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Report on
Detailed Soil Survey of IRIL Watershed Jhum Control Pilot Project, Unit No. II
P. S. Ukhral, District - East, Manipur State

Regional Centre
Calcutta

National Bureau of Soil Survey & Land Use Planning
Indian Council of Agricultural Research
NAGPUR - 440006

FINAL REPORT ON DETAILED SOIL SURVEY OF IRIL WATERSHED JHUM CONTROL PILOT PROJECT, UNIT NO.II P.S. UKHRAL, DISTRICT - EAST, MANIPUR STATE.

Regional Centre, Calcutta.

NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING
(INDIAN COUNCIL OF AGRICULAURAL RESEARCH)

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C O N T E N T S :

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Draft Report on Iril Water-shed Jhum Control Pilot Project, Unit No.II, P.S. Ukhral, District - East, Manipur.

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1.. INTRODUCTION :

Soil survey of N.E.C. Project areas in Iril watershed in Manipur State was carried out at the request of the Director of Agriculture, Manipur State, received through the North Eastern Council by National Bureau of Soil Survey and Land Use Planning (I.C.A.R.), Regional Centre, Calcutta during 1976-77. The N.E.C. 'Jhum control scheme' envisages settlement of Jhumias for permanent cultivation instead of shifting cultivation being practised by local inhabitants. The survey aims at the study of soils, terrain condition, hazards, problems and potentialities along with other land features to prepare a plan for integrated development programme for the watershed.

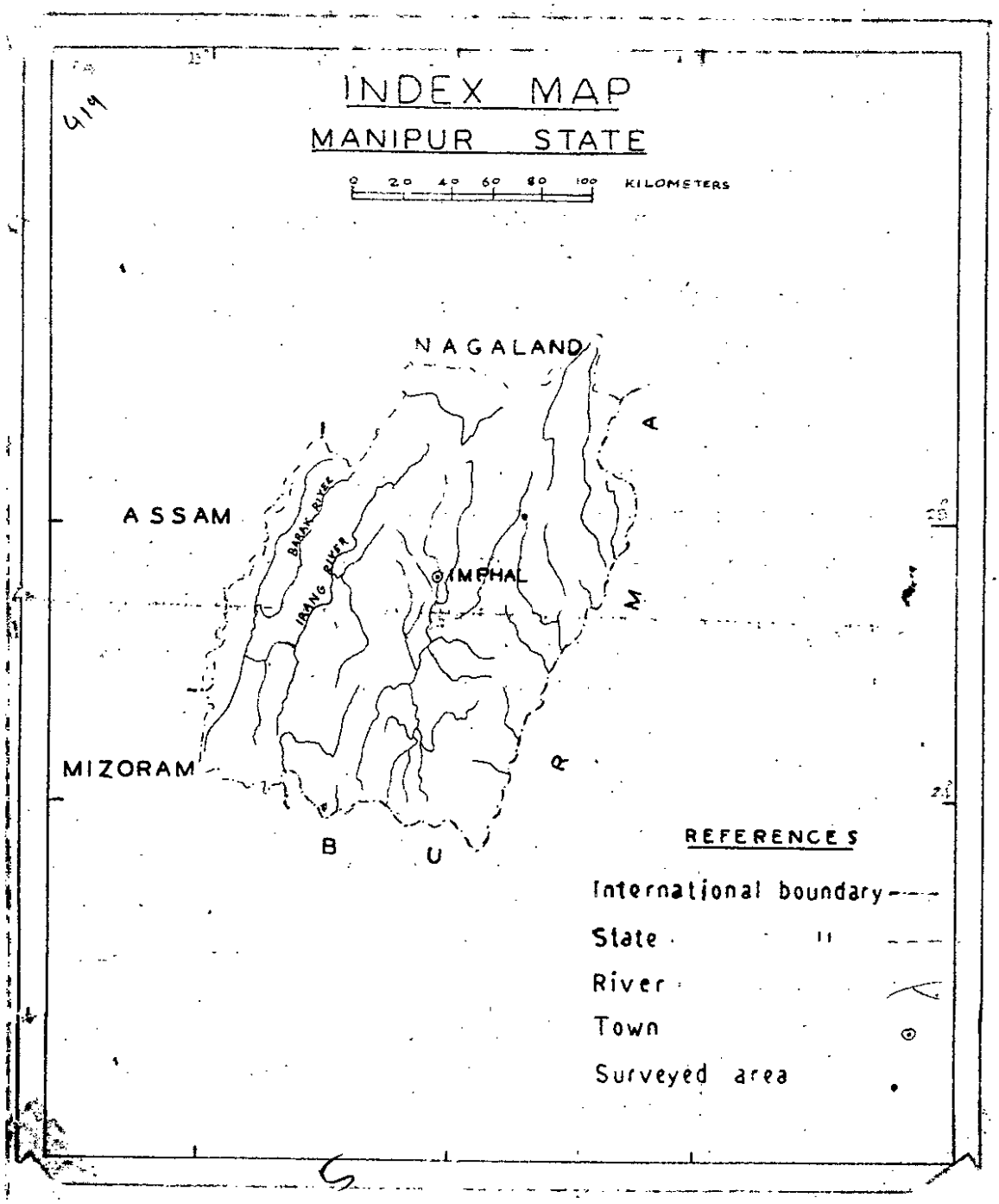
2.. DESCRIPTION OF THE AREA :

2.1 Location and Extent :

The surveyed area is located in Ukhral police station, East District of Manipur State and lies in between north latitudes 25°10' and 25°15' and east longitudes 94°10' and 94°15'. The project area comprises villages Phungther, Tingsong and Changda with the hamlet having an area of 196 ha. The villages are located both on the left and right sides of the Iril river on the hill tops.

2.2 Physiography, relief and drainage :

The physiography is hilly and highly undulating and dissected by narrow to medium gently sloping to nearly level valleys. The altitude is about 900 m. above M.S.L.


INDEX MAP
MANIPUR STATE
0 20 40 60 80 100 KILOMETERS
NAGALAND
ASSAM
BARAK RIVER
IRANG RIVER
IMPHAL
MIZORAM
REFERENCES
International boundary
State "
River
Town
Surveyed area

The region is drained by the river Iril which flows from north to south follows a meandering course along with its tributaries through the intermontane valleys. Terraces are observed on both sides of the river.

2.3 Geology :

The geology consists of Argillacious sandstones and shales of Tertiary period. The sandstones are soft, gray to brownish in colour with sand, gravel, pebbles cemented by ferruginous material.

2.4 Climate :

The climate is humid tropical. The mean maximum and minimum temperatures are 26.5°C and 14.4°C respectively. The average annual rainfall is about 1350 mm. Humidity ranges from 55 to 80 percent (Appendix-III). Monsoon generally breaks by the middle of May. The mean winter and mean summer temperatures are 13.5°C and 24.8°C respectively. The temperature regime may be classified as "Thermic".

2.5 Natural vegetation :

The hills are covered with medium to thick tropical deciduous and ever green forests. Bamboo forests are found everywhere which exhibit a better growth in lowlying areas. Sal (Sorea robusta) and Teak trees are common. Apart from these Mesua ferrea, Carea arbotrea, Ficus electica, etc. are also found. After jhuming the abandoned lands are under bushes and tall grasses with thin jungle of medium canopy.

3.. SOCIO-ECONOMIC CONDITION :

The population of this district is about 62229 which represents 6% of the total population of Manipur State.

The density of the population per sq. km. is 10 only. The tribal population of the district belongs to Rihang Naga and Tankhul Naga. Due to isolation from outside world, the development of the region has long been handicapped. Each village has at least a lower middle school. No railway facilities exist at present. The road transport is the only means of communication which is very inadequate. The Ukhral police station of East district is connected with Imphal, the capital of the State, by road transport.

4.. AGRICULTURE AND PRESENT LAND USE :

4.1 Agriculture :

Agriculture, though of primitive type is the main means of livelihood of the tribal communities in the region. Hill slopes and valley lands are utilised for agriculture in which paddy is the chief crop. In the strongly sloping lands and in the upland position, Jhum cultivation is practised. The cultivators are not familiar with modern methods of cultivation and technology and lack experience in applying manures and fertilizers. Instead, they apply only cowdung as manure and till the soil by spade. Buffalos are used as draught animals.

Recently they are growing few cash crops like sugarcane, chillies, pulses and mustard on the hill slopes. Local varieties of wild ginger and sweet potatoes are grown without following proper cultural operations.

4.2 Land use :

The lands on hill tops and upper slopes are covered with dense forests. Middle hill slopes are under jhum cultivation and terraced paddy cultivation with mixed crops like arum, oil-seeds, etc. and foot hills and valley lands are under wet paddy cultivation. At places, citrus fruit trees are planted.

5.. S O I L S :

5.1 Soil survey procedure and technique :

The soil survey of the area was carried out according to the procedure outlined in the soil survey manual of the All India Soil and Land Use Survey Organisation, (I.A.R.I., New Delhi). The base map used was in the scale of 16"=1 mile supplied by the State Agricultural Department, Manipur. The area was traversed and profiles were examined in different physiographic units. Mapping unit boundaries were delineated on the basis of auger bores. Soil samples from different horizons of representative soil profiles were collected for laboratory analysis and characterisation.

The soils of the surveyed area are mainly grouped into three categories (1) Soils occurring on hill slopes of medium hills - top and lower slopes (2) Soils of piedmont areas - upper and lower piedmonts (3) Soils on river terraces, (4) Soils in the valleys, (5) Soils of flood plains and (6) Soils of slip off slopes. Soils on hill slopes have developed in situ on shales and sandstones. The piedmont river terraces and valley land soils have developed on mixed colluvial and alluvial materials transported from the adjacent hill slopes. Soils of the flood plains and slip off slopes are developed on alluvial deposits. Twelve soil series have tentatively been described and mapped. Brief descriptions of each soil series are given below. The pedon descriptions of each soil series are given in Appendix-I.

5.2 Brief descriptions of Soil Series :

Pengrum Series (P) :

Comprises well drained, deep, dark grayish brown soils occurring on strongly sloping top slopes of medium hills. The texture of the surface soil varies from loam to silty clay loam and

subsoil is silty clay. The soils are moderately to severely eroded and are under Jhum cultivation, thin forest or shrubs (Ultic Hapludalfs).

Pengrumkong Series (Pk) :

Comprises well drained, deep, very dark grayish brown soils occurring on moderately to strongly sloping lower slopes of medium hills. The texture of the surface soil varies from loam to silt loam and subsoil is gravelly clay loam to gravelly silty clay loam. The soils are moderately eroded and are mostly under Jhum cultivation or waste lands (Ultic Hapludalfs).

Tingsong Series (T) :

Comprises well drained, moderately deep, dark grayish brown soils occurring on upper piedmont slopes. The texture of surface soil varies from silt loam to silty clay or clay and subsoil is gravelly silty clay loam. The soils are slightly to moderately eroded and are mostly under terraced paddy cultivation surrounded by thin forests (Typic Haplaquepts).

