the survey area and depth in the soil profile, are located in the, ABCD area. Interestingly, within this area, there is a clear distinction between samples located in highland, medium highland and medium lowland/lowland positions respectively.

The medium lowland/lowland samples have a very narrow distribution, being mainly silty clay loams, silty clays and clays with very low sand contents. The samples taken from medium highland soils have a broader distribution. Not only are clays, silty clays and silty clay loams-often with higher sand contents than lower-lying soils - included, there is also a narrow band representing all textural classes between sand and silt loam. In the latter range, clay contents are generally between 5 and 15 percent; clay contents above 15 percent are always associated with very low sand contents. Samples collected from highland soils have the widest textural range as indicated by the AECD area. The majority of samples is located in the silt loam corner, while clays are only present just outside the silty clay area.

It appears from the triangle that textures with more than 10 to 20 percent clay and more than 10 to 20 percent sand are not typical for Ganges sediments. Heavy sandy loams and loams, sandy clay loams and clay loams, sandy clays and most clays should not be normally expected.

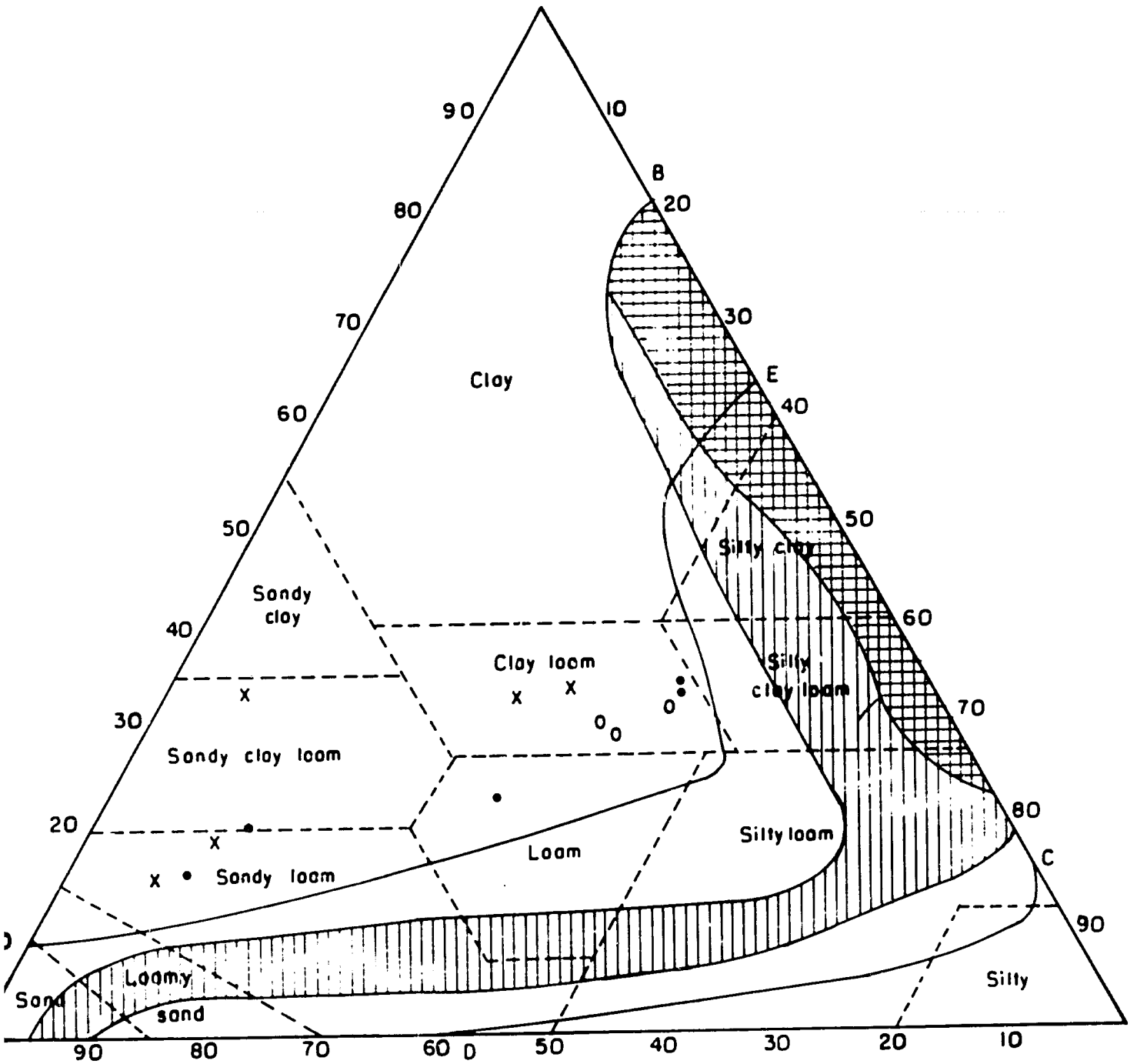
Organic Carbon, Nitrogen and C/N Ratios. Contents of organic carbon in soils of the old and young Ganges meander floodplain are generally low. Highest and lowest values recorded for topsoils and subsoils and disregarding the man-made variants, are 2.87 and 0.28 percent and 1.26 and 0.04 percent respectively. Both the minimum values were recorded in a very recent sandy alluvium soil and the maximum values in an older, fine textured basin soil. Representative figures for peat soils are not available.

From the data, it is apparent that the organic carbon content increases with decreasing sand/increasing clay content, as shown in Table 24.

Table 24

Comparison Between Organic Carbon Contents (%) And Textural Class

	sandy loam-loam	silt loam	silty clay loam	silty clay	clay
			Topsoil		
Mean	0.42	0.54	0.93	1.45	1.62
Range	0.28-0.60	0.41-1.03	0.75-1.36	0.96-2.59	0.75-2.87
			Subsoil		
Mean	0.20	0.35	0.49	0.59	0.98
Range	0.04-0.36	0.21-0.49	0.44-0.59	0.38-0.77	0.67-1.26



X Medium lowland / Lowland

O Medium highland

• Highland

A — B / D — C All soils

A — E / D — C Highland soils

Medium highland soils

Medium lowland / Lowland soils

Fig 4: — Textural Triangle

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At the same time, there is a clear correlation between the organic carbon content and length of period of soil saturation and flooding as shown in Table 25 for combined silty clay and clay textural classes.

Table 25

Comparison Between Organic Carbon Contents (%) And Soil Wetness

Topsoil

	highland	medium highland	medium lowland/lowland
Mean	1.12	1.42	1.98
Range	1.06-1.19	0.87-2.19	0.75-2.87

Subsoil

Mean	0.68	0.70	0.95
Range	0.46-0.94	0.38-1.22	0.66-1.26

Nitrogen contents are low to very low in all soils and show the same trends as organic carbon. Topsoil contents in medium and moderately fine textured soils on highland and medium highland positions are less than 0.10 percent; fine textured topsoils in medium highland positions vary between 0.10 and 0.20 percent, and only in fine textured topsoils of medium lowland and lowland soils does the nitrogen content rise above 0.20 percent. Subsoil contents are well below those of the topsoil.

In most soils the organic matter is fairly well mineralized as indicated by the C/N ratios which generally vary between 8 and 12. Trends down the profile are rather erratic, probably partly due to the very low carbon and nitrogen contents.

Cation Exchange, Base Saturation and Soil Reaction. Cation exchange capacities are high to very high. When expressed in milli-equivalents per 100 gram of clay- after making a deduction for the contribution of organic matter - it appears that in topsoils of highland soils the CEC generally varies between 50 and 80, in topsoils of medium highland soils between 40 and 60 and in topsoils of medium lowland and lowland soils between 40 and 50. Similar trends are present in the subsoils. In addition, CEC shows an increase with depth in most profiles. These values for CEC confirm the clay mineralogy of Ganges floodplain soils which, apart from a mixture of illite, chlorite and kaolinite, contain considerable amounts - upto 50 percent - of montmorillonite.

The representative profile of Mominpur series has an exceptionally low CEC in all horizons analysed. From a value of about 20 meq/100 gram clay in the topsoil, it rises to about 30 meq in the substratum. Together with the typical texture, this might indicate a different parent material.

Although the base saturation percentage cannot be exactly calculated, it can be inferred that in virtually all soils the value will be well over 50 throughout the profile. Calcium is the dominant cation while in soils without free carbonates the Ca/Mg ratio is generally between 2 and 6. It is possible that soils with an exchangeable sodium percentage of more than 15 occur in very small, localized patches. They have not been identified during the present survey but previous work indicates that they could occur. In any case, their extent will be insignificant, (if present at all).

