ISSN: 0974-5823 Vol. 7 No. 4 April, 2022

International Journal of Mechanical Engineering

Characterization of Soil-Physical Properties, Surajpur, India

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Abstract

Study of characteristics of soil, the primary goal of this research is to gather data analysis of on soil Physical Properties and find of the relation of crops production in agriculture. Physical properties are Soil colour, soil textures (Sand%,Slit%,Clay%), Maximum water holding Capacity(Gravitational in disturbed samples%), Bulk Density, Particle density and Porosity. Soil samples were taken from agriculture land at several locations throughout the Surajpur district at Sargija division, including the villages- (Ramanujnagar, Premnagar, Surajpur, Bhaiyathan, Pratappur and Odgi). These analytics agricultural are with help of the research, we discovered that Bulk Density value ranged from 1.52 to 1.60(Mg/m^3). The Particle Density value is typical and ranges from 2.51 to 2.60 (Mg/m$^{3)}$. The percentage of WHC detected ranged from 42.63 percent to 47.59 percent, which is a low - to - medium amount. The percentage of porosity detected ranged from 37.01 percent to 40.77 percent indicating a medium to moderate level. All of these qualities aid in a better knowledge of soil physics, agricultural applications, and remote sensing data analysis. This research also aids farmers in making the best crop choices.

Keywords: Physicochemical properties, soil, district, village, depth, nutrients.

1. Introduction

Soil is defined as a thin layer of the earth's crust which acts as a natural substrate for plant growth. Soil provides a growing substrate for plants to meet our food and fibre requirements. Soil fertility is one of the most critical variables that regulates crop growth and production. Soil is considered to be a vital aspect of ecosystem which must be conserved in the context of the environment, and it really is crucial to investigate the potential total impact of preservation measures. Whenever a soil degrades, related ecological aspects degrade as well [1]. Soils are perhaps the most important natural resources for agricultural operations. Agriculture and its allied pursuits, which are founded on the research of soil resources, are responsible for the production of fodder, food, and fuel to meet the ever-increasing demands of humans and animals. Plant needs enough excellent soil to contain their roots and give necessary nutrients. Soil is used to cultivate food, fibre, ornamental plants, and lumber, progressively, biofuels. Varied soil management approaches are needed for various agricultural purpose [2]. Furthermore, industrial product variations are reliant on agriculture and forest products that are directly derived from the soil. For long-term production, it's crucial to be familiar with soil's potential, limitations, and uses, as well as how to maintain soil without deteriorating it. It's also crucial to put damaged land back into use after proper reclaiming. Understanding of these types of soil, as well as its distribution, is critical for effective planning and optimal are using in agriculture output. The one and only way to make a soil inventory is to conduct a soil assessment [3]. Soil assessment helps determine soil potency and agricultural production restrictions, and also provide extensive data on many soil factors [4]. Soil is agriculture's most fundamental asset, and it must be managed properly in order to preserve agricultural output and soil health. Soil testing has been one of the greatest instruments for determining the physical properties and nutrient content of a land in order to determine the fertiliser requirements for a crop or farming pattern, as well as to determine the revitalization demands if the soil is saline/sodic in character. The best current strategy for collecting the financially feasible potential crop yields by boosting inputs resource utilization and sustaining soil quality is fertiliser administration depends on soil analyses [5]. Rice is grown in greater quantities in India's central region. Chhattisgarh is a state in India's central region.

Chhattisgarh is subdivided geographically into three major areas of land: the plains of Chhattisgarh, the Bastar Plateau, and the Northern Hill Regions. In different parts of the state, yearly rainfall ranges from less than 1200 mm to more than 1600 mm. The states of Uttar Pradesh within north, Bihar in the northeast, Orissa in the east, Andhra Pradesh in the south and southeast, Maharashtra in the southwest, and Madhya Pradesh in the west all border Chhattisgarh. Paddy is indeed the state's principal crop, and the state was once famous as the "Rice Bowl of Central India" due to the abundant paddy cultivation. Yellow and red dirt cover large areas of Chhattisgarh. In Chhattisgarh, there are many varieties of soil, however the four primary types are Kanhar, Matasi, Dorsa, and Bhata, that comprise the large portion of total landmass. Un - hydrated ferric oxide and moderately hydro-oxides are responsible for the red colour of soil. Iron oxides are also responsible for the soil's yellow tint. Significant mineral components such as nitrogen, phosphorus, lime, and potash are concentrated in the bottom regions of the soil layer in the region's soils. The region's tropical yellow and red soils, as well as red sandy soils, provide texture that is appropriate for producing crops. The most common soil types in the state are red and yellow loamy soils. Varied soils have variable percolation/water retention capacities, as well as different productive capacities. In Chhattisgarh, the following soil types can be found:

Kanhar (clayey) is a dark bluish black low-lying soil with a strong moisture absorption capability. It's perfect for rabi crops, especially wheat.