Hondran Series (H) :

Comprises well drained, very deep, dark grayish brown soils occurring on very gently to gently sloping lower piedmont slopes. The texture of the surface soil varies from loam, silt loam to silty clay loam and subsoil is silty clay to clay. The soils are moderately eroded and are partly waste land with grass cover and partly under cultivation (Ultic Hapludalfs).

Kaipo Series (K) :

Comprises imperfectly drained, very deep, dark grayish brown soils occurring on very gently sloping to gently sloping river terraces. The texture of the surface soil varies from silty

clay loam to clay and the subsoil is silty clay loam to silty clay. The soils are slightly eroded and are under intensive paddy cultivation (Typic Ochraqualfs).

Maringkong (MR) :

Comprises poorly drained, very deep, dark grayish brown soils occurring on very gently to gently sloping river terraces. The texture of the surface soil varies from silty clay loam to silty clay and subsoil is silty clay loam having prominent mottles in subsoil horizon. The soils are slightly eroded and mostly under paddy cultivation (Typic Haplaquepts).

Iril Series (I) :

Comprises well drained, very deep, dark gray soils occurring on nearly level to gently sloping flood plains. The texture of the surface soil varies from loam, silt loam to silty clay loam and subsoil is sandy loam. The soil profiles reveal stratification and lithological discontinuity. The soils are slightly eroded and mainly under paddy cultivation (Typic Udifluvents).

Shamu-lam-jao Series (S) :

Comprises imperfectly drained, very deep, dark gray soils occurring on very gently sloping to gently sloping flood plains. The texture of the surface soil varies from sandy clay loam to silty clay loam followed by anisotropic layers of coarse and moderately fine textured subsoils. The soils are slightly eroded and partly under paddy cultivation and partly left fallow (Aquic Udifluvents).

Masengkong Series (M) :

Comprises imperfectly drained, deep, dark brown soils occurring on gently sloping valleys. The texture of the surface

soil is silty clay loam and subsoil is also silty clay loam underlain by layer of rounded pebbles below 51 cm. depth. The soils are slightly eroded and under paddy cultivation (Typic Haplaquepts).

Chowri Series (C) :

Comprises poorly drained, very deep very dark gray to black soils occurring on nearly level valley lands. The texture of the surface soil is silty clay loam followed by silty clay subsoil. The soils are slightly eroded and are under paddy cultivation (Typic Haplaquepts).

Wagshang Series (W) :

Comprises well drained, shallow, dark gray soils occurring on very gently to moderately sloping lands in upper valleys. The texture of the surface soil varies from silty clay loam to clay loam or clay followed by unconsolidated weathered sandstone. The soils are moderately to severely eroded and mostly under waste land (Lithic Ustorthents).

Lilok Series (L) :

Comprises well drained, moderately deep, brown soils occurring on gently sloping slip off slopes of the river Iril. The texture of the surface soil is loam and subsoil is loamy sand to sand. The soils are moderately eroded and partly under waste lands and partly under cultivation (Lithic Udipsamments).

6.. MAPPING UNITS :

The soil map contains mapping units with land capability classes and subclasses. Each mapping unit is described in relation to the physiographical units. Mapping is done at the phase level. Each soil unit is described by symbols, viz. PeE2,

where P indicates the soil series, e the type (surface soil texture), E the slope class (10-15%) and 2 erosion which is moderate.

Geomorphic unit.	Soil series.	Mapping unit.	Description.	Present land use.	Land capability class and subclass.	Area (ha.)	Percentage.
1.	2.	3.	4.	5.	6.	7.	8.
Medium hill :							
Top slopes.	Pengrum:	P	Deep, well drained, dominantly fine clayey in control section (25-69 cm.) on E(10-15%) slopes, moderately to severely eroded.				
		PeE3	Same as above with loamy surface on E(10-15%) slopes, severely eroded.	J,F_1	IVe	28.3	14.4
		PjE2	Same as above with silty clay loam surface on E(10-15%) slopes, moderately eroded.	J,F_1, T.	IIIe	17.8	9.0
Lower slopes.	Pengrum-kong.	PK	Deep, well drained, dominantly loamy skeletal in control section (25-56 cm.) on D(5-10%) and E(10-15%) slopes, moderately eroded.				
		PKfD2	Same as above with silt loam surface on D(5-10%) slopes, moderately eroded.	J	IIIe	1.2	0.6

1.	2.	3.	4.	5.	6.	7.	8.
		PKeE2	Same as above with loamy surface on E(10-15%) slopes, moderately eroded.	J,W_1	IIIe	13.3	6.8
Upper piedmont.	Tingsong:	T	Moderately deep, well drained, clayey skeletal in control section (0-30 cm.) on B(1-3%), C(3-5%) and D(5-10%) slopes, slightly to moderately eroded.				
		TjD2	Same as above with gravelly silty clay loam surface on D(5-10%) slopes, moderately eroded.	C_1,F_1	IIIes	3.7	1.9
		TfD2	Same as above with silt loam surface on D(5-10%) slopes, moderately eroded.	C_1,F_1	IIIes	3.6	1.8
		TfB1	Same as above with silt loam surface on B(1-3%) slopes, slightly eroded.	C_1	IIIs	1.0	0.5
		TfC2	Same as above with silt loam surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes	0.4	0.2
		TlD2	Same as above with silty clay surface on D(5-10%) slopes, moderately eroded.	C_1,F_1	IIIes	0.5	0.2

1.	2.	3.	4.	5.	6.	7.	8.
		TlC2	Same as above with silty clay surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes	2.2	1.1
		TjC2	Same as above with silty clay loam surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes	6.4	3.3
		TmB1	Same as above with clay surface on B(1-3%) slopes, slightly eroded.	C_1	IIIs	1.5	0.8
Lower piedmont.	Hondran:	H	Very deep, well drained, fine clayey in control section (25-100 cm.) on B(1-3%) and C(3-5%) slopes, moderately eroded.				
		HfB2	Same as above with silt loam surface on B(1-3%) slopes, moderately eroded.	W_1,C_1	IIIe	2.5	1.3
		HeC2	Same as above with loamy surface on C(3-5%) slopes, moderately eroded.	W_1,C_1	IIIe	6.4	3.3
		HjC2	Same as above with silty clay loam surface on C(3-5%) slopes, moderately eroded.	W_1,C_1	IIIe	1.7	0.9
		HfC2	Same as above with silt loam surface	W_1,C_1	IIIe	2.9	1.5

1.	2.	3.	4.	5.	6.	7.	8.
			on C(3-5%) slopes, moderately eroded.				
		HjB2	Same as above with silty clay loam surface on B(1-3%) slopes, moderately eroded.	W_1,C_1	IIIe	2.0	1.0
River terrace.	Kaipo:	K	Very deep, imperfectly drained, dominantly fine clayey in control section (25-100 cm.) on B(1-3%) to C(3-5%) slopes, slightly eroded.				
		KjB1	Same as above with silty clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	4.9	2.5
		KmB1	Same as above with clay surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	2.9	1.5
		KjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIw	9.4	4.8
River terrace.	Maring-kong:	MR	Very deep, poorly drained, dominantly fine clayey in control section (25-100 cm.) on B(1-3%) to C(3-5%) slopes, slightly eroded.				

1.	2.	3.	4.	5.	6.	7.	8.
		MR1C1	Same as above with silty clay surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIw	2.4	1.2
		MRjB1	Same as above with silty clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	13.9	7.~
Flood plain.	Iril:	I	Very deep, well drained, dominantly coarse loamy in control section (25-100 cm.) on A(0-1%), B(1-3%) and C(3-5%) slopes, slightly eroded.				
		IfB1	Same as above with silt loam surface on B(1-3%) slopes, slightly eroded.	C_1	IIs	0.5	0.2
		IeB1	Same as above with loam surface on B (1-3%) slopes, slightly eroded.	C_1	IIs	0.4	0.2
		IjB1	Same as above with silty clay loam surface on B(1-3%)slopes, slightly eroded.	C_1	IIs	1.9	1.0
		IjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1	IIs	16.6	8.5
		IjA1	Same as above with silty clay loam surface on A(0-1%) slopes, slightly eroded.	C_1	IIs	3.0	1.5

1.	2.	3.	4.	5.	6.	7.	8.
Flood plain:	Shamu-lam-jao :	S	Very deep, imperfectly drained, coarse loamy in control section (25-100 cm.) on B(1-3%) slopes, slightly eroded.				
		SjB1	Same as above with silty clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	0.4	0.2
		SiB1	Same as above with sandy clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	6.8	3.5
		SiC1	Same as above with sandy clay loam surface on C(3-5%) slopes, slightly eroded.	W_1	IIIw	0.9	0.5
Valley land.	Maseng-Kong:	M	Deep, imperfectly drained dominantly fine clayey in control section (25-49 cm.) on C(3-5%) slopes, slightly eroded.				
		MjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIsw	2.2	1.1
Valley land.	Chowri:	C	Very deep, poorly drained, dominantly fine clayey in control				

1.	2.	3.	4.	5.	6.	7.	8.
			section (25-100 cm.) on A(0-1%) slopes, slightly eroded.				
		CjA1	Same as above with silty clay loam surface on A(0-1%) slopes, slightly eroded.	C_1(P)	IIIw	3.5	1.8
Valley land.	Wagshang:	W	Shallow, well drained dominantly fine loamy over fragmental in control section (0-15cm) on B(1-3%), C(3-5%) and D(5-10%) slopes, moderately to severely eroded.				
		WjD3	Same as above with silty clay loam surface on D(5-10%) slopes, severely eroded.	W_1	IVes	3.5	1.8
		WjC3	Same as above with silty clay loam surface on C(3-5%) slopes, severely eroded.	C_4	IVes	1.4	0.7
		WhC3	Same as above with clay loam surface on C(3-5%) slopes, severely eroded.	C_4	IVes	0.9	0.5
		WhB2	Same as above with clay loam surface on B(1-3%) slopes, moderately eroded.	C_4	IVs	6.1	3.1
		WmB2	Same as above with clay surface on B(1-3%) slopes, moderately eroded.	C_4	IVs	2.1	1.1

1.	2.	3.	4.	5.	6.	7.	8.
		WmC3	Same as above with clay surface on C(3-5%) slopes, severely eroded.	C_4	IVes	3.1	1.5
		WmD3	Same as above with clay surface on D(5-10%) slopes, severely eroded.	C_4	IVes	2.5	1.3
Slip off slope.	Lilok:	L	Moderately deep, well drained, dominantly sandy in control section (25-40 cm.) on C(3-5%) slopes, moderately eroded.				
		LeC2	Same as above with loam surface on C(3-5%) slopes, moderately eroded.	C_4,W_1	IVs	0.8	0.4

7. INTERPRETATION OF SOIL ANALYSIS DATA :

Analytical data of soil series are given in Appendix-II. Soils are mostly medium to moderately fine textured Presence of gravelly layer in the profile is observed in Pengrumkong, Tingsong, Hondran and Iril Series. This may possibly adversely affect the performance of crops particularly during dry spells.

Soil acidity is in the range of strong acid to extreme acid. Soils need correction of pH by the application of lime.