Soil reaction, as determined in the laboratory on the dried samples, varies considerably with the age and position of the soils. The very young sandy and silty alluvia are moderately to strongly alkaline with the pH well over 8.5 in many layers. Slightly older soils such as Sara and Gopalpur series are mildly to moderately alkaline. With increasing age of the soils, and because of leaching of carbonates, acidification intensifies starting in the topsoil and, eventually, throughout the profile. Thoroughly leached soils such as Batra and Mominpur are strongly acid in the surface soil becoming slightly acid with depth. In such soils, when flooded, the soil reaction normally becomes less acid which has important implications for the availability of plant nutrients.

Salts and Electrical Conductivity. Calcium carbonate is present in many of the soils in the survey area. Because of its very low solubility in water it does not present any potential danger to plant growth. It appears that calcium carbonate percentages of around 10 are fairly typical for horizons that have not yet been subject to leaching. With time, carbonates are leached from the soils, at a more rapid rate in lower positions because higher organic matter contents produce more CO_2 which is necessary for the conversion of the carbonates into soluble bicarbonates.

Measurements of the electrical conductivity indicate that the amount of soluble salts is generally very low. Only in a few cases do horizons show a conductivity of more than 1 millimhos but even then, the amount of soluble salts is well below the critical level for all crops.

Water Quality. A number of water samples from deep tubewells and streams were collected for analysis to provide some guidance as to the water quality for irrigation. When applying the standards set by the US Salinity Laboratory, virtually all water samples are of moderate quality in terms of electrical conductivity and do not have a residual sodium carbonate hazard. It was not possible to determine the amount of sodium so the sodium adsorption could not be calculated. In general, however, and taking into account the abundant leaching that will occur during the monsoon season, there does not appear to be any hazard of salinity developing.

13.3 Tabulated Analytical Data on Different Soil Series

Lab. No.	Depth in.	Tex.	% Sand US	% Silt US	% Clay	CEC	Exchangeable Cations, m.e./100g Ca	Mg	Ph	EC 10^3	SP	% C	% N	C/N	% CaCO3
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Amjhupi, medium highland phase, location: 15/70W-236															
09097	0-2½	SiC	10	48	42	25	13.8	3.3	6.1	0.14	54.39	0.96	0.10	10	Nil
09098	2½-4	SiC	9	44	47				6.5						Nil
09099	4-13	SiC	13	45	42	26	17.6	5.5	6.6	0.12	60.75	0.47	0.07	8	Nil
09100	13-17½	SiC	10	50	40				6.8						Nil
09101	17½-25	SiL	13	61	26				7.1						Nil
09102	25-40	SiL	7	75	18	19			7.7	0.26	59.98	0.24	0.03	8	2.7
09103	40-44	LS	81	12	7				7.7						1.0
09104	44-58	S	91	6	3				7.9	0.22	30.76				1.0
Baradi, medium highland phase, location: 1/68E-15															
09157	0-3	SiL	25	52	23	17	8.6	1.1	4.8	1.60	40.35	0.57	0.07	8	Nil
09158	3-5	CL	24	45	31				5.7						Nil
09159	5-11	CL	23	45	32	23	14.0	2.6	6.2	0.10	48.11	0.38	0.06	6	Nil
09160	11-17	SiCL	6	56	38				6.2						Nil
09161	17-28	SiC	4	52	45				6.9						Nil
09162	28-40	SiCL	4	60	36	27	14.4	4.6	7.0	0.30	62.40	0.25	0.05	5	Nil
09163	40-58	SiL	9	70	21				6.9	0.37	58.05				Nil
Batra, medium lowland, slow draining phase, location: 1/68E-13															
09064	0-4	C	6	27	67	40	16.0	6.6	5.2	0.25	72.45	2.63	0.26	10	Nil
09065	4-5	C	10	24	66				5.2						Nil
09066	5-11½	C	5	19	76	44	24.3	10.1	6.2	0.14	87.22	1.26	0.158	8	Nil
09067	11½-25	C	21	29	50				6.3						Nil
09068	25-35	SCL	59	7	34	20.0	11.8	3.4	6.4	0.14	42.31	0.38	0.068	6	Nil
09069	35-40	SL	70	12	18				6.6						Nil
09070	40-54	SL	77	8	15				6.5	0.30	29.24				Nil

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Benapl, medium highland phase, location: 39/70W-234															
09056	0-35	C	5	24	71	45	19.2	9.2	5.6	0.20	68.49	1.36	0.119	11	Nil
09057	35-55	C	3	26	71				5.7						Nil
09058	55-175	C	2	29	69	45	27.2	10.2	6.4	0.18	77.17	0.74	0.091	8	Nil
09059	175-28	C	1	36	63				6.5						Nil
09060	28-32	SiC	3	52	45				6.8						Nil
09061	32-42	SiC	5	50	45	30	17.6	7.8	6.9	0.20	58.01	0.25	0.048	5	Nil
09062	42-50	SiC	8	51	41				6.5						Nil
09063	50-58	SiCL	12	54	34				6.5	1.40	59.15				Nil
Darsana, medium highland phase, location: 153/69W-43															
09315	0-3	SiCL	7	65	28	21	15.7	6.4	6.8	0.16	49.09	0.75	0.062	12	Nil
09316	3-5	SiCL	7	62	31				6.8						Nil
09317	5-13	SiCL	9	55	36	25	16.6	4.7	6.4	0.50	53.54	0.59	0.053	11	Nil
09318	13-21	SiCL	3	66	31				6.6						Nil
09319	21-30	SiC	1	59	40				7.9						6.7
09320	30-43	SiC	1	55	44				8.0						8.1
09321	43-57	SiCL	2	70	28	22			8.1	0.16	83.55	0.33	0.032	10	10.2
Gangni, highland phase, location: 1/70W-234															
09029	0-4	C	9	38	53	37	20.2	8.5	6.2	0.26	50.69	1.06	0.13	8	Nil
09030	4-55	SiC	6	48	46				6.1						Nil
09031	55-11	C	15	37	48	32	20.5	15.0	6.5	0.14	58.81	0.94	0.06	16	Nil
09032	11-17	SiCL	19	49	32				6.7						Nil
09033	17-23	SiL	33	51	16				7.1						3.53
09034	23-32	SiL	10	74	16	17			8.1	0.35	47.22	0.29	0.03	10	11.05
09035	32-46	SiC	5	52	43				7.7						5.18
09036	46-50	CL	21	45	34				7.1	1.20	55.87				1.50

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Garuri, medium lowland, slow draining phase, location: 16/70W-236															
09105	0-5	SiCL	4	60	36	23.0	8.6	2.7	5.1	0.20	63.95	1.36	0.13	10	Nil
09106	5-11	SiC	1	57	42	27.0	13.1	5.3	5.8	0.14	80.22	0.77	0.09	9	Nil
09107	11-17½	SiC	1	56	43				6.6						Nil
09108	17½-22	SiCL	2	68	30				6.8						Nil
09109	22-24	SiL	34	55	11	14.0	8.3	3.4	6.9	0.20	48.07	0.23	0.04	6	Nil
09110	24-30	SiCL	1	69	30				7.0						Nil
09111	30-39	SiL	8	75	17				7.5						Nil
09112	39-44	SiCL	1	69	30				7.8						6.0
09113	44-50	SiC	2	57	41				7.7						4.2
09114	50-58	C	3	39	58				7.4	0.16	90.47				2.3
Ghior, medium highland phase, location: 1/70W-232															
09164	0-3	C	7	26	67	38.0	21.1	5.0	5.7	0.20	72.37	1.57	0.15	10	Nil
09165	3-4½	C	3	26	71				5.5						Nil
09166	4½-11	C	1	33	66	40.0	25.6	7.3	6.3	0.18	79.16	0.67	0.13	5	Nil
09167	11-22	SiC	1	50	49				7.4						3.6
09168	22-32	SiC	1	47	52				7.8						6.3
09169	32-38	CL	30	40	30	21.0	16.6	1.6	7.2	0.18	44.63	0.12	0.06	2	Nil
09170	38-50	CL	30	39	31				7.4	0.16	58.59				Nil
Gopalpur, highland phase, location: 36/70W-234															
09007	0-3½	SiCL	1	69	30	19.9			7.5	0.24	60.77	0.83	0.10	8	6.1
09008	3½-8½	SiCL	1	69	30				7.9						7.1
09009	8½-17	SiCL	15	49	36	21.0			7.9	0.18	69.95	0.55	0.07	8	6.2
09010	17-23	SiCL	1	65	34				7.8						5.1
09011	23-32	SiCL	1	69	30	20.0			7.9	0.20	68.06	0.42	0.06	7	7.7
09012	32-48	SiCL	1	62	37				7.9						8.8
09013	48-56	SiL	12	75	13				7.9	0.22	70.40				7.8