Matasi (sandy loamy) is a yellow sandstone soil with a clay admixture. It only holds a small amount of moisture. Despite the fact that it is utilised for paddy.

Dorsa (clay-loam)- This soil type is halfway between kanhar and matasi in terms of soil moisture retention. This colour is classified as loamy, and it is a mix of brown and yellow. Bhata (laterite) is a red sandy-gravelly soil with a coarse texture found on upland summits. Minerals and other productivity-enhancing micronutrients are in short supply.

2. Materials and Methods

2.1 Soil Sampling

At depths ranging from 0 to 20 cm, soil samples were gathered in a crisscross pattern from numerous sites Surajpur District at Sarguja division of Chhattisgarh, India (Block: Ramanujnagar, Premnagar, Surajpur, Bhaiyathan, Pratappur, Odgi). For every sample, five holes were made. After properly coordinating all the previous soil samples, a composite sample weighing 3 to 4 kg was taken, indicating that a single site was recommended. When arranging compound samples that represented all the sites, this technique was applied once more. The gyrator sieve shaker, which also aids in the separation of topsoil samples, is used to separate the finer particles first. These small particles are sieved and then dried for approximately 24 hours at around 60°C in a hot air oven to remove any residual moisture.

2.2 Theory

In the analysis lab, the physicals characteristics of soil sample are calculated. The inquiry uses a large number of soil specimens with a variety of physical and chemical characteristics. This study only looks at the changes and effect physical of soils in crops production.

2.2.1 SOIL MOISTURE PARAMETERS

We can calculate additional soil water content characteristics by knowing the soil bulk density b and particle density p. For instance, mass of water content mg may be expressed as

$$m_g = \frac{\text{Mass of water}}{\text{Mass of dry soil}} = \frac{m_w}{m_s} = \frac{\rho_w b}{\rho_p c} \quad ..... (1)$$

Where, ρw Where w is the density of water, b is the corresponding depth of water, and c is the equivalent depth of solids. The mass of water is given by the difference between the before ms+w and after ms readings. However, knowing mg does not offer enough information to estimate the comparable depth of water in the field without knowing the volume of water. As a result, mv is defined as:

$$m_v = \frac{\text{Volume of water}}{\text{Bulk volume of soil}} = \frac{b}{D} \quad ..... (2)$$

And it is just the ratio of the corresponding depth of water to the equivalent depth of solid D soil. Thus, mv = 0.36 if 360 mm of water is detected in 1000 mm of soil. Because of its simple and direct relationship to other parameters of relevance, this measurement is the most usable statement of soil water content. Using Eq. (2), the equivalent depth of water is defined as follows:

$$b = m_v D \quad .... (3)$$

These ideas also allow for the expression of porosity relations in a rather straightforward manner. The soil's total porosity is stated as

$$P = \frac{\text{Total pore volume}}{\text{Buulk volume of soil}} = \frac{(a+b)A}{DA} = \frac{a+b}{D} \quad .... (4)$$

Where a denotes the airspace and A denotes the region. P's value may range between 0.3 and 0.6. (30 and 60 percent). Thus, in a saturated soil, all of the pore volume would be filled with water mv (saturated) = P. The air-filled pore volume is expressed as

$$P_a = \frac{\text{air pore volume}}{\text{Bulk volume of soil}} = \frac{aA}{DA} = \frac{a}{D} \quad ..... (5)$$

Another parameter often used is relative saturation mvt, the ratio of mv to its saturated volume mvs, given as

$$m_{vr} = \frac{bA}{(a+b)A} = \frac{b}{a+b} = \frac{m_v}{m_{vs}} \quad ..... (6)$$

In practice, wet mass, dry soil mass, and bulk volume are measured and mg, mv, and b are determined. If b for the soil is known, the other values may be computed using the aforementioned relationships. Another unintended consequence of the above equation is

$$m_g = \frac{m_{s+w} - m_s}{m_s} \quad .... (7)$$

Where ms+w is the moist soil mass and ms is the dry soil mass. This equation avoids the requirement to calculate the mass of water and is based just on the fundamental date. A knowledge of mv is often sought since it is simple to convert it to mg using the relation.

$$m_v = \frac{\rho_b}{\rho_w} m_g \quad ..... (8)$$

Which of the following needs just knowledge of b? It is typical practise to measure b once throughout the season and presume that it does not vary over time. Except for top soil, this assumption holds true for many soils.