Organic matter in the surface layer is high. Yet addition of organic matter may be ensured for sustained yield. Waterholding capacity is generally in the medium range. Available water capacity is likely to be low in some of the soils viz. Pengrum, Pengrumkong, Pingsong, Hondran, Masengkong and Wagshang Series. Other series are in the medium range of available water capacity. Cation exchange capacity is in the medium range in most of the soils.

Soils need application of lime for the pH correction and application of manures and fertilizers for ensuring satisfactory crop performance.

8.. INTERPRETIVE GROUPING OF SOILS :

The land capability classification is an interpretive grouping of soils that provides information at two different levels of generalisation viz. (i) capability class and (ii) subclass.

The lands are evaluated according to potentialities and limitations for sustained production of crops. The interpretive grouping is based on various characteristics that influence the use and management of soils. The soils of a capability subclass are nearly homogeneous in respect of major crop adaptability, management practice and general level of yield response. The limitations are risk of erosion (e), wetness, drainage or overflow (w) and root zone limitations (s).

Soils grouped in classes I to IV are capable of producing commonly cultivated crops under proper and specific management practices. Soils of class V to VII are not suitable for agricultural crops but suitable for permanent vegetation, plantation crops, pasture, farm forestry etc. Class VII lands may be kept under permanent vegetation, forest wild life,

recreation, etc. The surveyed areas include lands under capability class II, III and IV. In the present report soils are grouped at sub-class level which are briefly described below.

Sub-class IIs :

Comprises very deep, moderately well drained soils occurring on nearly level to gently sloping valley lands and flood plains. Gravel and pebbles are found in the subsoil which obstructs root penetration and also leads to droughtiness during dry periods. The soils are suitable for most crops. This subclass is represented by soil units IfB1, IeB1, IjB1, IjC1 and IjA1 of Iril series.

Sub-class IIIw :

Comprises very deep imperfectly drained to poorly drained soils occurring on nearly level to gently sloping lands occupying the terraces and flood plains. The soils are wet due to impeded drainage and excess moisture. Drainage and protection from possible overflow at times are the important management problems. The soil is suitable for moisture tolerant crops. Paddy is grown during Kharif season. This may be followed by dry land crops during rabi season.

Soil units MRlC1 and MRjB1 of Marinkong Series, SjB1, SiB1, SiC1 of Sham-lam-jao series, CjA1 of Chowri series and KjB1, KmB1, KjC1 of Kaipo series comes under this subclass.

Sub-class IIIs :

Comprises moderately deep, well drained soils occurring on very gently sloping piedmont lands. Limited soil depth and gravelly subsoils are the major limiting factors. The soil suffers from droughtiness even during short dry spells. The soil is suitable for short duration drought resistant crops. This subclass consists of soil units TfB1 and TmB1 of Tingsong series.

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Sub-class IIIsw :

Comprises deep, imperfectly drained soils occurring on gently sloping valley lands. Limited soil depth and wetness are the hazards. Water accumulates during monsoon period and the soil also needs protection from possible overflow and outwash. Gravel and pebbles are found below 49 cm. from the surface which obstructs the roots. This subclass includes only one mapping unit, MjC1 of Masengkong series.

Sub-class IIIe :

Comprises deep to very deep well drained soils occurring in the piedmont. Soils are moderately susceptible to erosion due to slopes. Part of the surface soil has been lost by erosion. The soils are suitable for many crops under favourable moisture condition. The principal management requirements are control of erosion, maintainance of fertility and conservation of organic matter and moisture. This subclass includes mapping units PjF2 of Pengrum, HfB2, HeC2, HjC2, HfC2 and HjB2 of Hondran series.

Sub-class IIIes :

This subclass consists of moderately deep to deep well drained soils occurring on gently sloping to strongly sloping hills and piedmont slopes. The soils are moderately susceptible to erosion due to slopes and have lost part of the surface soil by erosion. The soils also suffer from drought due to presence of gravel in the subsoil. These can be cultivated to various crops but need efficient management that can prevent further erosion, preserve tilth and maintain the supply of organic matter. This subclass consists of mapping units TjD2, TfD2, TfC2, TlD2, TlC2, TjC2 of Tingsong and PKfD2, PKfD2, PKeE2 of Pengrumkong series.

Sub-class IVs :

This subclass consists of shallow well drained soils occurring on very gently sloping valley lands and gently sloping slip off slopes. They are underlain by unconsolidated weathered sandstone or sand. The soils are moderately eroded and have been brought under cultivation by reclamation. They can be cultivated under careful management, to conserve soil moisture and prevent soil erosion. Mapping units WhB2 and WmB2 of Wagshang and LeC2 of Lilok series come under this subclass.

Sub-class IVe :

This subclass consists of deep well drained soils occurring on hill tops. Soils are highly susceptible to erosion due to slopes and texture. Considerable portion of the original top soil has been lost by erosion. Soils are best suited to horticultural and plantation crops, but can be cultivated occassionally for agricultural crops with appropriate soil conservation measures to control erosion and conserve moisture. This subclass is represented by soil unit PeB3 of Pengrum series.

Sub-class IVes :

Comprises shallow well drained soils occurring on gently to strongly sloping valley lands. The soils are gravelly and stony and underlain by unconsolidated weathered parent material. They are highly susceptible to erosion and have lost major portion of the original top soil. The soils can be cultivated occasionally under careful management to control erosion and conserve moisture. This subclass includes mapping units - WjD3, WjC3, WhC3, WmC3 and WmD3 of Wagshang series.

9.. USE AND MANAGEMENT :

Geomorphic unit.	Soil series.	Description.	Present land use.	Land capability class & subclass.	Problems.	Suggested land use, soil conservation measures; suggested cropping pattern, grass land development.
1.	2.	3.	4.	5.	6.	7.
Top hill slopes.	Pengrum :	Deep, well drained, dominantly fine clayey in control section (25-60 cm.) on E(10-15%) slopes, moderately to severely eroded.				
	PjE2	Same as above with silty clay loam surface on E(10-15%) slopes, moderately eroded.	J,F_1,	III	1)Soil erosion, 2)Fertility, 3)Droughtiness.	Soils are susceptible to erosion and drought. Need intensive soil conservation measures. Narrow based contour terraces may be constructed. Water holding capacity and moisture equivalent are medium. Addition of lime is likely to improve the soil condition for plant growth. Soils are suitable for horticultural/plantation crops. Deep ploughing avoided as the effective soil depth is

1.	2.	3.	4.	5.	6.	7.
						likely to reduced during the process of construction of terraces which involves about 30 cm. Cutting and filling.
	PeE3	Same as above with loam surface on E(10-15%) slopes, severely eroded.	J,F_1	IVe	1)Soil erosion, 2)Fertility, 3)Droughtiness, 4)Limited soil depth.	Same as in soil PeE3. Soils are susceptible to severe erosion. More intensive soil conservation measures are required.
Lower hill slopes.	Pengrumkong:	Deep, well drained, dominantly loamy skeletal in control section (25-56 cm.) on D(5-10%) and E(10-15%) slopes, moderately eroded.				
	PKfD2	Same as above with silt loam surface on D(5-10%) slopes, moderately eroded.	J	IIIes	1)Soil erosion, 2)Droughtiness, 3)Fertility, 4)Limited soil depth.	Soils need intensive soil conservation measures. Contour trenching or bunding is recommended; narrow based contour trenches may be suitable. Depth of

1.	2.	3.	4.	5.	6.	7.
						cutting for mechanical soil conservation structures may be kept to the mini mum. Soils are susceptible to drought due to limited soil depth and being gravelly. Deep ploughing may be avoided. Soils are strongly acidic and need liming for better crop performance. Water holding capacity is medium and moisture equivalent is low. Soils are suitable for permanent vegetation e.g. plantation crops, pasture, etc. Millets, root crops, oil seeds, pulses, etc. may also be grown with adequate care.
	PKeE2	Same as above with loamy surface on E(10-15%) slopes, moderately eroded.	J,M1	IIIes	1)Soil erosion, 2)Droughtiness, 3)Fertility, 4)Limited soil depth.	
						Same as in PKfD2. Soils need intensive conservation measures due to higher slopes and severe erosion.
Upper piedmont.	Tingsong:	Moderately deep, well drained, clayey skeletal in control section (0-30 cm.) on B(1-3%), C(3-5%) and D(5-10%) slopes, slightly to moderately eroded.				

1.	2.	3.	4.	5.	6.	7.
	TjD2	Same as above with gravelly silty clay loam surface on D(5-10%) slopes, moderately eroded.	C_1,F_1	IIIes	1)Soil erosion, 2)Fertility, 3)Droughtiness, 4)Limited soil depth.	Soils are of moderate productivity. Susceptible to erosion. Narrow based contour terraces may be constructed. Gravelly texture causes excessive droughtiness even during short dry spells in kharif. Short duration drought resistant field crops may be grown. Water holding capacity and moisture e equivalent are medium. Application of lime will give better crop performance. Soils may be kept under permanent vegetation/pasture. Cereals, millets, pulses, etc. may be grown with special care and management particularly with maintenance of suitable moisture regime and use of fertilizers.
	TfD2	Same as above with silt loam surface on D(5-10%) slopes, moderately eroded.	C_1,F_1		1)Soil erosion, 2)Fertility, 3)Droughtiness, 4)Limited soil depth.	

1.	2.	3.	4.	5.	6.	7.
						Same as in soil TjD2. Available water holding capacity is less than TjD2 and the soil is susceptible to severe drought. Field crops may be grown with adequate care for ensuring proper moisture regime. Field terracing may be done as a measure of soil conservation.
	TfB1	Same as above with silt loam surface on B(1-3%) slopes, slightly eroded.	C_1	IIIs	1)Soil erosion, 2)Droughtiness, 3)Limited soil depth.	Same as in TjD2. Field terracing may be done as soil conservation measure. More suited for short duration crops during kharif.
	TfC2	Same as above with silty loam surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes	1)Soil erosion, 2)Fertility, 3)Droughtiness, 4)Limited soil depth.	Same as in soil TfD2. More intensive soil conservation measures like contour terracing with minimum depth of cutting may be suitable. Field crops may be grown.

1.	2.	3.	4.	5.	6.	7.
	T1D2	Same as above with silty clay surface on D(5-10%) slopes, moderately eroded.	C_1	IIIes	-do-	Same as in soil TjD2. Soils are of better texture with less gravel. Moisture holding capacity and available water capacity are better than TjD2. Field crops may be grown.
	T1C2	Same as above with silty clay surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes	1)Soil erosion, 2)Fertility, 3)Droughtiness, 4)Limited soil depth.	Same as in soil TfC2. Soils may be used for field crops, with careful management in respect of soil conservation measures, addition of fertilizers and manures. Moisture regime may be maintained by conserving available water.
	TjC2	Same as above with silty clay loam surface on C(3-5%) slopes, moderately eroded.	C_1	IIIes.	-do-	Same as in soil T1C2. Soils may be used for raising field crops during kharif season.

