

Original Research Article

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Assessment of Soil Physical Analysis for Reclamation of Soil of Jiribam District, Imphal East, Manipur, India

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ABSTRACT

An assessment of physical properties of soil of “Jiribam district” an area of Manipur, India was carried out in 2019-20. The prime objective of this study was collection of information from sampling sites and analysis of physical properties of soil, to make more aware to the farmers. For assessment 9 sampling sites were selected. Soil sample were collected with respect to depth 0-15cm and 15-30cm. The study revealed that mean particle density ranges from 2.355 to 3.4g/cc, mean bulk density from 1.05 to 1.14g/cc, mean pore space range from 70.13% to 56.87% and mean solid space in between 43.42% to 29.83%. The mean water holding capacity range from 80.15% to 66.15% and the mean specific gravity of soil is range from 2.265 to 1.57. Soil texture classes were silty clay to silty loam soil. The soil color found in this region is varied from place to place. Light gray, light yellow brown, olive brown and grayish brown are the most prominent color of these selected sites. It clearly indicated that soil is rich in organic matter and ferrous oxide. A very good water holding capacity of soil and has good physical condition observed.

Keywords

Jiribam district,
Physical properties,
Soil color, Soil
condition etc.

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Introduction

Soil health is the capacity of soil to function as a vital living system, within ecosystem and land used boundaries, to sustain plant and animal productivity maintain or enhance water and air quality, and promote plant and

animal health. Anthropogenic reduction in soil health, and of individual components of soil quality, are a pressing ecological concern (Doran and Zeiss, 2000). The determination of soil quality and health is the combined result of soil fertility, biological degradation (decline of organic matter,

biomass, decrease in activity and diversity of soil fauna), increase in erodibility, acidity, and salinity, and exposure of compact subsoil of poor physicochemical properties. Northeast India is characterized by high soil acidity, toxicity, heavy soil, and carbon loss, severe water scarcity during most part of year though it is known as high rainfall area. The problem soil is those, which owing to land or soil characteristic cannot be used for the cultivation of crop without adopting proper reclamation measures. Highly eroded soil, ravine land, soil on steeply sloping lands etc. constitute one set of problem soil. Acid soil, saline soil and alkaline soil constitute another set of problem soil (Saha *et al.*, 2012). Soil degradation has raised some serious debate and it is an important issue in the modern era, it refers to decline in soil inherent capacity to produce economic goods and perform economic function. It is the net result of dynamic soil degradative and restorative soil process regulated by the natural and anthropogenic factors. The degree of soil degradation depends on soil susceptibility to degradative process, land use, the duration of degradative land use and the management. Among the anthropogenic shifting cultivation play a major role in hilly regions of North East India. 1/3th of the total cultivated land is degraded by shifting cultivation. Thus, create heavy soil erosion in this area. with all this fact in concern, the present work attempted to analyse the physical parameters of Jiribam soil of Manipur. The main reason to study this area is to evaluate soil health status at various depth by analysing the physical properties of soil. So that to make recommendation towards achieving sustainable utilization and agricultural production. The most important reason for choosing this area is that as of very less research paper in this region most of the farmers are not aware about the soil condition. Thus, still they are dependent on conventional method without implementing advance technology.

Materials and Methods

Site details

Manipur is a state of North East India. Geographical area of 22,347 Sqkm and cultivable land 2117Sqkm and forest cover 1,699Sqkm which is 75.46% of state geographical area. District Jiribam lies in western part of Manipur at border of Assam. District lies in 24°48'0.00"N Latitude and 93°07'12.00"E Longitude. Soil sample were taken from Jiribam district of Manipur. Jiribam is highly humid throughout the year. The highest relative humidity occurs during monsoon season, more than 96%. It is maximum of 100% and minimum of 79% in June. Certain type of soil found in Jiribam town and its environment that are mainly well drained except in few flat lands. It varies from sandy to loam and clay to loam and silty clay loam, having variety of color from yellowish to bluish gray (Fig. 1).