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ishurdi, medium highland phase, location: 37/70W-234															
09021	0-4½	SiC	1	50	49	34.0			7.7	0.38	97.5	1.13	0.15	8	2.6
09022	4½-5½	SiC	11	42	47				7.8						5.7
09023	5½-14	SiC	1	51	48	28.0			7.9	0.13	67.80	0.59	0.09	7	6.3
09024	14-19	SiC	13	41	46				8.0						7.2
09025	19-24	SiL	1	81	18	22.0			8.1	0.20	58.88	0.37	0.05	7	4.6
09026	24-32	C	8	37	55				7.9						5.2
09027	32-46	C	9	39	52				7.7						3.1
09028	46-52	C	2	36	62				7.6	0.20	67.91				2.1
Jhenida, highland phase, location: 1/69W-47															
09141	0-3	SiC	6	44	50	33.0	17.6	5.9	5.6	0.28	58.75	1.19	0.14	8	Nil
09142	3-5	SiC	4	44	52				6.1						Nil
09143	5-15	SiC	1	50	49	33.0	21.4	5.9	6.5	0.26	55.95	0.63	0.11	6	Nil
09144	15-32	SiCL	1	68	36	27.0	45.7	6.4	7.2	0.14	49.04	1.71	0.06	28	Nil
09145	32-38	SiCL	5	65	30				7.2						Nil
09146	38-50	SiC	4	54	42				7.1						Nil
09147	50-60	C	1	38	61				6.9	0.14	90.83				Nil
09148	60-80	SiL	14	70	16				7.1	0.10	47.26				Nil
Kasiani, medium highland phase, location: 4/70W-236															
09121	0-5	SiC	11	43	46	25.0	10.2	9.8	5.7	0.32	41.08	1.30	0.12	11	Nil
09122	5-13	SiC	4	48	48	27.0	14.4	7.5	6.0	0.14	65.44	0.63	0.08	8	Nil
09123	13-19	SiC	5	51	44				6.4						Nil
09124	19-27	SiCL	8	63	29				7.0						Nil
09125	27-40	SiL	10	78	12	14.0	7.0	2.7	6.8	0.12	46.26	0.08	0.04	2	Nil
09126	40-44	SiL	8	67	25				6.6						Nil
09127	44-56	S	88	9	3				7.2	0.08	43.90				Nil

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Kumarkhali, medium lowland phase, location: 47/68F-16															
09263	0-5	C	4	39	57	32.0			7.6	0.30	75.83	0.87	0.094	9	4.3
09264	5-11	C	1	39	60	31.0			7.7	0.23	71.95	0.71	0.073	10	1.2
09265	11-17	SiCL	4	58	38	23.0			7.8	0.18	69.00	0.49	0.051	10	9.7
09266	17-30	SiL	42	51	7				8.0						8.9
09267	30-42	SiL	14	71	15				7.8						7.2
09268	42-54	SiC	1	45	54				7.6	0.55	82.11				6.8
Magura, medium highland phase, location: 82/68E-15															
09296	0-5	C	5	19	76	40.9	18.2	3.6	4.6	0.20	58.99	1.84	0.176	10	Nil
09297	5-10	C	1	21	78	40.9	26.2	7.2	5.8	0.12	79.84	1.00	0.117	9	Nil
09298	10-15	C	5	23	72				6.4						Nil
09299	15-24	C	7	31	62				6.6						Nil
09300	24-38	C	13	34	53	30.3	17.9	7.0	6.5	0.08	55.83	0.44	0.054	8	Nil
09301	38-48	SL	62	26	12				6.8						Nil
09302	48-60	SL	67	28	5				5.5	0.55	49.58				Nil
Mahespur, medium lowland phase, location: 103/68E-16															
09288	0-4	C	6	25	69	51.1	29.1	6.7	5.9	0.50	83.62	1.04	0.504	9	Nil
09289	4-6	C	3	23	74				5.8						Nil
09290	6-16	C	1	31	68	45.8	22.7	5.5	6.6	0.32	84.44	1.21	0.159	8	Nil
09291	16-27	C	1	20	79				7.6						Nil
09292	27-37	C	1	28	71				7.0						Nil
09293	37-49	C	1	26	73				7.3						Nil
09294	49-59	SiC	1	53	46	27.4	21.1	3.8	7.2	0.24	71.46	0.67	0.047	14	Nil
09295	59-64	SiCL	1	63	36				7.4	0.38	69.61				Nil

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mehendiganj, medium highland phase, location: 1/68E-17															
09134	0-5	SiC	8	41	51	34.1	19.2	5.1	6.1	0.16	70.16	1.54	0.15	10	Nil
09135	5-16	SiC	1	53	46	29.7			7.7	0.16	73.50	0.38	0.08	5	6.9
09136	16-24	SiC	1	48	51				7.8						6.0
09137	24-32	C	1	32	67				7.7						2.5
09138	32-38	C	1	35	64	41.4	28.8	8.8	7.4	0.32	77.97	0.95	0.11	9	1.9
09139	38-48	SiC	1	41	58				7.3						0.6
09140	48-60	SiC	3	48	49				7.6	0.16	64.07				1.2
Mirpur, highland phase, location: 37/70W-236															
09089	0-4	SiL	22	59	19	13.9	8.9	0.8	6.4	0.16	39.98	0.53	0.07	8	Nil
09090	4-55	SiCL	15	58	27				6.5						Nil
09091	55-13	SiL	15	61	24	21.8	10.6	5.9	6.6	0.16	58.84	0.45	0.06	6	Nil
09092	13-21	SiL	19	64	17				6.4						Nil
09093	21-28	SiL	10	74	16	18.9	29.4	1.4	7.8	0.21	54.10	0.34	0.05	7	8.8
09094	28-41	SiL	25	67	8				8.1						9.3
09095	41-50	SL	73	22	5				7.1						3.5
09096	50-60	SiL	39	54	7				7.6	0.40	38.87				8.1
Mominpur, highland phase, location: 83/68E-15															
09282	0-4	SL	75	13	12	4.0	1.3	0.7	5.1	0.32	25.66	0.28	0.05	6	Nil
09283	4-11	SL	66	21	13	6.5	2.6	1.0	5.3	0.12	27.44	0.36	0.05	7	Nil
09284	11-20	ScL	66	14	20				5.8						Nil
09285	20-31	SL	73	11	16	5.7	3.5	3.0	5.8	0.10	31.73	0.11	0.03	4	Nil
09286	31-40	S	90	2	8				6.4						Nil
09287	40-48	S	95	2	3				6.5	0.12	43.65				Nil

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Paksey series, location: 152/69W-42															
09303	0-4	L	42	43	15	9.7			7.8	0.20	40.6	0.60	0.051	12	2.9
09304	4-20	L	36	47	17	11.5			8.0	0.20	48.9	0.25	0.031	8	6.5
09305	20-27	SiL	36	51	13				8.2						5.4
09306	27-31	L	48	41	11	9.7			7.8	1.10	40.1	0.17	0.025	7	5.9
09307	31-38	SiL	22	58	20				8.1						13.4
09308	38-50	SiL	14	61	25				8.1	0.24	51.2				10.3
Patkelpota, highland phase, location: 18/70W-242															
09339	0-3½	SiL	32	57	11	10.0	6.4	1.3	6.5	0.26	40.32	0.48	0.055	9	Nil
09340	3½-14	L	47	35	18	14.0	8.3	3.7	6.0	0.13	39.51	0.32	0.080	4	Nil
09341	14-20	SL	59	25	15				5.9						Nil
09342	20-28	LS	82	16	2	5.0	3.2	2.6	7.0	0.14	38.73	0.13	0.020	6	Nil
09243	28-51	LS	84	15	1				7.1						Nil
09244	51-59	SiL	42	56	2				8.3	0.32	37.82				4.9
Rajair series, location: 126/69W-47															
09356	0-6	CL	31	35		59.0			7.6	1.25	81.6	40.84	0.94	43	24.5
09357	6-15		Nd	Nd	Nd	72.0			8.4			42.82	0.69	62	17.6
09358	15-22		Nd	Nd	Nd	Nd			7.6						32.9
09359	22-36		Nd	Nd	Nd	Nd			7.5						32.0
09360	36-48	SiCL	2	59	39	Nd			7.8						14.0
Ramdia, medium lowland phase, location: 81/68E-15															
09275	0-5	C	7	35	58	42.0	26.9	9.6	6.0	0.55	72.02	2.87	0.25	12	Nil
09276	5-8	C	6	32	62				6.1						Nil
09277	8-15	C	1	27	72	42.0	31.0	5.6	7.1	0.20	65.65	1.10	0.15	7	Nil
09278	15-21	SiC	1	59	40	21.0			7.85	0.20	70.33	0.47	0.04	11	9.4
09279	21-30	SiCL	1	64	35				8.0						13.2
09280	30-42	SiC	1	53	46				7.9						10.4
09281	42-50	C	1	39	60				7.6	0.85	77.81				6.2