1.	2.	3.	4.	5.	6.	7.
	TmB1	Same as above with clay surface on B(1-3%) slopes, slightly eroded.	C_1	IIIs	- do -	Same as in soil TfB1.
Lower piedmont.	Hondran:	Very deep, well drained, fine clayey in control section (25-100 cm.) on B(1-3%) and C(3-5%) slopes, moderately eroded.				
	HfB2	Same as above with silt loam surface on B(1-3%) slopes, moderately eroded.	W_1,C_1	IIIe	1)Soil erosion, 2)Fertility.	Soils are productive. Field terracing may be taken up with diversion drains to eliminate excess run off from upper reaches. Soils are strongly acidic and need application of lime for better crops performance. Water holding capacity and moisture equivalent are of medium status. Soils are suitable for field crops. Paddy may be grown during kharif season followed by pulses, oil seeds, vegetables, etc. in the rabi season.

1.	2.	3.	4.	5.	6.	7.
	HeC2	Same as above with loam surface on C(3-5%) slopes, moderately eroded.	W_1,C_1	IIIe	- do -	Same as in soil HfB2. These are suitable for field crops.
	HjC2	Same as above with silty clay loam surface on C(3-5%) slopes, moderately eroded.	W_1,C_1	IIIe	- do -	Same as in soil HjC2. Soils are suitable for field crops.
	HfC2	Same as above with silt loam surface on C(3-5%) slopes, moderately eroded.	W_1, C_1	IIIe	1)Soil erosion, 2)Fertility.	Same as in soil HeC2. Soils are suitable for field crops.
	HjB2	Same as above with silty clay loam surface on B(1-3%) slopes, moderately eroded.	W_1,C_1	IIIe	-do-	Same as in HfB2. Soils are suitable for field crops.
River terrace.	Kaipo:	Very deep, imperfectly drained, dominantly fine clayey in control section (25-100 cm.) on B(1-3%) to C(3-5%) slopes, slightly eroded.				

1.	2.	3.	4.	5.	6.	7.
	KjB1	Same as above with silty clay loam surface on B(1-3%)slopes, slightly eroded.	C_1(P)	IIIw	1)Wetness, 2)Fertility.	Soils are productive. Field terracing may be done as soil conservation measure. Water holding capacity and moisture equivalent are medium. Soils are extremely acidic and need application of lime for better crop performance. Soils are suitable for field crops. Paddy may be grown during kharif season followed by cereals, pulses, oil seeds, vegetables, etc. during rabi.
	KmB1	Same as above with clay surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	-do-	Same as in KjB1. Suitable for field crops. Double cropping of paddy may be attempted.
	KjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIw	-do-	Same as in KjB1. Suitable for field crops. Double cropping of paddy may be attempted.

1.	2.	3.	4.	5.	6.	7.
River terrace.	Maringkong:	Very deep, poorly drained, dominantly fine clayey in control section(25-100cm.) on B(1-3%) to C(3-5%) slopes, slightly eroded.				
	MR1C1	Same as above with silty clay surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIw	1)Wetness, 2)Fertility,	Soils are productive. Bench terracing is suggested for raising field crops. Water holding capacity is medium and moisture equivalent is low. Soils are strongly acidic and application of lime is necessary. Suitable for field crops. Paddy may be grown during kharif season followed by pulses, oil seeds, vegetables, etc. in rabi season.
	MRjB1	Same as above with silty clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	-do-	Same as in MR1C1; Field terracing is suggested . Suitable for field crops.

1.	2.	3.	4.	5.	6.	7.
Flood plain.	Iril:	Very deep, well drained, dominantly coarse loamy in control section (25-100 cm.) on A(0-1%), B(1-3%) and C(3-5%) slopes, slightly eroded.				
	IfB1	Same as above with silt loam surface on B(1-3%) slopes, slightly eroded.	C_1	IIs	1)Soil erosion, 2)Fertility, 3)Droughtiness.	Soils are productive and suitable for intensive farming. Field terracing is suggested. Water holding capacity is medium and moisture equivalent is low. Soils are extremely acidic and need liming for better crop performance. Suitable for field crops. Paddy may be grown during kharif season followed by pulses, oil seeds, etc. during rabi season.
	IeB1	Same as above with loam surface on B(1-3%) slopes, slightly eroded.	C_1	IIs	-do-	Same as in soil IfB1; Suitable for field crops.

1.	2.	3.	4.	5.	6.	7.
	IjB1	Same as above with silty clay loam surface on B(1-3%)slopes, slightly eroded.	C_1	IIs	-do-	Same as above in IfB1.
	IjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1	IIs	-do-	Same as in IfB1. Bench terracing is suggested; Suitable for field crops.
	IjA1	Same as above with silty clay loam surface on A(0-1%) slopes, slightly eroded.	C_1	IIs	-do-	Same as in IfB1; suitable for field crops. Double cropping of paddy may be attempted during kharif season followed by other field crops.
Flood plain.	Shamulam-jao:	Very deep, imperfectly drained, coarse loamy in control section (25-100 cm.) on B(1-3%) and C(3-5%) slopes, slightly eroded.				
	SjB1	Same as above with silty clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	1)Wetness, 2)Fertility.	Soils are susceptible to wetness due to excessive moisture during rainy season.

1.	2.	3.	4.	5.	6.	7.
						Field terracing is suggested. Water holding capacity is high and moisture equivalent is medium. These are strongly acidic soils and need liming for better crop production. Suitable for field crops. Paddy may be grown during kharif season and pulses, oil seeds, etc. as rabi crops.
	SiB1	Same as above with sandy clay loam surface on B(1-3%) slopes, slightly eroded.	C_1(P)	IIIw	-do-	Same as above in SjB1. Suitable for field crops.
	SiC1	Same as above with sandy clay loam surface on C(3-5%)slopes, slightly eroded.	C_1	IIIw	-do-	Same as above in SiB1. Suitable for field crops.
Valley land.	Masengkong: Deep, imperfectly drained, dominantly fine clayey in control section (25-49 cm.) on C(3-5%) slopes, slightly eroded.					

1.	2.	3.	4.	5.	6.	7.
	MjC1	Same as above with silty clay loam surface on C(3-5%) slopes, slightly eroded.	C_1(P)	IIIsw	1)Wetness, 2)Fertility.	Soils are susceptible to wetness and limited soil depth Narrow based terraces may be constructed keeping the depth of cutting to the minimum. Water holding capacity and moisture equivalent are the medium range. Soils are extremely acidic and need liming for better crop performance. Suitable for field crops. Paddy may be grown during kharif.
Valley land.	Chowri: Very deep, poorly drained, dominantly fine clayey in control section (25-100cm.) on A(0-1%) slopes, slightly eroded.					
	CjA1	Same as above with silty clay surface on A(0-1%) slopes, slightly eroded.	C_1(P)	IIIw	1)Wetness, 2)Fertility.	Soils are productive and suitable for a variety of crops. Field terracing is suggested as soil conservation measure. Water holding capacity is high and moisture equivalent is medium. Soils respond well

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1.	2.	3.	4.	5.	6.	7.
						to fertilizer applications. Suitable for field crops. Paddy may be grown during kharif followed by pulsed, oil seeds, etc. in rabi season.
-do-		Wagshang: Shallow, well drained dominantly fine loamy over fragmental in control section (0-15 cm.) on B(1-3%), C(3-5%) and D(5-10%) slopes, moderately to severely eroded.				
	WjD3	Same as above with silty clay loam surface on D(5-10%)slopes, severely eroded.	V_1	IVes	1)Soil erosion, 2)Shallow depth, 3)Fertility, 4)Droughtiness.	Soils are susceptible to severe erosion. Contour trenching or graded contour bunding are suggested as soil conservation measures. Deep ploughing may be avoided. Soils are susceptible to severe drought during dry spell of even short duration. Permanent vegetation is suggested.

1.	2.	3.	4.	5.	6.	7.
						Suitable for pasture. Short duration and drought resistant varieties of field crops may be grown during kharif season.
	WjC3	Same as above with silty clay loam surface on C(3-5%) slopes, severely eroded.	C_4	IVes	-do-	Same as in soil WjD3. Suitable for permanent vegetation. Field crops may be grown occasionally with caution.
	WhC3	Same as above with clay loam surface on C(3-5%) slopes, severely eroded.	C_4	IVes	-do-	Same as in soil WjC3.
39	WhB2	Same as above with clay loam surface on B(1-3%) slopes, moderately eroded.	C_4	IVs	-do-	Same as in soil WhC3. Field terracing with short duration field crops recommended during kharif.
	WmB2	Same as above with clay surface on B(1-3%) slopes, moderately eroded.	C_4	IVs	-do-	Same as soil WhB2.
	WmC2	Same as above with clay surface on C(3-5%) slopes, severely eroded.	C_4	IVes	-do-	Same as in soil WhC3.

1.	2.	3.	4.	5.	6.	7.
	WmD3	Same as above with clay surface on D(5-10%) slopes, Severely eroded.	C_4	IVes	-do-	Same as in soil WmC3. More intensive soil conservation measures are required. Contour trenching is suggested as a mechanical soil conservation measure.
Slip off slope.	Lilok :	Moderately deep, well drained, dominantly sandy in control section (0-28 cm.) on C(3-5%) slopes, moderately eroded.				
	LoC2	Same as above with loam surface on C(3-5%) slopes, moderately eroded.	C_4, W_1	IVs	-do-	Soils are susceptible to moderate erosion. Narrow based terraces are suggested. Water holding capacity is medium and moisture equivalent low; soils may be brought under horticultural and plantation crops; field crops may be grown occasionally with caution.

L E G E N D :

Soil Series :	Symbol:
Pengrum	P
Pengrumkong	Pk
Tingsong	T
Hondran	H
Kaipo	K
Maringkong	MR
Iril	I
Shamu-lam-jao	S
Masengkong	M
Chowri	C
Wagshang	W
Lilok	L

Present land use :	
Cultivated to single crop.	C_1
Cultivated to single crop - wet land paddy	C_1 (P)
Waste land fit for cultivation	W_1
Jhum cultivation	J
Shrubs and weeds	T
Thin forest	F_1
Occasionally cultivated land.	C_4

Slope :	Symbol:
Nearly level to level (0-1%)	A
Very gently sloping (1-3%)	B
Gently sloping (3-5%)	C
Moderately sloping (5-10%)	D
Strongly sloping (10-15%)	E

Soil Texture :	
Loam	e
Silt loam	f
Clay loam	h
Sandy clay loam	i
Silty clay loam	j
Gravelly silty clay loam	j'
Silty clay	l
Clay	m

Erosion:	
Slight	1
Moderate	2
Severe	3

-: oOo :-

A P P E N D I X - I :

Descriptions of Soil Series.

PENGRUM SERIES (P) :

Comprises well drained, deep soils occurring on strongly sloping top hill slopes. The pedons have dark grayish brown moderately fine textured Ap horizon grading to yellowish red to reddish brown moderately fine to fine textured B horizon underlain by partly weathered sandstone and shales in the C horizon. The soils are moderately to severely eroded.

The Pengrum series comprises a member of fine clayey mixed thermic family of Ultic Hapludalfs.