The plain has formation of fertile alluvial deposition by the Jiri river. The rainfall is abundant compared to other places of the state. most of the rainfall 90% is in the form of precipitation. about 20-30% of annual rainfall occur in rainy season, second half of June to September, ranging from 1000mm to 1600mm. It constitutes till November in small quantity while that of pre-monsoon is in the form of thunder and shower. A meager quantity of frost is also found in between second half of December.

Soil sampling

Soil sample were collected from different areas within the Jiribam district region having variation in color, slope/ topography. Soil is collected from nine sites with a depth of 0-15cm and 15-30cm. The soil sample were transferred into air tight polythene bags and brought to the Laboratory for further analysis.

Sampling location

Sample selected village of Jiribam district are Lakhipur, Kamranga and Hilghat. The exact location is assimilated with the help of global positioning system (GPS).

Laboratory analysis

The collected soil sample were examining for various physical parameters such as soil color, texture, pore space, solid space, bulk density (B.D), particle density (P.D), specific gravity, water holding capacity (WHC) of soil. The soil color has been compared with Universally accepted Munsell colorchart. All the parameters were analyses as per the method Manual Soil, Plant and Water Analysis, Dr.P.C. Jaiswal

Result and Discussion

Soil texture

The soil texture (Sand, Silt and clay%) of different village of Jiribam district region, Manipur, India (Table 1). The soil texture was found in three different village are silty clay and silty clay loam. The minimum percentage of sand, silt and clay found in three different regions were 15.6% (Lakhipur), 37.95% (kamranga) and 34.71% (Hilghat) respectively. The maximum sand % is in Kamranga (22.32%), silt is in Hilghat (43.52%) and Clay %is maximum in Lakhipur (41.08). Soil texture refers to the relative percentage of sand, silt and clay within a soil layer. Only particle <2mm in equivalent spherical diameter (e.s.d) are included in soil texture descriptions because most physico-chemical activity is in this fine size fraction. Soil texture and textural are especially important aspect of modern soil research because they affect water holding capacity and base saturation, which related to agronomic productivity.

Soil color

The soil color (Dry method) of three different village of Jiribam district, Imphal East, Manipur. The soil color of the village varies from brown to gray color. The sample of Lakhipur and Hilghat is mostly of light-yellow brown in color. Whereas the Kamranga soil is light gray color. The soil color (wet method) of most of the village found is light brown gray, olive brown and grayish brown. Kamranga soil is dominant by grayish brown color and Hilgh at soil color is olive brown to light olive brown color. The soil color is often determined by the presence of iron oxide and organic matter. When the presence of iron oxide dominates than organic matter, it appears from brown to reddish brown color (Woperis *et al.*, 2009). Most of the soil appear gray or greenish brown by the presence of reduce (ferrous) iron oxide. The presence of other material can also affect soil color, manganese oxide causes black color, glauconite make the soil green and calcite make the soil arid and appears white color (Table 2 and 3).

Bulk density

In village the maximum mean bulk density was found at Lakhipur (S_1) and minimum bulk density is found Kamranga (S_5) and Hilghat (S_8). The bulk density decreases with increases soil depth. Different level of erosion of soil depending upon the slop and management. Soil particles also responsible for higher bulk density which might be due to greater compaction that might have occurred in the lower horizon of the soil profile with time. Bulk density is dependent on soil organic matter, soil texture, the density of soil mineral (sand, silt, and clay) and their packing arrangement. As a rule of thumb, most rocks have a density of 2.65 g/cm^3 so ideally, a silt loam soil has 50% pore space and a bulk density of 1.33 g/cm^3 (Fig. 2 and Table 4).