Nd = Not determined

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rasulpur, medium highland phase, location: 38/70W-236															
09079	0-2½	SiC	5	49	46	31.0			6.8	0.26	64.85	1.46	0.14	11	Nil
09080	2½-4½	SiC	2	52	46				7.1						2.6
09081	4½-10½	SiCL	8	61	31	25.0			7.8	0.30	50.35	0.62	0.07	9	5.0
09082	10½-20	SiL	3	69	28				7.9						12.7
09083	20-31	SiCL	10	58	32				8.0						9.2
09084	31-41	SiL	17	70	13	18.0			8.0	0.26	49.96	0.19	0.03	6	10.6
09085	41-52	SiL	3	74	23				8.1						12.6
09086	52-62	C	1	36	63				7.8						10.0
09087	62-80	C	10	22	68				7.3	0.35	86.41				2.1
Rayna, highland phase, location: 49/69W-41															
09253	0-5	SiL	19	68	13	12.0			7.6	1.2	42.74	0.49	0.04	12	6.6
09254	5-12	SiL	5	77	18	16.0			8.1	0.31	50.41	0.41	0.05	8	8.4
09255	12-19	SiL	12	73	15				8.1						8.9
09256	19-22	L	43	50	7	9.0			8.0	0.33	40.39	0.08	0.02	4	8.2
09257	22-25	SiL	10	71	19				8.0						8.9
09258	25-30	LS	74	23	3				8.0						5.3
09259	30-33	SiL	31	60	9				8.1						6.6
09260	33-37	SiL	24	69	7				8.1						7.8
09261	37-50	SiL	13	70	17				8.0						5.9
09262	50-62	SiL	16	72	12				8.2	0.18	45.60				5.4
Sandy Ganges alluvium, highland phase, location: 50/69W-39															
09322	0-7	SL	62	33	5	2.5			7.8	0.60	37.00	0.43	0.02	18	5.0
09323	7-14	SL	74	22	4	4.8			8.9	0.16	35.00	0.04	0.02	3	4.9
09324	14-19	SL	60	37	3				9.0						6.4
09325	19-26	SL	48	46	6	6.5			8.8	0.30	62.00	0.21	0.03	8	5.9
09326	26-35	SiL	9	79	12				8.3						7.4
09327	35-40	SiL	30	63	7				8.4						6.4
09328	40-48	SiL	6	82	12				8.3						6.9
09329	48-56	SiCL	1	66	33				8.0	0.35	65.00				7.6
09330	56-65	C	1	39	60				7.9						3.7

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sara, highland phase, location: 156/68E-15															
09014	0-4	SiL	18	70	12	9.8			7.9	0.85	45.16	0.41	0.07	6	5.5
09015	4-12½	SiL	15	73	12	13.0			8.1	0.35	44.86	0.24	0.04	6	6.0
09016	12½-16	SiL	10	75	15				8.1						8.5
09017	16-26	Si	4	86	10				7.9						8.0
09018	26-31	SiL	13	75	12				8.0						8.5
09019	31-46	SiL	3	74	23	19.8			7.9	0.60	62.36	0.37	0.05	7	8.0
09020	46-52	SiC	2	53	45				7.7	0.36	57.45				1.6
Sara, made land variant, location: 31/69W-41															
09345	0-4	SiL	18	65	17	13.0			7.8	0.66	48.5	0.80	0.10	8	4.0
09346	4-8	SiL	12	66	22				8.1						8.5
09347	8-15	SiL	18	62	20	15.0			8.0	0.26	49.8	0.72	0.06	12	5.6
09348	15-30	SiL	22	59	19				8.0						4.5
09349	30-46	SiL	25	64	11	4.0			8.2	0.30	42.2	0.13	0.02	7	0.3
09350	46-60	SiL	31	55	14				8.2	0.50	43.4				0.9
Satia series, location: 125/69W-47													% OM		
09351	0-5	HCL*		31	35				7.4		40.82		1.17	35	17.5
09352	5-19	-	Nd	Nd	Nd				7.6		45.00		2.00	23	13.9
09353	19-23	-	Nd	Nd	Nd				7.7		43.57		0.76	57	26.4
09354	23-36	-	Nd	Nd	Nd				7.6		42.87		0.72	60	29.4
09355	36-48	SiC	1	59	40				7.6						11.6

* Mucky clay loam, Nd Not determined

Silty Ganges alluvium, highland phase, location: 34/70W-22B															
													% N		
09331	0-5	SiL	30	64	6	6.0			7.8	1.15	40.50	0.41	0.03	14	5.9
09332	5-10	SiL	12	79	9	9.0			8.2	0.20	50.52	0.21	0.03	7	7.4
09333	10-15	SiL	15	76	9				8.2						6.9
09334	15-31	SiL	3	70	27	11.0			8.5	0.55	51.90	0.61	0.05	12	6.5
09335	31-37	SiL	19	69	12				8.6						7.6
09336	37-42	SiL	4	71	25				8.2						6.5
09337	42-46	SL	70	28	2				8.5						6.3
09338	46-55	SiL	27	64	9				8.6	0.40	39.67				7.9

A3.4 Data on Water Sample Analyses

Stop no. Location	Container No.	Soluble Cations: m.e./L Ca	Mg	EC_3 10^3	Soluble anions: m.e./L SO_4	CO_3	HCO_3	Cl
32/69W-41	06-1	3.2	4.6	0.22	Nil	0.4	1.[illegible]	0.8
17/70W-230	DT No.5	3.4	5.1	0.27	Nil	0.4	2.4	1.0
5/70W-230(D)	DIZ-1	4.4	4.2	0.36	Nil	0.8	2.9	1.4
30/70W-230	MK-1	5.6	5.2	0.47	Nil	0.6	3.8	1.2
06/70W-234	06/13	4.0	4.0	0.31	Nil	0.8	2.5	1.4
DDR/70W-228	DTW/DX-18	3.8	4.6	0.40	Nil	1.0	2.9	1.2
Kr1/70W-228	DTW/Kx-18	3.4	4.6	0.41	Nil	0.8	3.4	1.2
10/69W-41	MT-1	3.4	3.6	0.27	Nil	0.8	1.8	1.0

A4. SOIL MOISTURE DATA

A4.1 Introduction

A characterisation of the water behavior in the soil is essential in any irrigation project. To do this, four methods were used according to the soil condition and the available time, equipment and manpower.

They included:

- Measuring of infiltration rates using a double cylinder infiltrometer;
- Measuring of permeability by auger hole method:
- Measuring of permeability by inversed auger hole method:
- Measuring of hydraulic conductivity in the laboratory on core samples

A description of the methods used for analyses is given below.

A4.2 Analytical Methods

Determination of water behavior in the soil. The determination of infiltration characteristics was carried out with the double ring infiltrometer method. One steel cylinder of 0.3 meter diameter is tapped into the soil upto 10 to 15 cm. Another cylinder is tapped around the first one upto the same depth. Three replicates are made.

Water is then poured into the 2 cylinders and the level of the water into the inner cylinder is recorded against the time.

The total amount of water infiltrated since the beginning of the experiment is blotted on semi-log paper against the time since the beginning of the experiment. An average straight line is drawn through the plots of the three replicates. The different characteristic values are calculated from the following formulas:

- Cumulative infiltration = $a \times time^{n}$
- Instantaneous infiltration= $a\,xn \times time^{(n-1)}$

Where a and n are measured on the graph

The permeability coefficient was measured with direct and inversed auger hole method.

In the direct auger hole method a hole of 8 cm diameter is bored into the soil below the water table. After a few hours the level of the water table is recorded and the water inside the hole removed with a bailer. Using a tape attached to a float, the rising of the water level (Δy, is then recorded against the time (Δt) the coefficient of permeability R is given by the formula $R = C \frac{\Delta y}{\Delta t}$ where C is measured from a standard graph and depends from the height of the water, the depth and breadth of the hole and the depth of the impervious substratum.

In the inversed auger hole method a hole of 8 cm diameter is bored into the soil above the water table. The depth of the hole is measured and water is poured into it. Using a tape attached to a float, the decreasing of the water level inside the hole is recorded against the time and plotted on semi-log peper. The slope coefficient of the straight line so obtained is directly related to the soil permeability.

Laboratory measurement of hydraulic conductivity. The laboratory hydraulic conductivity was measured on saturated core samples of known dimensions. Rings are pressed vertically into the different layers using an appropriate sampler. The flow of water through the undisturbed core sample is measured together with the hydraulic head (water pressure) that causes the flow. The reading in cm/hour is converted into cm/day using Darcy's law.