Typifying Pedon : Pengrum silty clay loam - Jhum.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-9	Dark grayish brown (10YR 4/2 m) silty clay loam; weak fine granular; moist friable, wet slightly sticky; plentiful fine, few medium roots; clear wavy boundary.
B1	9-22	Yellowish red (5YR 5/4 m) silty clay; fine subangular blocky; moist friable, wet sticky and plastic; many fine and medium roots; gradual, smooth boundary.
B21t	22-45	Yellowish red (5YR 4/6 m) silty clay; weak medium subangular blocky; moist friable, wet sticky and plastic; few fine and very fine coarse roots; thin patchy clay films on on ped faces; gradual, smooth boundary.

Horizon:	Depth: (cm.)	Description:
B22t	45-69	Reddish brown (2.5YR 4/4 m) silty clay; weak medium subangular blocky; moist friable, wet sticky and plastic; thin continuous clay skins on ped faces; gradual, smooth boundary.
C	69-100 +	Weathered sandstone and shale mixed with little reddish brown (2.5YR 5/4 m) clay in matrix.

Range in characteristics :

The thickness of the solum ranges between 69 and 70 cm. and is underlain by weathered sandstone and shale. The soil types vary from loamy in the surface soil and gravelly clay loam to gravelly clay in the subsoil. The colour of the surface soil is dark yellowish or grayish brown to dark brown in hue of 10YR with value 3 to 4 and chromas 2 to 4 and that of subsoil from reddish brown to yellowish red in 5YR to 2.5YR with value 4 to 5 and chroma 4 to 6.

Competing series and their differentia :

Competing series are Pengrumkong and Hondran series. The depth to paralithic contact in Pengrumkong soil is 56-70, in Pengrum soil 69-90 and Hondran soil 100-120 cm. The clay content within the depth of 15 cm. to paralithic contact varies from 27 to 37% in Pengrumkong soil, 47 to 52% in Hondran soil and 47 to 57 percent in Pengrum soil. The colour of the soil in argillic horizon of Pengrumkong and Hondran is in hue of 10YR while the colour hue in Pengrum soils become redder in 5YR to 2.5YR through depth. Mottlings of yellowish brown (10YR 5/6) and strong brown

(7.5YR 5/6) colours are found in the lower part of Hondran soil while it is absent in Pengrum and Pengrumkong series.

Drainage and permeability :

Well drained with moderate to slow permeability.

Distribution and extent :

Occurs mostly on the top hill slopes in the surroundings of Phungthen village, P.S. Ukhral, District East and State-Manipur.

Use and vegetation :

Mostly under Jhum cultivation and also under thin forest and shrubs.

Type location :

About 1½ km. from Phungthen hamlet to north-west on the hill slopes. P.S. Ukhral, East District of Manipur State.

PENGRUMKONG SERIES (PK) :

Comprises well drained deep soils occurring on mostly to strongly sloping lower hill slopes. The pedons have very dark grayish brown medium textured Ap horizon grading to dark brown to dark grayish brown moderately fine textured gravelly B horizon underlain by partly weathered sandstone and shales in the C horizon. The soils are moderately eroded.

The Pengrumkong series comprises members of loamy skeletal mixed thermic family of Ultic Hapludalfs.

Typifying Pedon : Pengrumkong silty loam - Jhum.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-8	Very dark grayish brown (10YR 3/2 m) silt loam; crumb, dry slightly hard, moist friable;

The colour ranges in hue of 10YR with moist value and chroma from 3 to 4 and 1 to 3. Clay content increases with depth and reaches a maximum 37% in B2t horizon. The percentage of base saturation in the argillic horizon is below 60.

Competing series and their differentia :

Competing series are Pengrum and Hondran. The depth of paralithic contact in Pengrumkong series is 56 to 70, in Pengrum and in Hondran 100-120 cm. The clay content within the depth of 15 cm. to paralithic contact varies from 27 to 37% in Pengrumkong 47 to 52 percent in Hondran, and 47 to 57 in Pengrum series. The colour of the soil in the argillic horizon of Pengrumkong and Hondran series is in hue of 10YR whereas the colour becomes redder (5YR to 2.5YR). Mottling of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) colour are found in the lower part of Hondran series. It is absent in Pengrum and Pengrumkong series.

Drainage and permeability :

Well drained with moderately slow permeability.

Use and vegetation :

Mostly under jhum cultivation but also as waste lands.

Distribution and extent :

Occurs mostly on moderately to strongly sloping lower hill slopes surrounding the Phungthen village of P.S. Ukhral, East district, Manipur State.

Type location :

About 1½ km. north-west of Phungthen Hamlet of P.S. Ukhral, East District, Manipur State.

Horizon:	Depth: (cm.)	Description:
		plentiful fine and few medium roots; micro pores; clear, smooth boundary.
B1	8-36	Dark brown (10YR 4/3 m) gravelly clay loam; weak medium subangular blocky; moist firm, wet sticky and plastic; presence of 50% gravel and stone of 1.5 to 10 cm. size; few very fine roots; few micro pores: clear, smooth boundary.
B2t	36-56	Dark brown (10YR 4/3 m) gravelly silty clay loam; moderate medium subangular blocky; moist firm, wet sticky and plastic; very few fine roots; thin dark colour patchy clay films on ped faces; gradual, smooth boundary.
C1	56-105 +	Dark grayish brown (10YR 4/2 m) gravelly silty clay loam mixed with partly weathered sandstone and shale.

Range in characteristics ;

The thickness of the solum ranges between 56 to 70 cm. and is underlain by partly weathered sandstone and shales. Coarser fragments larger than 2 mm. within the depth of 10 cm. to paralithic contact ranges between 35 and 40% clay content varies from 27 to 37 percent.

The texture of the fine earth in A horizon varies from loam to silt loam. The soil colour ranges in hue of 10YR with medium value and low chroma for moist soil. The thickness of the B horizon varies from 40 to 50 cm. The texture of the fine earth varies from gravelly clay loam to gravelly silty clay loam.

TINGSONG SERIES (T) :

Comprises well drained, moderately deep soil occurring on piedmont slopes. The pedons have dark grayish brown moderately fine textured A horizon grading to dark gray moderately fine textured gravelly B horizon which is underlain by dark gray light textured C horizon. The soil is slightly to moderately eroded.

The Tingsong series comprises members of clayey skeletal mixed thermic family of Typic Haplaquepts.

Typifying Pedon : Tingsong gravelly silty clay - cultivated. (colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-11	Dark grayish brown (10YR 4/2 m)silty clay loam; weak medium subangular blocky; moist firm, wet sticky; plentiful fine roots; gradual, smooth boundary.
B2	11-30	Dark gray (10YR 4/1 m) gravelly silty clay loam; weak fine granular; 40% 5-10 mm. sized gravel present; moist firm, wet sticky; very few fine roots; prominant yellowish brown (10YR 5/6) mottlings; gradual, smooth boundary.
C1	30-71	Dark gray (10YR 4/1 m) gravelly silt loam [illegible] with 80% by volume 5-10 mm. gravel; moist friable, wet slightly sticky; very few fine roots; gradual, smooth boundary.
C2	71-100 +	Gravel and pebbles mixed with weathered shale in the matrix.

Range in characteristics :

Soil depth ranges between 25 and 30 cm. Coarser fragments larger than 2 mm. ranging between 20 and 53% are present. Ap horizon is dark grayish brown in colour and silty clay loam to silty clay in texture. B2 horizon is dark gray with silty clay loam to silty clay texture.

Competing series and their differentia :

Competing series are Maringkong and Masengkong series. The depth to paralithic contact in Maringkong series is 90 to 100 cm. in Masengkong 40 to 50 cm. and in Tingsong 25 to 30 cm. In Maringkong and Masengkong series in the lower part of the pedon transitional to C horizon, coarse fragments may be 3 and 5 percent whereas in Tingsong series it may increase to 70 to 80%. Clay fraction within the depth of 15 cm. to paralithic contact varies from 36 to 40 percent in Maringkong series, 36 to 38% in Masengkong series and 21 to 41% in Tingsong series. Soil colour remains uniform in all the series. Soils are severely mottled.

Drainage and permeability :

Well drained with moderate permeability.

Distribution and extent :

Occurs in the piedmont slope of Tingsong village, P.S. Mao, District - East, Manipur State; fairly extensive.

Use and vegetation :

Cultivated to paddy and surrounded by sparce jungle.

Type location :

About 1½ km. west of Tingsong hamlet, P.S. Mao, District East, State Manipur.

HONDRAN SERIES (H) :

Comprises well drained very deep soils occurring on very gently sloping to gently sloping lower piedmont slopes. The pedons have dark grayish brown, medium textured A horizon grading to yellowish brown gray fine textured B horizon. The soils are moderately eroded.

Hondran series comprise members of fine clayey mixed thermic of Ultic Hapludalfs.

Typifying Pedon : Hondran silt loam - fallow.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description.
A	0-3	Dark grayish brown (10YR 4/2 m) silt loam; weak fine crumb; moist friable, wet slightly sticky; abundant fine roots; many micro pores; clear, wavy boundary.
B21t	3-30	Yellowish brown (10YR 5/6 m) silty clay; weak medium subangular blocky; moist friable, wet sticky and plastic; thin patchy clay films on ped faces; very few fine roots; many micro pores; gradual, wavy boundary.
B22t	30-65	Yellowish brown (10YR 5/4 m) clay; moderate medium subangular blocky; moist friable, wet very sticky and plastic; thin continuous clay skins on ped faces; very few fine roots; few micro pores; clear wavy boundary.

Horizon:	Depth: (cm.)	Description.
B3t	65-110 +	Light brownigh gray (5Y 6/2 m) silty clay; prominent mottles of yellowish brown (10YR 5/6) colour; massive, moist friable, wet sticky and plastic; thin patchy clay skins; no roots; few micro pores.

Range in characteristics :

The solum depth is very deep and ranges between 100 and 120 cm. Coarse fragments larger than 2 mm. within the depth of 10 cm. to 100 cm. ranges between 11 and 17 percent. The thickness of A horizon varies from 3 to 5 cm. The colour of the A horizon ranges from very dark gray to dark grayish brown in hue of 10YR with value 3 to 4 and chroma 1 to 2. The colour of the B horizon varies from yellowish brown to light brownish gray in hue of 10YR with value ranging from 5 to 6 and chroma 2 to 6. The subsoils are prominently mottled with reddish yellow to yellowish brown colour. The clay content increases regularly with depth and reaches a maximum value of about 51% in B22t horizon but in major cases ranges between 45 to 50%. The percentage of base saturation in argillic horizon lies between 42 and 47 percent.

Competing series and their differentia :

Competing series are Pengrum and Pengrumkong series. The depth of paralithic contact in Pengrumkong Series is 56 to 70 cm. in Pengrum 69 to 90 cm. and in Hondran 100 to 120 cm. The clay content within the depth of 15 cm. to paralithic contact varies from 27 to 37 percent in Pengrumkong, 47 to 52% in Hondran and 47 to 57 percent in Pengrum Series. --

Mottlings of yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) colour are found in the lower part of Hondran Series. It is absent in Pengrum and Pengrumkong Series.

Drainage and permeability :

Well drained with moderate permeability.

Distribution and extent :

Occurs on lower piedmont slope near the valleys of Phungthen village, P.S. Ukhral, District East of Manipur State.

Use and vegetation :

Partly fallow and partly under cultivation.

Type location :

West of Phungthen hamlet of P.S. Ukhral, Dist. East of Manipur State.