3. Result and discussion

The research helps in deciding the advantage of different physical framework and nutrient congregation of soil from Surajpur District at Sarguja division of Chhattisgarh, India (Blocks-Ramanujnagar, Premnagar, Surajpur, Bhaiyathan, Pratappur, Odgi).

Physical properties

The study aids in determining the benefits of various physical frameworks and nutrient concentrations in soil from the Surajpur District at Sarguja division of Chhattisgarh, India. Physical Properties like this – Soil texture. Soil colour bulk density, particle density, porosity and maximum water holding capacity etc. it's very important parameters for good production of crops and good health of soil.

This area's soil is mostly black. Soil investigation labs examine the soil's physical-characteristics. Filtration and sedimentation methods are used to determine the soil's textural makeup. The soil triangle is used to figure out what kind of soil you have. A great number of samples collected, each with its own different texture, are collected. The soils are dried and processed into a fine powder in an oven. Figure 1, 2 and 3 shows that sand rates decrease as the Water holding Capacity increases, whereas they increase with the level of residue and earth in the soil increases. The physical parameters of soil in the Surajpur District at Sarguja division of Chhattisgarh, India are shown in Table 1.

Table 1: Physical characterization of soil samples of Surajpur District at Sarguja division of Chhattisgarh, India Region

S. No.	Location	Bulk Density (Mg/m^3)	Particle Density	Maximum water holding capacity	(%) Primary particles based on ISSS Fraction				Porosity
			(Mg/m^3)	%	Sand%	Silt% P	Clay%	Textural Name	%
1.	Ramanujnagar	1.54	2.60	42.63	52	36	12	Silty loam	40.77
2.	Premnagar	1.56	2.58	45.27	52	38	10	Silty Loam	39.54
3.	Surajpur	1.52	2.56	43.51	68	18	14	Loam	40.62
4.	Bhaiyathan	1.60	2.54	47.59	86	4	10	Loamy Sand	37.01
5.	Pratappur	1.56	2.51	47.20	78	10	12	Loamy Sand	37.85
6.	Odgi	1.58	2.53	43.76	86	6	8	Loamy sand	37.54

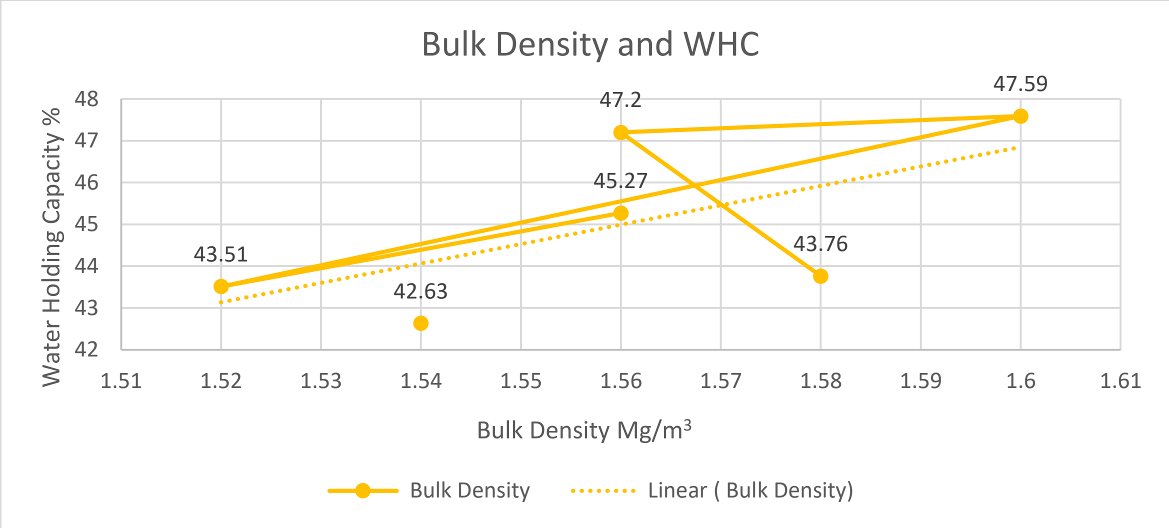

Fig. 1. Variation of Bulk Density with various Water holding capacity.