Infiltration

Infiltration experiments have been conducted during the dry season for most of the soil series on both topsoil and subsoil. Experiments were also conducted during the monsson season on a limited but representative number of soil series. In each experiment a number of physical quantities were determined so as to fully characterise the process of infiltration. These quantities comprise:

- a value: a measure of the magnitude of infiltration and characterising the cumulative water intake after one minute;
- n value: varies from 0 to 1 and reflects the change in infiltration rate with time;
- cumulative infiltration (I cum): the total volume of water that has infiltrated through a unit of horizontal area of soil surface over a given period of time measured from the start of infiltration;
- average infiltration rate (I av): the cumulative infiltration divided by the total time;
- instantaneous infiltration rate (I inst): the volume of water infiltrating through a horizontal unit area of soil surface at any instant (infinitely small period of time);
- basic infiltration rate (I bas): the relatively constant instantaneous rate that develops when the change in instantaneous infiltration rate is less than 10% when compared with that of the preceeding hour;
- t bas value: time required for reaching the basic infiltration rate;
- t(4 in) value: time required for reaching four inches cumulative intake.

In addition to these physical quantities the basic infiltration rates are classified according to a classification suggested by Rickard and Cossens (19) and the time required for four inches cumulative intake is designated according to a classification suggested by Van Beers (28). Both classifications specifically refer

to dryland crop irrigation and do not consider transplanted rice. Obviously, what is a favourable rate for dryland crops is undesirable for transplanted rice.

The data are given in tables 27A, 27B, 28A and 28B.

Discussion

In large parts of the project area, soils contain an appreciable amount of swelling clays. The interconnected crack system developing in such soils during the dry season has sometimes resulted in unrealistic infiltration values. To reject data as "unrealistic" caused some problems as the farmers cultivating these soils also complained about the difficulty of keeping standing water. This phenomenon has been discussed in section 3.21 in Part 3, Volume 1 of this report.

Problems arise also in the statistical analysis of the data. Comparative tests have to be made with non-parametric methods because no assumption of equal variances and normal distribution can be made.

Grouping the dry season basic infiltration rates according to three textural groups/moderate, moderately fine and fine and applying the WILCOXON test to both topsoil and subsoil values, no significant difference between the three groups was found to exist even at the 5% level of significance*. This shows that due to the wide range of infiltration rates within a textural group, more experimental value are needed to show significant differences, if any at all. The absence of correlation between infiltration and texture also shows that along with the textural class, there are other major factors influencing infiltration.

There is also no correlation (r = -0.059) between the dry season and monsoon season basic infiltration rates. This can partly be explained through the fact that, for technical reasons, the experiments where not carried out on the same sites. The lack of correlation clearly indicates that the criteria characterising soil series are different from those characterising the movement of irrigation water through the soils.

The Wilcoxon test for paired cases applied to the topsoil basic infiltration values versus the subsoil basic infiltration values shows that the rates for topsoils are significantly lower at the 0.5% level of significance; during both dry and monsoon seasons. This clearly indicates that cultivation practices reduce infiltration through the topsoil, and ultimately through the whole profile, as it is generally admitted that the least pervious layer at shallow depth regulates the vertical permeability.

Also the "n" values for topsoils are significantly lower than the "n" values for subsoils, showing that the instantaneous infiltration rates are changing faster in subsoils than in topsoils.

The coefficients of linear correlation between the basic infiltration rates of topsoils and subsoils equal 0.73 (dry season values) and 0.73 (monsoon season values). This correlation is significant at the 0.1% level for the dry season

* There are more than 5 chances in 100 that a statement of difference is wrong.

values at the 5% level for the monsoon season values. It indicates that most of the factors affecting infiltration do not change abruptly between topsoil and subsoil.

The Wilcoxon test for paired cases applied to the average dry season values versus the monsoon season values shows that the infiltration rates are significantly higher(2% level) during the monsoon season. Cultivation of transplanted aman on high land should not be recommended unless abundant irrigation water can be provided at low cost.

The basic infiltration rate is, per definition, not the rate prevailing after a few days of submersion. The values of the instantaneous rate after 24 hours are, for instance, approximately two times lower than the basic rates. The basic infiltration rate is generally achieved during the 5 or 6 hours experimental time and is therefore a useful quantity for international comparisons.

The designations of the basic infiltration rates show that nearly all the topsoils and most of the subsoils are classified as "low" or "very low". The classification related to the "4 inches cumulative infiltration time" seems somewhat more distinctive and thus more appropriate for these particular soils.

Field Permeability

Introduction: Since the auger hole method requires the presence of a water table at shallow depth, it could only be carried out on two late draining silty clay soils during the dry season and four soils during the monsoon season.

The inversed auger hole method was carried out in unsaturated layers of most of the major soils of the area. Results from both methods are shown in Tables 29 and 30.

Discussion

The depth range figures refer, for the inversed auger hole method, to the level of the water at the beginning of the experiment and the bottom of the hole; for the auger hole method to the level of the water table and the bottom of the hole. The values of permeability are thus characteristics for the soil between these two limits.

The subsoil permeability values recorded during the dry season are all higher than the subsoil basic infiltration rates. This is not the case with the values recorded during the monsoon season for which the tendency is reversed. It appears once again that dry season cracks are widely interfering with the theoretical process particularly for Amjhupi and Ghior series whose permeability values are too high when compared to those for silt loams and silty clay loams.

Even if the dry season values for Amjhupi and Ghior series are neglected, the coefficient of linear correlation between subsoil permeabilities and subsoil basis infiltration rates is only found to be 0.50 for the dry season values

and 0.66 for the monsoon season values. Statistically, this values are not high enough to prove a correlation even at the 10% level of significance. Admitting that differences could be expected because the auger hole methods measure also horizontal permeability, while infiltration is essentially a vertical process, the results obtained by the inversed auger hole method are a little disappointing. However, the fact that a correlation can not be statistically proved does not mean that it does not exist. Rather than be abandoned, the method should be carried out on a larger scale than the rather limited number of soils tested during the present survey.

The permeability values in the substratum are high in light textured soils but not much different from the subsoil values for silt loams and silty clay loams. However, the correlation coefficient between the subsoil and substratum values is found to be 0.08. For the dry season values and 0.29 for the monsoon season values. There is thus no correlation and this is easy to understand as the transition between the subsoil and substratum involves a change in most of the major factors affecting permeability such as texture, structure, bulk density and porosity.

1.5 Laboratory Hydraulic Conductivity Data: constant head method

In the survey two samples were taken from the Ap2 horizon and subsoil layers of seven soil series. Specific and average conductivity values are given in Table 26.

Table 26
Hydraulic Conductivity Values (Constant Head Method)

Series	Texture	Core n°1	Core n°2	Average	Designation in USDA Classification
a) Ap^2 horizon values (inches/day)					
Mirpur	SiL	4.62	3.26	3.94	Slow
Gopalpur	SiCL	0.44	0.05	0.24	Very slow
Darsana	SiCL	0.09	0.15	0.12	Very slow
Ishurdi	SiC	0.07	1.98	1.02	Very slow
Amjhupi	SiC	0.11	0.29	0.20	Very slow
b) Subsoil values (inches/day)					
Ravna	SiL	3.65	2.39	3.02	Slow
Mirpur	SiL	9.30	13.84	11.57	Moderately slow
Patkelpota	SiL	1.57	1.76	1.67	Slow
Gopalpur	SiCL	0.09	5.55	2.82	Slow
Darsana	SiCL	0.05	0.09	0.07	Very slow
Ishurdi	SiC	0.12	0.12	0.12	Very slow
Amjhupi	SiC	0.13	0.86	0.50	Very slow

Discussion

There are sometimes wide differences between the values of 2 cores in the same horizon. The average values must therefore be regarded as approximate.

The fact that the values are all lower than those of the basic infiltration rates is not surprising since the former are not influenced by macrofeatures cracks or worm galleries which are intentionally avoided at sampling.

Although no significant correlation can be found between the hydraulic conductivity and infiltration rate (r-0.52), it is obvious that a considerable part of irrigation or rain water does not enter the soil peds. The weak correlation indicates that similar soil and water properties have different effects on those two kinds of percolation. This phenomenon is likely to decrease further the conveyance efficiency of dryland crop irrigation practices and should be further investigated.

The coefficient of linear correlation between the Ap2 values and the subsoil values is found to be 0.93 which is significant at the 5% level*. This result is not surprising as the distance between the Ap2 samples and the subsoil samples was barely more than one or two inches.

The small number of experiments did not allow to show any significant difference between the silt loam, silty clay loam and silty clay soils, but apart from one "moderately slow" value, all the others are classified "slow" or "very slow". Once again the need for further investigation will be our final conclusion.

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* If we admit 5 chances on 100 to be wrong in our statement.