KAIPO SERIES (K) :

Comprises very deep imperfectly drained soils occurring on river terraces, very gently sloping to gently sloping. The pedons have dark grayish brown moderately fine to fine textured Ap horizon grading to yellowish brown to grayish brown fine textured B horizon. The soils are slightly eroded. Prominent mottles of yellowish red (5YR 5/6) colour are very common throughout the soil profile.

The Kaipo series comprises members of fine clayey mixed thermic family of Typic Ochraqualfs.

Typifying Pedon: Kaipo silty clay loam - cultivated. (Colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-16	Dark grayish brown (10YR 4/2 m) silty clay loam; puddled; mottles of yellowish red (5YR 5/6) colour; moist friable, wet sticky and plastic; plentiful paddy rootes; clear smooth boundary.
B21t	16-46	Grayish brown (10YR 5/2 m) silty clay loam; weak medium subangular blocky; prominent mottles of yellowish red (5YR 5/6) colour; moist friable, wet sticky and plastic; thin patchy clay films on ped faces; very few fine roots; clear, smooth boundary.
B22tg	46-63	Grayish brown (10YR 5/2 m) silty clay; weak medium subangular blocky; prominent mottlings of yellowish red (5YR 5/6) colour; moist firm, wet sticky and plastic; thin patchy clay films on the ped faces; very few fine roots; clear, smooth boundary.
B3g	63-115+	Pale brown (10YR 6/3 m) silty clay; massive; yellowish red mottles (5YR 5/6): moist firm, wet sticky and plastic.

Range in characteristics :

The thickness of the solum is very deep and the depth ranges from 100 to 115 cm. The silty clay loam texture with mottles is very common in A horizon. The colour of the mottles, ranges from yellowish red to brownish yellow, in hue of 5YR and 10YR. The colour of soil in A horizon varies from very dark gray to dark grayish brown in hue of 10YR with value 2.5 to 4 and chroma 1 to 2. The colour of the B horizon varies from dark

grayish brown to dark gray and sometimes pale brown to strong brown or grayish brown in 10YR hue with value 4 to 6 and chroma 1 to 3. Clay increases regularly with maximum 48 to 50% in B22t but decreasing with depth. The percentage of base saturation in the argillic horizon ranges between 47 and 54.

Competing series and their differentia :

Nil.

Drainage and permeability :

Imperfectly drained with slow to very slow permeability.

Use and vegetation :

Cultivated to paddy.

Distribution and extent :

The soils are widely distributed in the left bank of the Iril river near Phungthen village, P.S. Ukhral and District East of Manipur State.

Type location:

Nearly 5 km. west of Phungthen village, P.S. Ukhral, District East, Manipur State.

IRIL SERIES (I) :

Comprises well drained, very deep soils occurring on nearly level to gently sloping lands in the flood plains. Pedons have dark gray medium textured Ap horizon underlain by dark brown to dark grayish brown medium textured C horizon. The soil profiles reveal stratification and lithological discontinuity. Structural development is weak. The soil is slightly eroded.

Iril series comprises members of coarse loamy mixed thermic family of Typic Udifluvents.

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Typifying Pedon : Iril silt loam - cultivated.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-20	Dark gray (10YR 4/1 m) loam; weak fine granular to weak medium subangular blocky; moist friable, wet slightly sticky and slightly plastic; plentiful fine roots; clear, wavy boundary.
C1	20-45	Dark brown (10YR 4/3 m) sandy loam; weak medium subangular blocky; moist friable; few fine roots; many micro pores; clear, smooth boundary.
II C2	45-51	1-10 mm. size semirounded stones 80-90% and pebbles mixed with limited soil.
III C3	51-110+	Very dark grayish brown (10YR 3/2 m) loam: massive; moist friable, wet slightly sticky and slightly plastic; very few and very fine roots.

Range in characteristics :

Soil depth ranges between 130 and 150 cm. Coarser fragments larger than 2 mm. are few throughout the soil depth except a thin (5-6 cm.) gravelly layer which appears in the middle of almost all profiles. Stratification is common. The texture of fine earth A horizon is silt loam. Surface colour ranges in hue of 10YR with medium value and low chroma in moist condition. The underlying C horizon grades to variable textures leading to lighological discontinuity.

Competing series and their differentia :

The Maringkong series comprises members of fine clayey mixed thermic family of Typic Haplaquepts.

Typifying Pedon : Maringkong silty clay loam - cultivated.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-12	Dark grayish brown (10YR 4/2 m) silty clay loam; weak to moderate medium sub-angular blocky; moist firm, wet slightly sticky and slightly plastic; plentiful fine roots; clear, wavy boundary.
B21	12-30	Grayish brown (10YR 5/2 moist) silty clay loam with distinct mottles and of yellowish brown (10YR 5/8); irregular s shaped stone pieces weak to moderate medium subangular blocky; moist firm, wet sticky and plastic; few micro and micropores; very few fine roots; gradual wavy boundary.
B22	30-100	Brown (10YR 5/3 m) silty clay loam; prominent mottles of strong brown (7.5YR 5/8) and 10% of irregular shaped stones pieces of 1 mm. to 5mm.; moderate medium subangular blocky; moist very firm, wet very sticky and very plastic; many micro pores with root holes; abrupt wavy boundary.
II C1g	100 +	Massive unconsolidated materials mixed with sand, gravel, etc.

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Competing series and their differentia :

The competing series is Shamulamjao series. Both the soils are very deep but in Iril series a 5-6 cm. gravelly layer at a depth of 40 to 50 cm. from the surface is often met with. In both the soil stratification is common. The distribution of organic carbon through depth is irregular in Samulamjao series whereas in Iril series is varies from 1.6 to 0.57 through depth and does not decrease below 0.5%. The colour of the soil in both the soil is normally of 10YR hue with medium moist value and low chroma and in Shamulamjao series the chroma never exceeds 2.

Drainage and permeability :

Well drained with rapid permeability.

Use and vegetation :

Cultivated to paddy.

Distribution and extent :

Limited in extent; Confined to the banks of Iril river in Phungthen village of P.S. Ukhral, East District of Manipur State.

Type location :

5 km. north of Phungthen village, P.S. Ukhral, Dist. East, State Manipur.

MARINGKONG SERIES (MR) :

Comprises very deep, poorly drained soils occurring on river terraces, very gently sloping to gently sloping. The pedons have dark grayish brown moderately fine textured A horizon gradingto grayish brown to brown, moderately fine to fine textured B horizon. The soils are distinctly mottled and slightly eroded.

Range in characteristics :

The thickness of solum ranges from 90 to 100 cm. Clay content throughout the depth of 12 to 100 cm. ranges from 36 to 40 percent. Structural development in the solum is moderate and it is very distinct in B22g horizon. The texture of fine earth in Ap horizon is silty clay loam and in B horizon varies from silty clay loam to silty clay with moderately developed structure. The value for moist soil range from 4 to 3 and chroma 2 to 1. The colour of the soil is in hue of 10YR with medium moist value and chroma 2 to 3. B2 horizon is severely mottled with distinct mottlings of yellowish brown and strong brown colour. The unconsolidated material of sand, gravel, etc. represents the C horizon with lithological discontinuity.

Competing series and their differentia :

Competing series are Masengkong and Tingsong series. The depth to paralithic contact in Maringkong series is 90 to 100 cm. in Masengkong 50 to 60 cm. and in Tingsong 25 to 30 cm. In Maringkong and Masengkong series in the lower part of the pedon transitional to C horizon, coarse fragments range between 3 and 5 percent whereas in Tingsong series it is as high as 70 to 80 percent. Clay content within the depth of 15 cm. to paralithic contact varies from 36 to 40 percent in Maringkong series, 36 to 38% in Masengkong series and 21 to 41 percent in Tingsong series. In Tingsong series [illegible]

Drainage and permeability :

Poorly drained with slow permeability.

Distribution and extent :

Extensive.

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Use and vegetation :

Mostly cultivated to paddy but remains fallow occasionally.

Type location :

3 km. from Tingsong hamlet towards east direction, P.S. Mao, District East, State Manipur.

SHAMU-LAM-JAO SERIES (S):

Comprises imperfectly drained very deep soils occurring on very gently to gently sloping lands in the flood plains. Stratification is common. The pedon has dark gray moderately fine A horizon underlain by dark grayish brown to very dark gray C horizon. The soil is developed under hydromorphic condition and slightly eroded.

The Shamu-Lam-jao series comprises members of coarse loamy mixed thermic family of Aquic Udifluvents.

Typifying Pedon : Shamu-lam-jao silty clay loam - cultivated. (colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-22	Dark gray (10YR 4/1 m) silty clay loam; puddled; moist friable, wet slightly sticky and slightly plastic; plentiful paddy roots and few coarse roots; gradual smooth boundary.
C1	22-37	Dark grayish brown (10YR 4/2 m) silt loam with reddish brown (5YR 5/4 and 4/4) mottles; weak medium subangular blocky;

Horizon:	Depth: (cm.)	Description.
		moist friable, wet sticky and plastic: few fine roots· many micro pores and root holes; abrupt, smooth boundary.
C2	37-42	Dark grayish brown (10YR 4/2 m) loamy sand; weak fine granular; strong brown (7.5YR 5/8) mottles; moist friable, wet slightly sticky and slightly plastic; very few fine roots; many micro pores and root holes; abrupt, smooth boundary.
C3	42-93	Very dark grayish brown (10YR 3/2 m) sandy loam with faint yellowish red (5YR 4/6) mottles; massive; moist friable: very few fine roots: many macro and micro pores: gradual smooth boundary.
C4	93-105 +	Very dark gray (10YR 3/1 m) fine sandy loam; with faint yellowish red (5YR 4/6) mottles; massive; moist friable, wet slightly sticky and slightly plastic; many micro pores.

Range in characteristics :

The soil is very deep. Stratification is common. The distribution of clay, organic matter and sand are irregular throughout the depth. Prominent to faint mottles of 5YR and 7.5YR hue are found throughout. The colour of the A horizon varies from dark gray to dark grayish brown in 10YR hue with medium moist value and chroma 1 to 2. The colour of the C horizon ranges from very dark grayish brown to very dark gray in hue of 10YR with value 3 and chroma 1 to 2.

Competing series and their differentia :

The competing series is Iril. Both the soils are very deep but in Iril series a 5-6 cm. gravelly layer at a depth of 40 to 50 cm. from the surface is often met with. In both soils stratification is common. The distribution of organic carbon through depth is irregular in Samulamjao whereas in Iril series, it varies from 1.6 to 0.57 through depth and does not decrease below 0.5%.

Drainage and permeability :

Imperfectly drained with moderate permeability.

Distribution and extent :

Not extensive.

Use and vegetation :

Partly cultivated and partly fallow.

Type location :

South west of Phungthen hamlet, P.S. Ukhral, District East and State Manipur.

MASENGKONG SERIES (M) :

Comprises deep imperfectly drained soils occurring on gently sloping land in the valleys. The pedons have dark brown medium textured A horizon grading to dark grayish brown fine textured B horizon underlain by layer of rounded pebbles, partly decomposed shales in C horizon. The soil is slightly eroded.