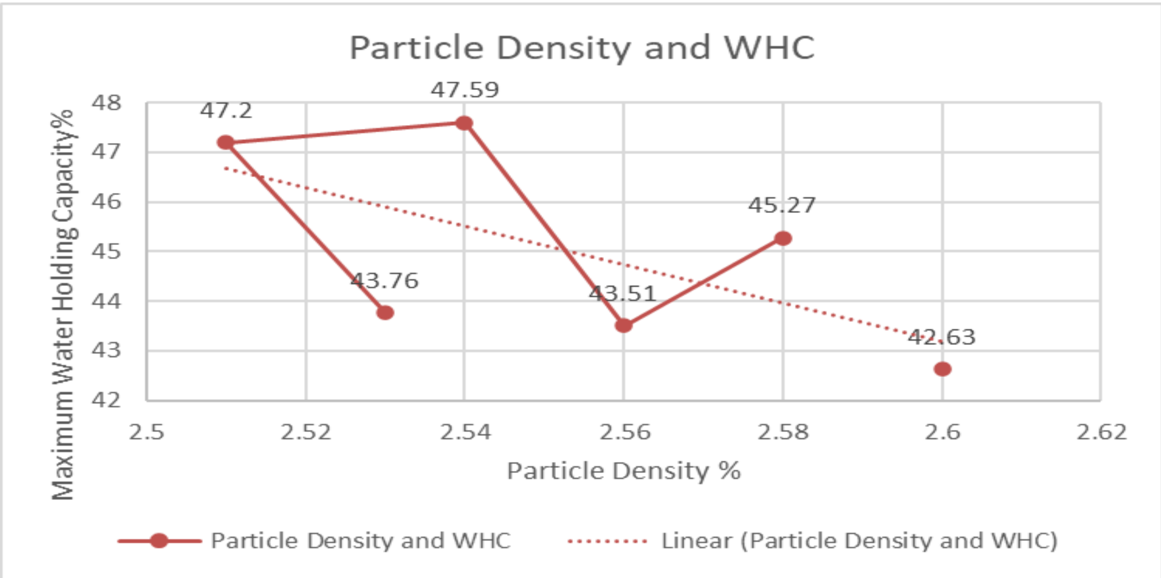

Figure 2. Deviation of Particle density with various WHC for soil sample.

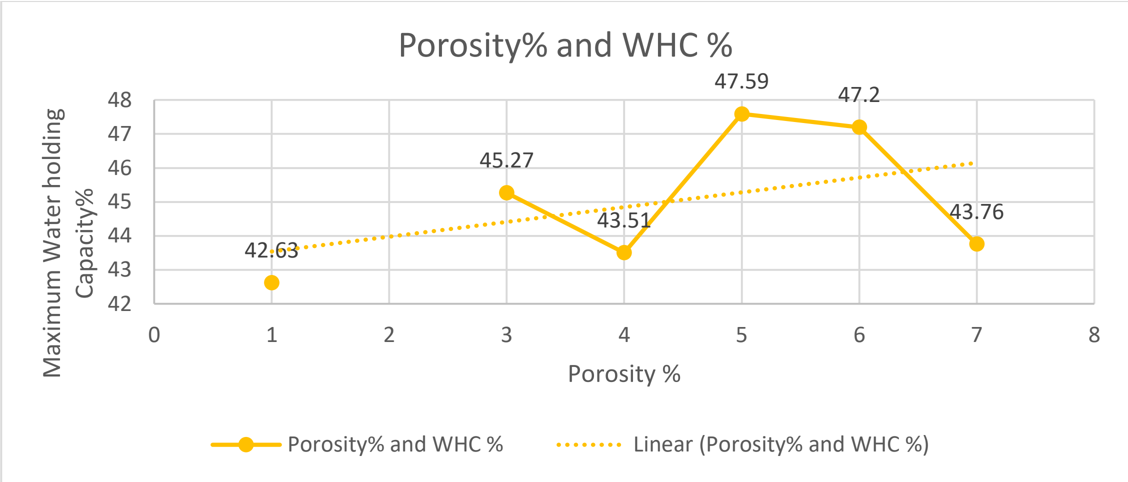

Figure 3. Deviation of Porosity with various WHC for soil sample.

4. Conclusions

These findings are beneficial to agricultural scientists and scientists who work in the field of remote sensing and others That measuring regional variability and mapping soil attributes is a crucial pre-requisite for agricultural soil maintenance, as well as for focusing on the areas of land degradation. Since these maps will quantify regional variation and offer the foundation for regulating it, the creation of soil nutrient maps is first stage in precision farming. This would aid in minimising the number of inputs provided to the soil in the form of supplements in order to avoid overburdening the soil, which could result in contamination and land degradation. The findings reveal that soil attribute's regional distribution and spatial dependence might differ even in the same local authority jurisdiction. These findings can be utilised to provide suggestions for optimal management practises in the area, as well as to enhance small - scale farmer's livelihoods. Benefits of farmers to increases of crops production and choice right seeds -crops.

5. Conflict of interest

There is no conflict to declare.

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