Table.1 Evaluation of soil texture of different soil of Jiribam district Manipur

Village	Sand %	Silt %	Clay%	Textural class
LAKHIPUR	15.6	42.6	41.08	Silty clay
KAMRANGA	22.32	39.73	37.95	Silty clay loam
HILGHAT	21.77	43.52	34.71	Silty clay loam

Table.2 Soil color (Dry method) of different depth (0 -15cm and 15 -30cm) of three different village of Jiribam district, Manipur

Village		0 -15 cm Depth	15 – 30 cm Depth
Lakhipur	S ₁	2.5Y,7/2 light gray	2.5Y,6/2 light brownish gray
	S ₂	2.5Y,6/4 light yellow brown	2.5Y,6/4 light yellow brown
	S ₃	2.5Y,7/2 light gray	2.5Y,6/4 light yellow brown
Hilghat	S ₄	2.5Y, 6/4 light yellow brown	2.5Y,6/4 light yellow brown
	S ₅	2.5Y,6/4 light yellow brown	2.5Y, 6/4 light yellow brown
	S ₆	2.5Y,6/4 light yellow brown	2.5Y,5/4 light olive brown
Kamranga	S ₇	2.5Y,7/2 light gray	2.5Y, 7/2 light gray
	S ₈	2.5Y, 7/2 light gray	2.5Y,7/2 light gray
	S ₉	2.5Y, 7/2 light gray	2.5Y, 7/2 light gray

Table.3 Soil color (wet method) of three different village of Jiribam district, Manipur

Village		0-15 cm Depth	15 – 30 cm Depth
Lakhipur	S ₁	2.5Y, 6/2 light brown gray	2.5Y4/4 Olive Brown
	S ₂	2.5 Y, 5/2 Grayish brown	2.5Y,5/4 Light olive brown
	S ₃	2.5Y,5/2 grayish brown	2.5Y, 4/2 Dark grayish brown
Hilghat	S ₄	2.5Y ,4/4 olive brown	2.5Y 4/4 Olive brown
	S ₅	2.5Y,4/4 Olive brown	2.5Y, 5/4 light olive brown
	S ₆	2.5Y, 4/4 Olive brown	2.5Y,5/4 light olive brown
Kamranga	S ₇	2.5Y, 5/2 Grayish brown	2.5Y,5/2 Grayish brown
	S ₈	2.5 Y,5/2 Grayish brown	2,5Y, 5/2 Grayish brown
	S ₉	2.5Y,5/2 Grayish brown	2.5Y, 5/2 Grayish brown

Table.4 Physical properties of soil with two depth (0-15cm and 15-30cm) of three different village

Parameters	Village Name																	
	Lakhipur						Kamranga						Hilghat					
	0-15cm			15-30cm			0-15cm			15-30cm			0-15cm			15-30cm		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₇	S ₈	S ₉
Bulk density	1.11	1.05	1.05	1.17	1.11	1.17	1.11	1.05	1.05	1.11	1.05	1.11	1.05	1.05	1.05	1.11	1.05	1.17
Particle density	3.0	2.71	3.16	2.42	2	2.12	3	2.71	3.16	2.25	2.37	2.25	3.8	3.8	3.1	3	2.71	2.83
Pore space	66.66	63.15	68.42	58.82	50.00	52.94	66.66	63.15	68.42	55.55	57.89	55.55	73.60	73.60	68.42	66.66	63.15	64.70
Solid space	33.33	36.84	31.57	41.17	50.00	47.05	33.33	36.84	31.57	44.44	42.10	44.44	26.31	26.31	31.57	33.33	36.84	35.29
Specific gravity	2.02	1.73	1.72	2.26	2.16	2.14	2.13	1.40	1.83	2.40	1.74	2.09	1.76	1.70	1.86	1.81	1.83	1.85
Water holding capacity	81.08	81.08	71.05	80.00	80.55	69.44	76.31	74.35	69.23	70.27	73.68	67.56	69.23	76.92	68.42	63.15	64.86	63.88

Fig.1 Satellite map of sampling sites of Jiribam district



Fig.2 Bulk density of soil with two depth (0-15 cm and 15-30cm)