The Masengkong series comprises members of fine clayey mixed thermic family of Typic Haplaquepts.

Typifying Pedon : Tasengkong silty clay loam - cultivated.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-12	Dark brown (10YR 4/3 m) silty clay loam; puddled structure; moist friable, wet slightly sticky and slightly plastic; plentiful paddy roots; clear smooth boundary.
B1g	12-28	Dark grayish brown (10YR 4/2 m) silty clay loam; weak medium subangular blocky; moist friable, wet sticky and plastic; yellowish brown (10YR 5/6) mottles; few fine roots; clear smooth boundary.
B2g	28-51	Dark grayish brown (10YR 4/2 m) silty clay loam; massive; moist friable, wet sticky and plastic; mottles of yellowish brown (10YR 5/6) colour; very few and fine roots; clear smooth boundary.
II C	51-65	Rounded pebbles 80% with shales.

Range in characteristics :

Soil depth ranges from 50 to 60 cm. The texture of fine earth fraction in A and B horizon is silty clay loam. The colour of A horizon ranges from dark brown to dark grayish brown and that of B horizon is dark grayish brown in hue of 10YR with value 3 to 4 and chroma 1 to 2. Organic carbon content decreases regularly with depth Structural development is weak to moderate.

Competing series and their differentia :

Competing series are Maringkong and Tingsong series. The depth to paralithic contact in Maringkong series is 90 to 100 cm. in Masengkong 50 to 60 cm. and in Tingsong 25 to 30 cm. In Maringkong and Masengkong series in the lower part of the soil pedon transitional to C horizon, coarse fragments range between 3 and 5% whereas it is between 70 and 80% in Tingsong series. Clay within the depth of 15 cm. to paralithic contact varies from 36 to 40% in Maringkong series, 36 to 38% in Maseingkong series and 21 to 41% in Tingsong series.

Drainage and permeability :

Imperfectly drained with moderately slow to slow permeability.

Distribution and extent :

Occurs by the side of the river Iril, limited in extent.

Use and vegetation :

Cultivated to paddy.

Type location :

3 km. from Phungthen hamlet towards north, P.S. Ukhral, District East, State Manipur.

CHOWRI SERIES (C) :

Comprises poorly drained very deep soils, occurring on nearly level to level lands in the valleys. The pedons have very dark gray to black moderately fine textured thick A horizon underlain by light gray fine textured thick B horizon. Water-table is within 65 cm. from the surface. The soils are slightly eroded.

The Chowri series comprises members of fine clayey mixed thermic family of Typic Haplaquepts.

Typifying Pedon : Chowri clay loam - cultivated. (colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-25	Very dark gray to black (7.5YR 2.5/0 m) silty clay loam moderate medium angular blocky; moist firm; wet sticky and plastic; many fine roots; slow permeability; abrupt smooth boundary.
B2	25-100	Light gray (2.5YR 7/0 m) silty clay; moderate medium angular blocky; moist firm, wet very sticky and very plastic; very few fine roots; very slow permeability;

Range in characteristics :

Profile observations are limited.

Competing series and their differentia :

Nil.

Drainage and permeability :

Poorly drained with very slow permeability.

Distribution and extent :

Toe slopes in the inter valleys; Phungthen village, P.S. Ukhral, District East of Manipur State.

Use and vegetation :

Cultivated to paddy.

Type location : 4-5 km. west of Phungthen in the valleys to west P.S. Ukhral, Dist. East, State Manipur.

WAGSHANG SERIES (W) :

Comprises shallow well drained soils occurring on very gently to moderately sloping lands in upper vallevs. The pedons have dark gray moderately fine textured A horizon underlain by round and semirounded stones, quartz gravel, etc. in the C horizon. The soil is moderately to severely eroded.

The Chowri series comprises members of fine loamy over fragmentals mixed thermic family of Lithic Udorthents.

Typifying Pedon : Wagshang silty clay loam - cultivated. (colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
Ap	0-15	Light gray (10YR 6/1) dry and dark gray (10YR 4/1 m) silty clay loam; weak medium subangular blocky; drv very hard, moist firm, wet very sticky and very plastic; common paddy roots; irregular difused boundary.
C1	15-40+	Round or semirounded stones with quartz gravel.

Range in characteristics :

The depth of the soil is very shallow to shallow. The surface texture ranges from silty clay to clay with colour varying from dark gray to gray in hue 10YR with medium moist value and low chroma.

Competing series and their differentia :

Nil.

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Drainage and permeability :

Well drained with moderately rapid permeability.

Distribution and extent :

Not very extensive; Confined to gullied lands in the upper vallys.

Use and vegetation :

Mostly waste lands; recently brought under paddy cultivation.

Type location :

Nearly 2 km. to the south east of village Tingsong, P.S. Mao, District East of Manipur State.

LILOK SERIES (L) :

Comprises moderately deep, well drained soils occurring on gently sloping slip off slopes ofthe river Iril. The pedon has brown medium textured A horizon grading to dark brown sandy C horizon underlain by debris of hard boulders of sandstone. The soils are moderately eroded.

The Lilok series comprises members of mixed thermic family of Lithic Udipsamments.

Typifying Pedon : Lilok loam - fallow.
(colours are for dry soil unless otherwise noted).

Horizon:	Depth: (cm.)	Description:
A1	0-8	Brown (10YR 5/3 m) loam; crumb; moist friable; many fine roots; clear smooth boundary.

Horizon:	Depth: (cm.)	Description:
C1	8-28	Dark brown (10YR 3/3 m) loamy sand; single grain; moist loose; many fine, few coarse and medium roots; gradual smooth boundary.
C2	28-40	Dark brown (10YR 3/3 m) fine sand; single grain; loose; many medium and few coarse roots; gradual smooth boundary.
II R	40-95+	Debris of hard boulders of sandstones.

Range in characteristics :

Profile observations are limited.

Competing series and their differentia :

Nil.

Drainage and permeability :

Well drained with rapid permeability.

Distribution and extent :

By the side of Iril river not very extensive.

Use and vegetation :

Small patches cultivated to paddy otherwise waste land, fit for cultivation.

Type location :

4 km. from Phungthen hamlet to the north, P.S. Ukhral, District East, State - Manipur.

APPENDIX-II:
ANALYTICAL DATA OF SOIL SERIES.

Percentage constituents on oven dry basis.

Sl. No.	Soil Series.	Depth: (cm.)	Gravel 2mm.	pH (1:2.5)	Organ carbon.	Sand %	Silt %	Clay %	W.H.C.	M.E.	T.E.B. (m.e.)	C.E.C. (m.e.)	Base saturation.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1.	Pengrum.	0-9	Nil	4.0	2.82	35.6	34.4	30.0	47.34	20.52	7.60	16.00	47.5
		9-22	4.4	3.8	1.05	19.6	33.4	47.0	61.63	32.83	9.60	20.80	46.1
		22-45	8.0	3.8	0.57	17.6	25.4	57.0	67.69	35.44	12.40	26.08	47.5
		45-69	10.0	4.0	0.30	15.6	27.4	57.0	69.27	35.71	12.00	26.00	46.1
2.	Pengrum-kong.	0-8	9.46	4.6	2.88	48.3	26.1	25.6	44.19	19.13	7.60	14.40	52.7
		8-36	36.00	4.3	0.90	46.3	26.1	27.6	46.41	20.07	7.20	14.40	50.0
		36-56	50.55	4.4	0.85	38.3	26.1	36.6	55.77	24.66	8.80	16.00	55.0
3.	Tingsong:	0-11	20.00	4.8	1.44	23.6	37.1	39.3	54.55	24.12	9.60	16.80	57.1
		11-30	42.63	5.2	0.66	29.6	36.1	40.3	56.18	25.41	10.00	18.08	55.3
		30-71	78.15	5.1	0.31	38.6	40.1	21.3	32.80	13.88	7.20	14.00	51.4
4.	Hondran:	0-3	17.00	4.5	2.34	43.2	34.8	22.0	44.13	19.25	6.80	13.20	51.5
		3-30	16.00	4.0	0.48	21.2	31.8	47.0	62.34	32.65	9.6	20.80	46.1
		30-65	12.50	4.0	0.21	10.6	29.1	51.3	66.87	35.03	10.0	22.40	44.6
		65-110	11.11	3.9	0.17	25.6	28.1	46.3	61.15	32.31	8.4	19.20	43.7

APPENDIX-II: (Contd..)

Sl. No.	Soil Series.	Depth (cm.)	Gravel 2mm.	pH (1:2.5)	Organ. carbon.	Sand %	Silt %	Clay %	W.H.C.	M.E.	T.E.B. (m.e.)	C.E.C. (m.e.)	Base saturation %
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
5.	Kaipo:	0-16	Nil	4.3	1.62	23.2	37.8	30.0	47.43	18.64	9.3	17.84	51.5
		16-46	"	4.1	0.75	25.2	36.8	38.0	54.11	24.39	9.6	19.20	50.0
		46-63	"	4.0	0.55	18.2	32.8	49.0	58.37	26.93	10.6	21.12	47.3
		63-115+	"	4.4	0.32	21.2	33.8	45.0	55.58	25.56	11.2	20.80	53.8
6.	Maring-kong.	0-12	Nil	4.4	1.24	34.20	30.5	35.3	41.12	18.03	9.2	18.08	50.8
		12-30	2.50	5.2	0.35	33.2	30.5	36.3	42.08	18.50	10.6	20.00	53.0
		30-100	3.33	5.5	0.30	31.2	29.5	39.3	44.18	19.71	13.6	22.84	59.5
7.	Iril:	0-20	Nil	4.8	1.60	50.0	28.7	21.3	42.64	18.31	6.0	11.20	53.5
		20-45	4.68	5.7	0.72	74.9	10.2	14.9	35.53	14.01	4.8	8.00	60.0
		45-51	82.70	.....	.....	g r a v e l	.....	.....	.....	.....	.....	.....	.....
		51-110+	Nil	5.9	0.57	62.9	20.2	16.9	37.03	15.87	5.6	9.20	69.5
8.	Shamulam-jao:	0-22	Nil	5.5	1.14	27.0	40.7	32.3	52.55	23.86	12.66	19.44	52.1
		22-37	"	5.5	0.51	49.0	27.7	23.3	44.39	18.98	6.4	10.4	61.5
		37-42	"	5.4	0.19	79.0	10.7	10.3	18.11	8.00	4.0	6.8	58.8
		42-93	"	5.8	0.32	75.0	7.7	17.3	20.22	9.13	4.8	7.2	66.6
		93-105+	"	5.5	0.25	67.0	13.7	19.3	26.48	11.66	5.6	8.8	63.6

APPENDIX - II : (Contd..)