Table 27A

Infiltration Data For Topsoils During Dry Season

Series	Texture	a Value (inches)	n Value	I cum after 24 hours (in)	I av. after 24 hours (in/h)	I inst after 1 min (in/h)	I inst after 24 hours (in/day)	t bas (minutes)	Basic infiltration rate (in/h)	(in/day)	Intake designation	t (4 inches) (hours)	Land designation
Momimpur	L*1	0.752	0.50	28.56	1.20	22.56	14.28	300	1.32	31.24	High	0.5	Marginal (too rapid)
Rayna	SiL	0.316	0.42	6.72	0.28	7.96	2.84	348	0.28	6.40	Low	7.0	Favourable
Palsey	SiL	0.120	0.575	7.84	0.32	4.16	4.52	255	0.40	9.44	Low	7.4	Favourable
Sira	SiL	0.192	0.46	5.44	0.24	5.28	2.52	324	0.24	5.60	Low	12.3	Somewhat unfavourable (slow)
Sara	SiL	0.544	0.41	10.72	0.44	13.40	4.40	354	0.44	10.08	Low	2.2	Favourable
Sara	SiL	0.256	0.655	30.00	1.24	10.08	19.64	207	1.60	38.36	High	1.1	Somewhat unfavourable (Rapid)
Mirpur	SiL	0.364	0.35	4.64	0.20	7.64	1.64	390	0.16	3.80	Low	15.7	Somewhat unfavourable (slow)
Mirpur	SiL	0.312	0.39	5.32	0.24	7.32	2.08	366	0.20	4.80	Low	11.6	Somewhat unfavourable (slow)
Mirpur	SiL	0.488	0.39	8.32	0.36	11.40	3.24	366	0.32	7.52	Low	3.7	Favourable
Patkelpota	SiL	0.600	0.21	3.56	0.16	7.56	0.60	474	0.04	1.40	Very low	139.7	Marginal (too slow)
Gopalpur	SiCL	0.252	0.39	6.80	0.28	5.88	1.68	366	0.16	3.84	Low	20.0	Marginal (too slow)
Gopalpur	SiCL	0.892	0.23	4.76	0.20	12.32	1.08	462	0.12	2.64	Low	11.0	Somewhat unfavourable (slow)
Darsana	SiL	0.528	0.245	3.12	0.12	7.76	0.76	453	0.08	1.84	Very low	64.8	Marginal (too slow)
Darsana	SiCL	-	-	-	-	-	-	-	0.20	4.80	Low	-	- *2
Darsana	SiCL	0.300	0.28	2.28	0.08	5.04	0.64	432	0.08	1.52	Very low	173.5	Marginal (too slow)
Baradi	SiCL	0.094	0.405	1.80	0.08	2.36	0.72	357	0.08	1.68	Very low	17.6	Somewhat unfavourable (slow)
Rasulpur	SiCL	0.108	0.61	8.72	0.36	3.96	5.56	234	0.40	9.16	Low	6.2	Favourable
Inhurdi	SiC	0.172	0.395	3.04	0.12	4.08	1.20	363	0.12	2.76	Low	46.0	Marginal (too slow)
Amjhupi	SiC	0.836	0.27	5.96	0.24	13.56	1.60	438	0.16	3.40	Low	5.5	Favourable
Garuri	SiC	0.076	0.575	4.96	0.20	2.64	2.84	255	0.24	5.96	Low	16.4	Somewhat unfavourable (slow)
Benapol	SiC	0.078	0.56	4.56	0.20	2.64	2.56	264	0.24	5.40	Low	18.9	Somewhat unfavourable (slow)
Benapol	SiC	0.520	0.41	10.32	0.44	12.80	4.20	354	0.40	9.60	Low	2.4	Favourable
Ghior	C	0.152	0.505	6.00	0.24	4.60	3.00	297	0.28	6.60	Low	10.8	Somewhat unfavourable (slow)
Batra	C	0.096	0.50	3.64	0.16	2.88	1.84	300	0.16	4.00	Low	28.8	Marginal (too slow)

*1 The subsoil is sandy loam

*2 Other data not reliable due to experimental problems

Table 27B

Infiltration Data For Subsoils During Dry Season

Series	Texture	a Value (inches)	n Value	I cum after 24 hours (in)	I av. after 24 hours (in/h)	I inst after 1 min (in/h)	I inst after 24 hours (in/day)	t bas (minutes)	Basic infiltration rate (in/h)	(in/day)	Intake designation	t (4 inches (hours)	Land designation
Mominpur	SL	0.288	0.89	186.36	7.76	15.36	165.72	66	12.52	300.08	Very high	0.3	Marginal (too rapid
Rayna	SiL	0.176	0.56	10.36	0.44	5.92	5.84	264	0.52	12.20	Low	4.7	Favourable
Paksey	SiL	0.116	0.44	2.84	0.12	3.08	1.24	336	0.12	2.84	Low	52.0	Marginal (too slow
Sara	SiL	0.216	0.52	9.84	0.40	6.80	4.80	285	0.44	10.36	Low	4.3	Favourable
Sara	SiL	0.124	0.85	60.16	2.52	6.32	50.80	90	3.20	77.20	Very high	1.0	Marginal (too rapid)
Mirpur	SiL	0.074	0.78	21.52	0.88	3.48	16.80	132	1.20	28.40	High	2.8	Favourable
Mirpur	SiL	0.172	0.56	11.68	0.48	6.00	6.76	252	0.60	14.08	Low	3.2	Favourable
Mirpur	SiL	0.156	0.53	7.64	0.32	5.04	4.08	279	0.36	8.76	Low	7.2	Favourable
Patkelpota	SiL	0.070	0.55	3.84	0.16	2.32	2.12	270	0.20	4.48	Low	26.1	Marginal (too slow)
Gopalpur	SiCL	0.023	0.78	6.76	0.28	1.08	4.88	136	0.36	8.84	Low	12.3	Somewhat unfavourable (slow)
Darsana	SiCL*	0.080	0.67	10.44	0.44	3.20	7.00	198	0.56	13.48	Low	5.7	Favourable
Darsana	SiCL	0.304	0.32	3.12	0.12	5.84	1.00	408	0.08	2.36	Very low	52.4	Marginal (too slow)
Darsana	SiCL	0.034	0.67	4.48	0.20	1.40	3.00	196	0.24	5.80	Low	20.2	Marginal (too slow)
Baradi	SiCL	0.084	0.58	5.72	0.24	2.92	3.32	252	0.28	6.88	Low	13.0	Somewhat unfavourable (slow)
Rasulpur	SiCL	0.146	0.68	20.52	0.84	5.60	13.96	192	1.12	26.60	Low	2.2	Favourable
Amjhupi	SiC	0.220	0.33	2.64	0.12	4.36	0.80	402	0.08	1.88	Very low	109.4	Marginal (too slow)
Amjhupi	SiC	0.200	0.27	1.48	0.08	3.32	0.40	435	0.04	0.96	Very low	896.8	Marginal (too slow)
Garuri	SiC	0.040	0.87	22.40	0.92	2.08	19.48	78	1.20	28.44	High	3.3	Favourable
Benapol	SiC	0.044	0.58	3.00	0.12	1.52	1.72	252	0.16	3.60	Low	39.7	Marginal (too slow)
Benapol	SiC	0.088	0.78	26.52	1.08	4.16	20.84	129	1.44	35.00	High	8.2	Favourable

* Very close to SiL

Table 28A
Infiltration Data for Topsoils During Monsoon Season

Series	Texture	a Value (inches)	n Value	I cum after 24 hours (in)	I av. after 24 hours (in/h)	I inst after 24 1 min (in/h)	I inst after 24 hours (in/day)	t bas (minutes)	Basic infiltration rate (in/h)	(in/day)	Intake designation	t (4 inches) (hours)	Land designation
Sara	SiL	0.011	0.760	2.82	0.12	0.51	2.14	144	0.20	4.87	Low	38.1	Marginal (too slow)
Mirpur	SiL	0.042	0.800	14.12	0.59	2.02	11.30	120	0.77	18.56	Medium	5.0	Favourable
Darsana	SiCL	0.040	0.735	8.38	0.35	1.76	6.16	159	0.46	11.05	Low	8.8	Somewhat unfavourable (slow)
Baradi	SiCL	0.032	0.580	2.20	0.09	1.13	1.28	252	0.11	2.65	Low	67.3	Marginal (too slow)
Ishurdi	SiCL	0.020	0.765	5.22	0.22	0.92	3.99	141	0.29	6.87	Low	17.0	Somewhat unfavourable (slow)
Amjhupi	SiCL	0.024	0.732	4.84	0.20	1.04	3.54	161	0.26	6.37	Low	18.5	Somewhat unfavourable (slow)
Ganqni	SiC	0.018	0.507	0.72	0.03	0.55	0.36	296	0.03	0.80	Very low	709.0	Marginal (too slow)
Batra	C	0.062	0.400	1.14	0.05	1.49	0.46	360	0.04	1.04	Very low	557.4	Marginal (too slow)