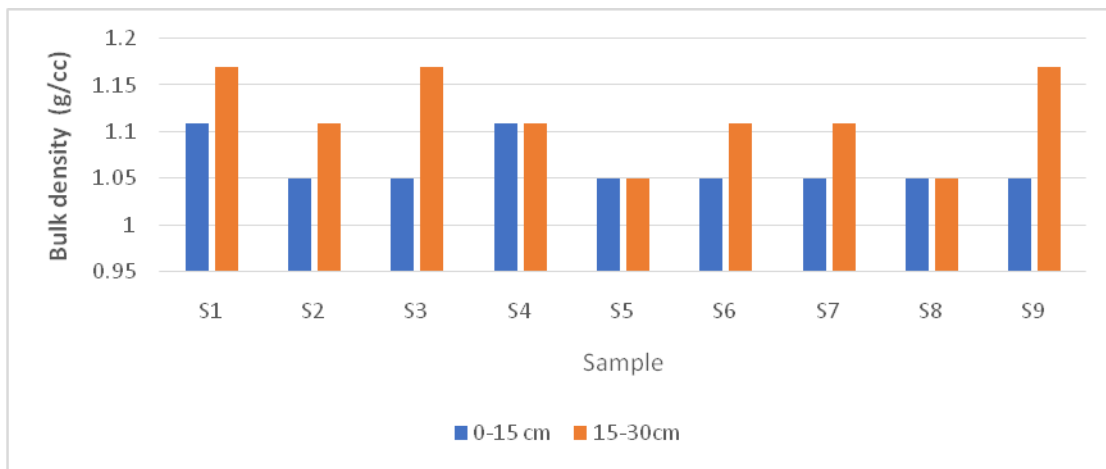


Fig.3 Particle density of soil with two depth (0-15 cm and 15-30cm)

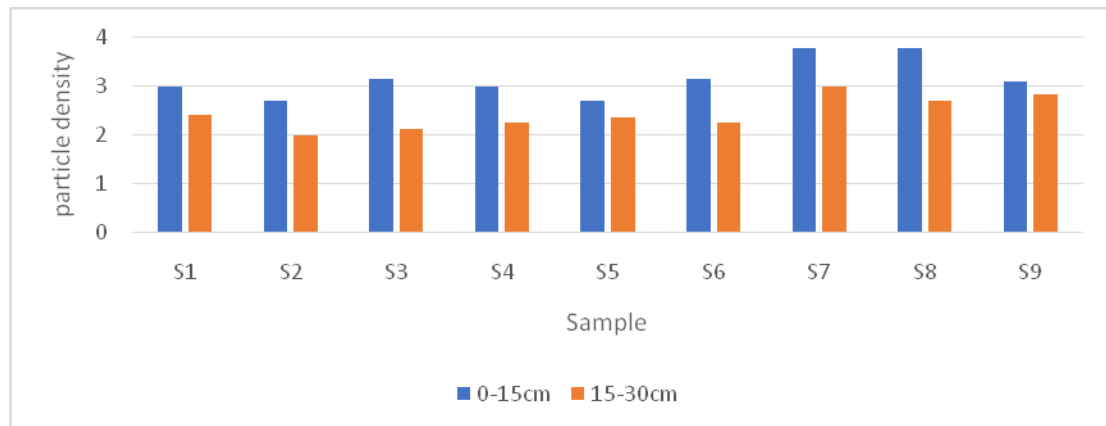


Fig.4 Pore space of soil with two depth (0-15cm and 15-30cm)