S.No.	Soil Series.	Depth (cm.)	Gravel 2mm.	pH (1:2.5)	Organ. carbon.	Sand %	Silt %	Clay %	W.H.C.	M.E.	T.E.B. (m.e.)	C.E.C. (m.e.)	Base Saturation %
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
9.	Maseng-kong.	0-12	Nil	4.2	1.56	40.9	28.5	30.6	46.17	20.31	7.2	14.4	50.0
		12-28	"	5.0	0.75	37.9	26.5	35.6	52.45	23.79	8.8	15.2	57.8
		28-51	2.5	5.3	0.57	37.9	25.5	37.6	56.68	26.28	10.8	17.6	61.3
10.	Chowri:	0-25	Nil	5.9	2.25	30.9	30.5	38.5	53.07	25.22	12.0	17.60	68.1
		25-100	"	6.2	0.24	32.9	28.5	40.6	52.19	25.03	12.4	17.60	70.4
11.	Tangshang:	0-15	8.0	4.9	1.22	33.7	33.3	33.0	45.18	19.46	8.4	15.6	63.8
12.	Lilok:	0-8	Nil	5.2	1.02	70.4	12.3	17.3	39.74	17.12	5.6	9.2	60.8
		8-28	"	5.3	0.42	76.4	14.3	9.3	27.36	10.06	4.0	6.4	62.5
		28-40	"	5.7	0.21	81.2	4.5	7.3	26.98	9.31	4.2	6.4	66.2

APPENDIX-III :
METEOROLOGICAL DATA.

Station : Imphal.

Based on observations from 1961 to 1970.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
A	21.3	23.3	27.0	28.5	29.1	28.8	28.9	28.6	29.1	27.5	24.8	21.9
B	3.5	6.2	10.4	14.7	24.6	20.4	21.3	20.9	20.9	16.4	9.5	4.9
C	78	72	63	68	73	82	82	83	81	83	84	85
D	61	53	46	59	65	79	77	79	78	78	75	72
E	14.3	34.2	61.1	94.3	107.3	316.9	225.0	209.3	112.5	134.2	25.7	16.2
F	1.4	3.0	5.5	8.4	10.3	16.0	16.3	15.7	8.2	7.1	2.2	0.8

A = Mean monthly maximum temperature in °C.
B = Mean monthly minimum temperature in °C.
C = Mean monthly relative humidity in % at 8-30 hrs.
D = Mean monthly relative humidity in % at17-30 hrs.
E = Total monthly rainfall in mm.
F = Total number of rainy days.

(M.A.T) = Mean annual temperature - 20.6°C.
(M.W.T) = Mean winter (Dec.,Jan. & Feb.) temperature - 13.5°C.
(M.S.T.)= Mean summer (June, July & Aug.) temperature 24.8°C.
Relative humidity ranges between 54.5 and 80.1.
Annual rainfall (about) - 1350 mm.

Source:

Director, Regional Meteorological Centre, Calcutta.
(through Agrl. Officer (S.L.S.) Manipur).

P A R T I C I P A N T S :

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* * *

SOIL MAP OF IRIL PILOT PROJECT (SHEET NO.I)

P.S. UKHRAL EAST DISTRICT MANIPUR STATE

N.B.S.S. AND L.U.P. (ICAR)
Regional Centre, Calcutta.

LEGEND

Geomorphic unit	Soil series	Mapping unit	Description	P.L.U.	Land capability class	Area ha.	Percentage
Medium hill Top slopes	Pangrum:	P	Deep, well drained, dominantly fine clayey in control section (25–69 cm) on E (00–15°) slopes, moderately to severely eroded.				
		PaE3	Same as above with loamy surface on E(00–15°) slopes, severely eroded	$J_1 F_1$	IVe	28·3	10·4
		PjE2	Same as above with silty clay loam surface on E(00–15°) slopes, moderately eroded.	$J_1 F_1 T$	IIIe	17·6	9·0
Lower slopes	Pangrumkong:	Pk	Deep, well drained, dominantly loamy skeletal in control section (25–56 cm) on B(5–10°) and E(00–15°) slopes, moderately eroded.				
		PkfD2	Same as above with silt loam surface on D(5–10°) slopes, moderately eroded.	J	IIIe	1·2	0·6
		PkaE2	Same as above with loamy surface on E(00–15°) slopes, moderately eroded.	J, W_1	IIIe	13·3	6·8
Upper piedmont	Tingsang:	T	Moderately deep, well drained, clayey skeletal in control section (0–30 cm) on B (1–3°), C(3–5°) and D (5–10°) slopes, slightly to moderately eroded.				
		TjD2	Same as above with gravelly silty clay loam surface on D(5–10°) slopes, moderately eroded.	C_1 F_1	IIIes	3·7	1·9
		TfD2	Same as above with silt loam surface on D(5–10° slopes, moderately eroded.	C_1 F_1	IIIe	3·5	1·8
		TfB1	Same as above with silt loam surface on B(0–3°) slope, slightly eroded.	C_1	IIIs	1·0	0·5
		TfC2	Same as above with silt loam surface on C(3–5°) slopes, moderately eroded	C_1	IIIes	0·8	0·2
		TlD2	Same as above with silty clay surface on D(5–10°) slopes, moderately eroded.	C_1 F_1	IIIes	0·5	0·2
		TlC2	Same as above with silty clay surface on C(3–5°) slopes, moderately eroded.	C_1	IIIes	2·2	1·1
		TjC2	Same as above with silty clay loam surface on C(3–5°) slopes, moderately eroded.	C_1	IIIes	6·4	3·3
		TmB1	Same as above with clay surface on B(0–3°) slopes, slightly eroded.	C_1	IIIs	1·5	0·8
Lower piedmont	Hondrai:	H	Very deep well drained fine clayey in control section (25–100 cm) on B(1–3°) and C(3–5°) slopes, moderately eroded.				
		HfB2	Same as above with silt loam surface on B(1–3°) slopes, moderately eroded.	$W_1 C_1$	IIIe	2·3	1·3
		HaC2	Same as above with loamy surface on C(3–5°) slopes, moderately eroded.	$W_1 C_1$	IIIe	6·4	3·3
		HjC2	Same as above with silty clay loam surface on C(3–5°) slopes, moderately eroded.	$W_1 C_1$	IIIe	1·7	0·9
		HfC2	Same as above with silt loam surface on C(3–5°) slopes, moderately eroded.	$W_1 C_1$	IIIe	2·9	1·5
		HjB2	Same as above with silty clay loam surface on B(1–3°) slopes, moderately eroded.	$W_1 C_1$	IIIe	2·0	1·0
River terrace	Kaipa:	K	Very deep imperfectly drained dominantly fine clayey in control section 25–100 cm. on B(0–3°) to C(3–5°) slopes, slightly eroded.				
		KjB1	Same as above with silty clay loam surface on B(1–3°) slopes, slightly eroded.	C_1 (P)	IIIw	4·9	2·5
		KnB1	Same as above with clay surface on B(0–3°) slopes, slightly eroded.	C_1 (P)	IIIw	2·9	1·5
		KjC1	Same as above with silty clay loam surface on C(3–5°) slopes, slightly eroded.	C_1 (P)	IIIw	9·4	4·8
River terrace	Maringkang:	MR	Very deep, poorly drained, dominantly fine clayey in control section (25–100 cm.) on B(1–3°) to C(3–5°) slopes, slightly eroded.				
		MrCl	Same as above with silty clay surface on C(3–5°) slopes, slightly eroded.	C_1 (P)	IIIw	2·4	1·2
		MrjB1	Same as above with silty clay loam surface on B(0–3°) slopes, slightly eroded.	C_1 (P)	IIIw	13·9	7·1
Flood plain	Iril:	I	Very deep, well drained dominantly coarse loamy in control section (25–100 cm) on A(0–1°), B(0–3°) and C(3–5°) slopes, slightly eroded.				
		IfB1	Same as above with silt loam surface on B(0–3°) slopes, slightly eroded.	C_1	IIIs	0·5	0·2
		IfB2	Same as above with loam surface on B(1–3°) slopes, slightly eroded.	C_1	IIIs	0·4	0·2
		IjB1	Same as above with silty clay loam surface on B(0–3°) slopes, slightly eroded.	C_1	IIs	1·9	1·0
		IjC1	Same as above with silty clay loam surface on C(3–5°) slopes slightly eroded.	C_1	IIs	16·6	8·3
		IjA1	Same as above with silty clay loam surface on A(0–1°) slopes, slightly eroded.	C_1	IIs	3·0	1·5
Flood plain	Shamu-Lam-jaw:	S	Very deep, imperfectly drained, coarse loamy in control section (25–100 cm) on B(0–3°) and C(3–5°) slopes, slightly eroded.				
		SjB1	Same as above with silty clay loam surface on B(0–3°) slopes, slightly eroded.	C_1 (P)	IIIw	0·4	0·2
		SlB1	Same as above with sandy clay loam surface on B(0–3°) slopes, slightly eroded.	C_1 (P)	IIIw	6·8	3·5
		SlC1	Same as above with sandy clay loam surface on C(3–6°) slopes, slightly eroded.	W_1	IIIe	0·9	0·5
Valley land	Moorighong:	M	Deep, imperfectly drained, dominantly fine clayey in control section (25–98 cm.) on C(3–5°) slopes, slightly eroded.				
		MjC1	Same as above with silty clay loam surface on C(3–5°) slopes, slightly eroded.	C_1 (P)	IIIw	2·2	1·1
Valley land	Chowri:	C	Very deep, poorly drained, dominantly fine clayey in control section (25–100 cm) on A (0–1°) slopes, slightly eroded.				
		CjA1	Same as above with silty clay surface on A(0–1°) slopes, slightly eroded.	C_1 (P)	IIIw	3·5	1·8
De	Wagang:	W	Shallow, well drained dominantly fine loamy over fragmental in control section (0–15 cm.) on B(0–3°), C(3–5°) and D(5–10°) slopes, moderately to severely eroded.				
		WjD3	Same as above with silty clay loam surface on D(5–10°) slopes, severely eroded.	W_1	IVes	3·3	1·8
		WjC3	Same as above with silty clay loam surface on C(3–5°) slopes, severely eroded.	C_2	IVes	1·4	0·7
		WkC3	Same as above with clay loam surface on C(3–5°) slopes, severely eroded.	C_2	IVes	0·9	0·5
		WkB2	Same as above with clay loam surface on B(0–3°) slopes, moderately eroded.	C_2	IVs	6·1	3·1
		WmB2	Same as above with clay surface on B(0–3°) slopes, moderately eroded.	C_2	IVs	2·1	1·1
		WmC3	Same as above with clay surface on C(3–5°) slopes, severely eroded.	C_2	IVes	3·1	1·5
		WmD3	Same as above with clay surface on D(5–10°) slopes, severely eroded.	C_2	IVes	2·3	1·3
Slip off slope	Litlak:	L	Moderately deep, well drained, dominantly sandy in control section (25–40 cm.) on C(3–5°) slopes, moderately eroded.				
		LeC2	Same as above with loam surface on C(3–5°) slopes, moderately eroded.	C_2, W_1	IVs	0·8	0·4

REFERENCES

P.L.U.	Present land use
F_1	Thin forest
J	Jhum cultivation
W_1	Waste land fit for cultivation
C_1 (P)	Cultivated single cropped land (paddy)
T	Bushes and weeds
C_4	Occasionally cultivated

Soil boundary
River and stream
Road: Metalled / Unmetalled
Settlement
Slope direction

619 – (2)

SOIL MAP OF IRIL PILOT PROJECT (SHEET NO. 2)

P.S. UKHRAL EAST DISTRICT MANIPUR STATE