Table 28B

Infiltration Data for Subsoils During Monsoon Season

Series	Texture	a Value (inches)	n Value	I cum after 24 hours (in)	I av. after 24 hours (in)	I inst after 1 min (in/h)	I inst after 24 hours (in/day)	t bas (minutes)	Basic infiltration rate (in/h)	(in/day)	Intake designation	t (4 inches) (hours)	Land designation
Sara	SiL	0.21	0.760	52.30	2.18	9.48	39.74	144	2.88	69.01	Very high	0.8	Marginal (too rapid)
Mirpur	SiL	0.06	0.940	53.57	2.48	3.61	56.00	36	2.91	69.87	Very high	1.4	Somewhat unfavourable (rapid)
Darsana	SiCL	0.14	0.825	56.52	2.36	6.93	46.62	105	3.07	73.66	Very high	1.0	Marginal (too rapid)
Baradi	SiCL	0.06	0.765	15.23	0.64	2.68	11.65	141	0.84	20.10	Medium	4.2	Favourable
Ishurdi	SiC	0.14	0.580	9.24	0.38	4.73	5.36	252	0.46	11.14	Low	5.7	Favourable
Amjhupi	SiC	0.02	0.880	10.35	0.44	0.91	9.11	72	0.54	13.04	Low	8.1	Somewhat unfavourable (slow)
Ganqni	C	0.01	0.840	3.42	0.14	0.38	2.87	96	0.18	4.43	Low	28.9	Marginal (too slow)
Batra	C	0.03	0.595	2.64	0.11	1.24	1.57	243	0.14	3.22	Low	49.0	Marginal (too slow)

Table 29

Field Permeability Data During Dry Season

Series	Texture	Depth (inches)	Permeability in / h	Permeability in/day	Designation in USDA Classification
a) Auger hole method					
Garuri	SiC	16-80	0.03	0.8	Very slow
Benapol	SiC	30-66	1.50	36.0	Moderate
b) Inversed auger hole method, subsoil data					
Rayna	SiL	6-12	1.96	47.0	Moderate
Paksey	SiL	6-13	0.88	21.1	Moderate
Sara	SiL	8-14	2.24	53.3	Moderate
Patkelnota	SiL	7-15	2.12	50.9	Moderate
Gopalpur	SiCL	10-18	0.72	16.8	Moderately slow
Darsana	SiCL	7-15	1.08	25.9	Moderate
Ishurdi	SiC	7-15	1.00	23.7	Moderate
Amjhupi	SiC	11-16	3.44	82.7	Moderately rapid
Ghior	C	8-14	4.20	102.7	Moderately rapid
c) Inversed auger hole method, substratum data					
Darsana	SL	18-28	6.24	149.6	Rapid
Patkelnota	FSL	21-30	1.68	39.8	Moderate
Paksey	Si	32-40	4.72	113.3	Moderately rapid
Rayna	SiL	38-44	2.84	67.7	Moderately rapid
Sara	SiL	22-31	1.36	32.6	Moderate
Gopalpur	SiL	25-33	1.12	26.9	Moderate
Ishurdi	SiL	28-38	0.84	19.7	Moderate
Amjhupi	SiL	29-37	0.44	10.1	Moderately slow
Darsana	SiCL	32-42	0.48	11.8	Moderately slow
Ghior	SiCL	19-29	1.60	38.4	Moderate

Table 30

Field Permeability Data During Monsoon Season

Series	Texture	Depth (inches)	Permeability in/h	Permeability in/day	Designation in USDA Classification
a) Auger hole method					
Darsana	SiL/FSL	28-76	2.17	52.00	Moderate
Baradi	SiL/FSL	24-88	1.50	35.88	Moderate
Batra	SiCL/SiL	26-74	0.34	8.06	Moderately slow
Ganani	C/SIC SICL/SiL	6-48	0.68	16.34	Moderately slow
b) Inversed auger hole method, subsoil data					
Sara	SiL	8-16	0.84	20.16	Moderate
Mirpur	SiL	6-14	2.82	67.68	Moderately rapid
Darsana	SiCL	8-16	1.36	32.57	Moderate
Baradi	SiCL	6-16	0.34	8.16	Moderately slow
Ishurdi	SiC	6-12	1.32	31.78	Moderate
Amjhupi	SiC	4-12	0.26	6.13	Moderately slow
Batra	C	6-14	0.17	4.15	Slow
c) Inversed auger hole method, substratum data					
Sara	SiL	28-40	0.36	8.74	Moderately slow
Mirpur	SiCL	30-40	2.84	68.30	Moderately rapid
Ishurdi	FSL	30-38	12.58	301.88	Very rapid
Amjhupi	FSL	30-40	1.64	39.50	Moderate
Amjhupi	SiL	30-40	0.24	5.76	Moderately slow

A5. AGRO-CLIMATIC DATA

A5.1 General Climatic Data

Station	Item		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Jessore	(a) Mean monthly maximum and minimum temperature and diurnal range (oF)														
		Max.	77.9	85.1	92.5	96.6	95.4	91.2	88.5	88.9	89.8	88.5	83.8	79.5	
		Min.	50.9	58.9	65.7	73.8	76.8	78.0	78.3	78.3	77.7	73.2	61.9	52.7	
		Mean	64.4	69.5	79.1	85.2	86.1	84.6	83.4	83.6	83.8	80.9	72.9	66.1	78.3
		Range	27.0	26.2	26.8	22.9	18.6	13.2	10.2	10.6	12.1	15.3	21.9	26.8	
Jessore	(b) Extreme monthly maximum and minimum temperature (oF)														
		Max.	90.0	96.1	100.0	109.0	108.0	105.1	96.1	99.0	98.1	99.0	95.0	87.1	
		Min.	36.0	37.9	46.9	57.0	64.0	70.0	70.0	72.0	72.0	57.9	44.1	39.9	
Jessore	(c) Relative humidity (%) at 9 A.M. and 6 P.M.														
		9 A.M.	74	77	72	75	79	85	86	88	87	84	80	82	
		6 P.M.	67	59	52	57	71	82	86	87	86	83	74	74	
		Mean	74	68	62	66	75	84	86	88	87	84	77	78	
Jessore	(d) Variability of the mean monthly and annual evaporation (inches)		0.4	0.4	0.7	1.2	1.3	0.9	0.6	1.0	0.5	0.4	0.5	0.3	8.2
	(e) Variability of the mean monthly and annual rainfall														
Jessore			0.5	1.0	1.6	2.5	2.8	3.7	3.0	3.6	3.1	3.1	0.7	0.3	9.4
Magura			0.5	0.9	1.4	7.7	3.1	4.3	4.9	3.2	3.3	2.4	2.8	0.3	11.3

A5.2 Dispersion of monthly and annual rainfall

Series	Item		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
	(a) Standard deviation (σ) coefficient of variation (cv) of monthly and annual rainfall:														
Jhenida	σ (inches)		0.7	1.3	2.1	3.1	4.1	4.6	3.8	4.8	4.1	3.8	1.0	0.6	11.7
	CV (%)		175	130	95	84	57	39	35	42	45	75	67	300	18
Magura	σ (inches)		0.6	1.1	1.8	3.3	4.3	5.7	6.5	4.1	4.2	3.3	1.3	0.5	15.3
	CV (%)		150	122	95	72	51	48	51	37	45	72	163	250	23
Jhenida	(b) Mean monthly and annual rainfall dispersion (inches)														
	Parameter:	Mn:	0.0	0.0	0.0	0.0	2.3	4.8	3.9	4.1	1.7	0.0	0.0	0.0	26.8
		LQ:	0.0	0.0	0.1	1.1	4.0	8.3	8.1	7.9	6.3	2.2	0.0	0.0	53.6
		Md:	0.1	0.4	1.5	2.8	6.4	11.2	10.9	10.3	8.2	3.8	0.2	0.0	55.7
		UQ:	0.6	1.6	2.8	5.8	8.9	13.9	12.9	13.7	10.4	7.2	1.0	0.0	71.3
		MX	3.2	5.4	7.3	11.5	27.5	23.1	20.3	31.4	18.7	15.9	3.5	3.6	85.6
Magura		Mn:	0.0	0.0	0.0	0.0	2.3	2.7	5.5	4.0	3.8	0.1	0.0	0.0	35.9
		LQ:	0.0	0.0	0.4	1.8	5.6	8.2	7.7	8.4	6.3	2.6	0.0	0.0	54.2
		MQ:	0.1	0.4	1.5	4.3	7.6	10.8	11.2	10.5	8.5	3.8	0.3	0.0	58.8
		UQ:	0.8	1.7	3.0	6.8	10.2	15.4	15.5	13.4	11.9	5.5	1.2	0.0	72.1
		MX	2.4	4.5	7.4	15.7	24.4	33.5	35.8	22.5	20.8	13.8	7.4	2.8	115.1