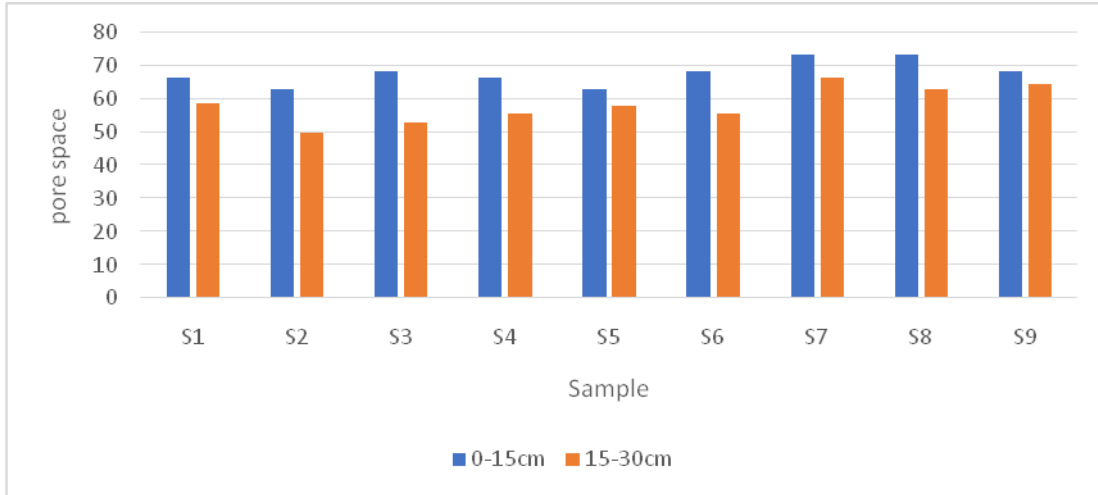


Fig.5 Solid space of soil with two depth (0-15cm and 15-30cm)

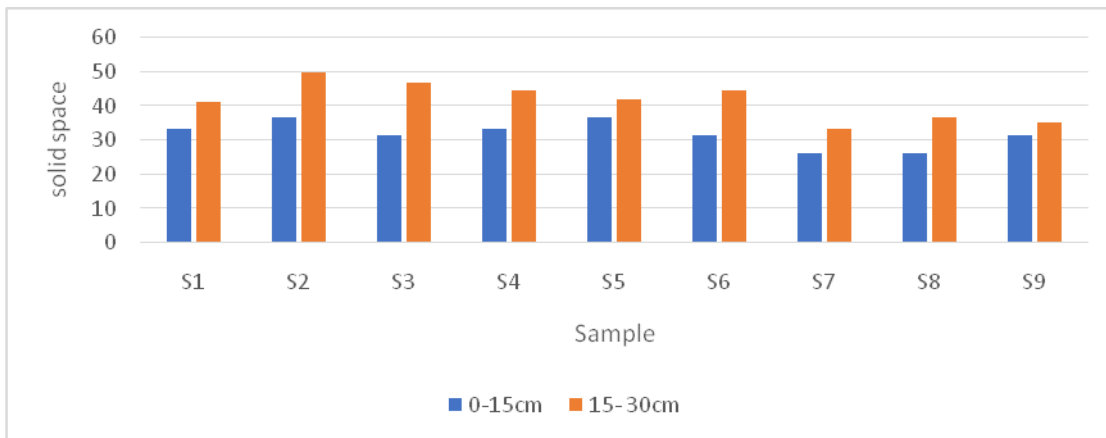


Fig.6 Specific gravity of soil with two depth (0-15cm and 15-30cm)