A5.3 Probability of Rainfall Exceeding Specified Amounts in any Month at Jhenida

Rainfall (inches	Probability (%)											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.4	28	50	70	92	100	100	100	100	100	98	39	10
1.0	15	32	58	79	100	100	100	100	100	96	26	6
2.0	3	23	36	57	100	100	100	100	98	83	11	2
3.0	1	11	20	48	96	100	100	100	96	60	5	2
4.0		1	16	37	79	100	98	100	92	49		
5.0		1	14	29	71	98	96	96	88	37		
6.0				22	58	90	90	92	81	33		
8.0					32	77	79	77	60	16		
10.0					18	61	59	54	33	15		
12.0						48	40	43	18	9		
16.0						20	12	15	9	1		
20.0						9	1	3				
24.0								1				

A5.4 Probability of Rainfall Exceeding Specified Amounts in any Month at Magura

Rainfall (inches)	Probability (%)											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.4	38	52	78	90	100	100	100	100	100	98	48	9
1.0	16	34	62	85	100	100	100	100	100	92	29	3
2.0	1	20	41	75	100	100	100	100	100	80	12	1
3.0		5	25	67	96	98	100	100	100	63	5	
4.0		1	14	55	89	96	100	100	98	49	1	
5.0				39	77	94	100	94	83	36	1	
6.0				34	71	89	94	91	78	23	1	
8.0					45	79	74	81	53	12		
10.0					28	60	62	61	37	9		
12.0						44	42	37	25	5		
16.0						24	23	15	7			
20.0						10	13	5	5			
24.0							5					

Glossary

Acid soil	A soil that gives an acid reaction (below pH 6.6)
Alkaline soil	Any soil that is alkaline in reaction (above pH 7.3)
Alluvium	Mineral materials (sand, silt and clay) that have been deposited by flowing water, such as streams or rivers.
Aman	Rice varieties grown in the monsoon season and harvested in November-December. Deepwater aman is mainly soon in March-April in basin sites and is normally known as broadcast aman. It can stand deep flooding if the rise of floodwater is not too rapid. It is also locally transplanted in the depressed sites in early July. Transplanted aman is sown in nursery beds and the seedlings transplanted in flooded fields in June-August.
Aus	Rice varieties grown in the pre-and early monsoon season, usually sown in March-April and harvested in June-July. Aus varieties do not need to be grown in flooded fields, although they will withstand flooding. Most of the crop is sown broadcast, but transplanted aus is grown either by irrigation water or by rainwater if sufficient rain occurs in March-April.
Basin	The lowest part of a floodplain landscape, usually saucer shaped.
Boro	Rice varieties growing in the dry season, usually with the help of irrigation. Boro varieties are sown in nursery beds and transplanted to flooded fields in January, to be harvested in April-May.
Calcareous soil	A soil that gives effervesence with dil. HCL acid (N/10 HCl in the field).
Clay	Mineral particles less than 0.002 millimeters (1/10,000th of an inch) in diameter. A clay soil: in which the clay content is higher than 40 percent.
Clod	An artificially formed soil mass.
Compact	Difficult to penetrate with a knife or spade when wet, moist or dry.
Compost	Organic residues or a mixture of organic residues and soil which have been piled, moistened and allowed to undergo biological decomposition.
Double crop	Two successive crops grown in a year.
Drainage	The removal of water from the soil or land, either naturally or by artificial means (e.g. by ditches or pumps). The terms used to describe natural soil drainage in this report are described below:

Moderately well drained condition refers to soils which seldom have any drainage impedence within the solum but may have seasonal high water table within 50 inches of the surface. The subsoils are usually brown and free from grey mottles in the upper part. After each heavy rainfall their topsoils may remain wet for a short while.

Imperfectly drained condition refers to soils which are periodically wet or intermittently flooded by rainwater for less than a foot for a few hours to less than 2 weeks at a time (where rainwater kept by low field bunds especially for transplanted aman, the duration of flooding above the field bunds should not exceed 3 days).

Poorly drained soils refers to continuous flooding for more than 2 weeks (within the low bunds of transplanted aman fields), but for less than 8 months per year.

Very poorly drained soils remain flooded for more than 8 months a year and wet for most of the dry season.

Droughty(ness) — A condition in which there is insufficient moisture in the soil for proper plant growth.

Dryland crop — A crop requiring good soil drainage at the time of the year when it is normally grown. Perennial dryland crops (such as sugarcane and bananas) require good soil drainage throughout the year for satisfactory growth. Annual dryland crops, such as maize may be grown either in the monsoon season on moderately well drained soils that remain dry during the growing season; others, such as wheat, can be grown only in the dry season and on land that does not remain wet during its normal growing period.

Fallow — Cultivated land left without a crop during one or more growing seasons.

Fertilizer — Any organic or inorganic material of natural or synthetic origin which is added to a soil in an attempt to provide plant nutrients.

Flood coating — Illuvial material (of clay, silt and humus) on the surfaces of subsoil peds and pores in seasonally flooded soils.

Floodplain — Land made by deposition of riverain or tidal alluvium and may be subject to periodic flooding.

General soil type — A rather nontechnical grouping of the soils of Bangladesh for the popular use. Each type includes a group of soils formed in the same way and have broadly similar properties.

Highland — Land lying above normal flood level.

HYV	High yielding variety.
Infilled channel	A channel that has been cut-off from the main river and filled up by the sediments.
Kharif	Term applied to crops grown in the wet (monsoon) season.
Landscape	The overall surface of a tract of land. For example, floodplain landscape normally includes both ridges and basins.
LIV	Local improved variety
Medium highland	Land that is flooded upto 3 feet deep during the monsoon season.
Medium lowland	Land that is flooded upto 3-6 feet deep in the monsoon season.
Mottled	Patches of different colours occurring side by side in the soil.
Ped	A natural soil structural unit.
Perennial crops	Crops which thrive for more than two successive growing seasons (e.g. sugarcane, bananas, fruit trees, etc.)
Permeable	Allowing air or water to pass through.
Permeability	The rate of movement of water and air through the soil. The term used to describe soil permeability in this report are defined below: Very slow permeability: rate of movement of water through the soil 3 cm per day. Slow permeability: rate of movement of water through the soil between 3-12 cm per day. Moderately slow permeability: rate of movement of water through the soil between 12-49 cm per day. Moderate permeability: rate of movement of water through the soil between 49-152 cm per day. Moderately rapid permeability: rate of movement of water through the soil between 152-305 cm per day. Rapid permeability: rate of movement of water through the soil between 305-610 cm per day.
Ploughpan	A compact layer, usually about 2-3 inches thick, occurring immediately below the cultivated layer in some soils. It is formed by repeated pressure from the plough during ploughing of the moist or wet soil.

Rabi crops	The crops grown and maturing in the dry season. Early rabi crops that sown in September-October. Late rabi crops that sown in November-February.
Reaction	A term referring to the degree of soil acidity or alkalinity. It is measured by laboratory or field chemical tests in terms of what is called pH.
Ridge	The term used for the relatively higher part of floodplain landscapes. Ridges or levees, developed by the deposition of sediments during high floods, form the natural banks of a river.
Sand	Mineral particles between 0.05-2 millimeters (roughly 1/500th to 1/10th of an inch) in diameter. Sandy soils contain more than about 70 percent of sand.
Silt	Mineral particles intermediate in size between clay and sand (i.e. 0.002-0.005 millimetres or about 1/10,000th to 1/500th of an inch). Silty soils generally contain more than 50 percent of silt. Silt as a soil textural class contains more than 80 percent silt.
Single crop	Only one crop grown in a year.
Soil association	This is a group of two or more soils regularly occurring together in the landscape, usually related to each other by topography. These are mappable.
Soil complex	When a pattern is so intricate that the soils change at intervals of less than about 100 yards, then it is termed as soil complex. These are also mappable.
Soil phase	A subdividion of soil series/type, usually based on important factors of practical significance such as erosion, slope, depth of flooding, etc.
Soil series	A soil series represents a group of soils developed in similar parent material resembling each other closely in their main properties such as colour, texture, structure, reaction, etc.
Soil structure	The arrangement of individual soil particles and their aggregates into certain defined patterns (or shapes).
Soil type	It is subdivision of series based on the texture of the surface soil.
Soil variant	When a soil differs from the established series in some of series differentiating criteria, such as drainage, reaction or presence of soluble salts or free lime in the topsoil or subsoil then it is termed as soil variant.

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