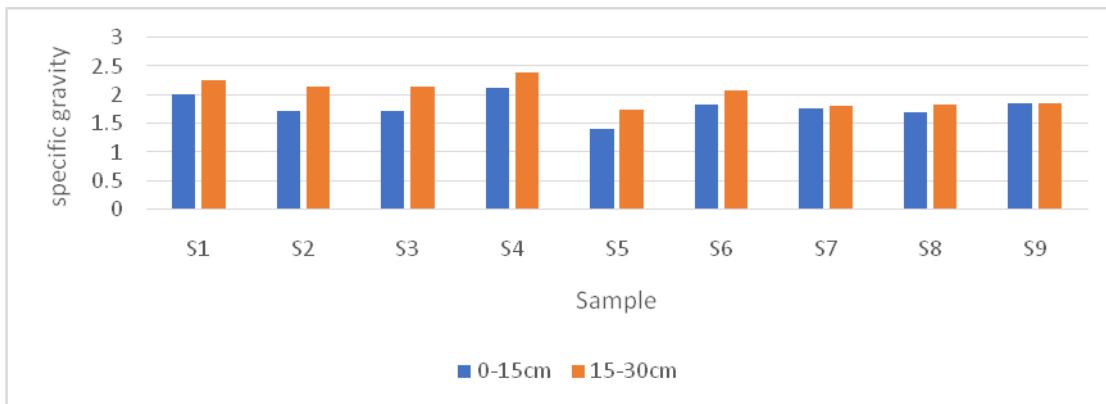
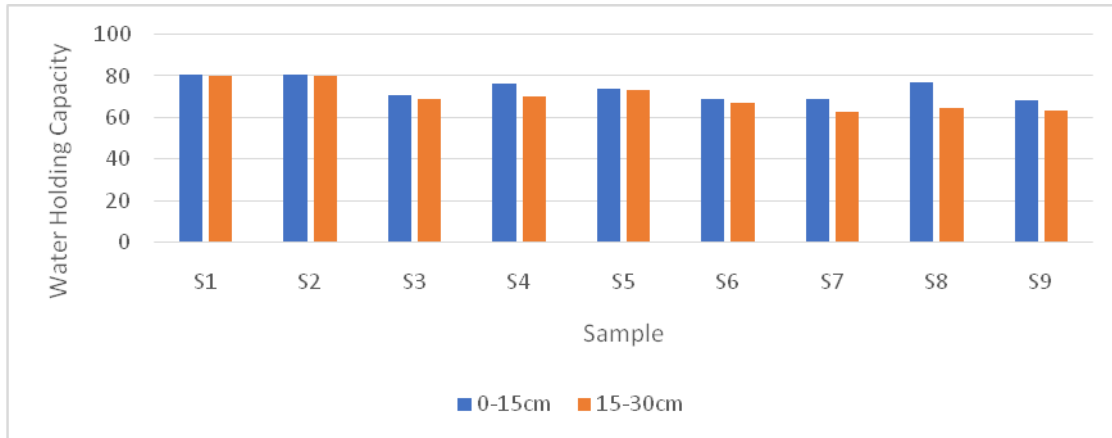


Fig.7 Water Holding Capacity of soil with two depth (0-15cm and 15-30cm)



Particle density

Particle density is the density of the solid particles that collectively make up a soil sample. The value is commonly expressed in grams per cubic centimeter. The common range among soils is 2.55 to 2.70 g cm⁻³ the highest mean particle density is found at Hilghat (S₇) and lowest is at Lakhipur (S₂). Particle density varied according to mineral content of the soil particle. It doesn't usually vary a lot in moist soil (Fig. 3).

Pore space

The highest mean pore space % was found at Hilghat (S₇) of 70.13% and lowest mean Pore space is at Lakhipur village (S₂) of 56.87%. The pore space of soil contains the liquid and gas phases of soil. In order to understand porosity better a series of equations have been used to express the quantitative interactions between the three phases of soil (Fig. 4).

Solid space

In village the highest solid space is at Lakhipur (S₂) and the lowest is at Hilghat (S₇). The solid phase that contains mainly minerals of varying sizes as well as organic compound (Fig. 5).

Specific gravity

In village the maximum mean specific gravity was found at Kamranga (S₄) and lowest at Kamranga (S₅). The specific gravity of the soil particles lies within the range of 2.65 to 2.85. Soils containing organic matter and porous particles may have specific gravity values below 2.0. Soils having heavy substances may have values above 3.0 (Fig. 6).

Water holding capacity (%)

Water Holding Capacity is the ability of a certain soil texture to physically hold water against the force of gravity. It does this by soil particles holding water molecules by the force of cohesion. As an example, a sandier soil has much less water holding capacity than a silt loam soil.

In village the highest mean water holding capacity was found at Lakhipur (S₂) 80.815% and lowest is at Hilghat (S₉) 66.15%. The variation was due to the silt, clay and organic carbon content and low water holding capacity in sandy soil due to high sand and less silt content. The irregular trend of water holding capacity with depth was due to the illuviation and eluviation of finer fraction in different horizons (Fig. 7).

As the result above concluded the physical condition of soil is good. Soil has very good water holding capacity and the electrical conductivity value found is good and won't affect the germination of seed.

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