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Evaluation of the Physical and Chemical Characteristics of the Soil

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ABSTRACT: Soil basically sustains human life through provision of food, clothing & shelter. Agriculture, especially, is prone to be entirely based on subsurface material health. In India, agriculture has been developed in the form of wheat, rice, jowar legumes, sugarcane, vegetables & fruits. Efficient management of agricultural l& is necessary for the optimal utilization of subsurface material resources, & knowledge of the physical structure & chemical properties of the subsurface material is critical. The study of subsurface material physico-chemical properties is particularly significant, since it can include the study of factors including acidity measure, electric conductivity, subsurface material particle composition, water availability in subsurface material, subsurface material thermal condition, organic matter, & the concentration of the macro & also micros nutrients. These parameters clearly have impact on how the subsurface material can be operated & are of paramount importance for the subsurface material sustaining the productivity to maintain the Indian agriculture a success.

KEYWORDS: physicochemical properties, subsurface material pH, electric conductivity

I. INTRODUCTION

Subsurface material is a biological rhythm - in which biological products (crops) grow & it is subjected to vegetation ecosystem. It is one of the most crucial natural resources of a nation & knowledge of its properties is highly essential in order to elaborate a better management strategy for enhancing agricultural production[1]. An undesirable change in the nutrient status of the subsurface material, the concentration of organic matter, structural characteristics, & harmful substances in the subsurface material causes subsurface material decomposition, which explains the decline in subsurface material productivity[2]. It is necessary to consider of the fact that subsurface material pollution can be anthropogenic or natural. The use of pesticides in agriculture or the release of radionuclides from nuclear power stations are two examples of specific activities that are linked to most pollutants. However, different pollution sources can produce a wide range of pollutants[3].

It takes industrialization & agricultural growth to provide people with the necessities of life. Environmental preservation is also essential. In an effort to increase agricultural output, the farmers misused fertilizers & pesticides, which had a negative impact on the environment quality & subsurface material health [4]. The balance of nitrogen, phosphorus, & potassium is a crucial indication in crop productivity that makes the distinction between balanced & unbalanced fertilization. Thus, for a good crop production, balanced fertiliser application is essential. Underst&ing the basic physico-chemical properties of subsurface material is essential since they impact environmental quality & food vintage[5].

Contribution of Physical & Chemical Attributes to Subsurface material Functionality

Though connected, l& & subsurface material is a pair of distinct units. Farml& is a 2D entity that reflects a geographic region & l&scape, but subsurface material, which is found beneath the surface of the l&, is a 3D body having length, width, & depth[6]. It is mainly concealed from view until it gets lost & leaves the area. To identify it, a pit must be excavated to show its profile. As a living interface, the Earth's subsurface material layer bridges the geological, aquatic, biological, & atmospheric spheres in a complex & responsive system [7]. Various biogeochemical processes support & aid in the development of essential ecosystem services such as water quality, biotic activity, & plant productivity. These activities occur here. Subsurface material separates the terrestrial hydrologic system[8].

The subsurface material divides the terrestrial hydrologic cycle into three components: runoff, percolation, & evapotranspiration. It is both a source & a sink for mineral elements & gases, as well as a place to grow plants & decompose crop residues[9]. It is a living factor in which millions of tiny organisms work around the clock to transform organic matter & participate in the carbon & nitrogen cycles. Life on our home planet, Earth, would be impossible

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without subsurface material, & life would be unrealistic without subsurface material[10]. It's no surprise that astronauts searching for evidence of subsurface material, life, & water on the moon brought subsurface material samples with them to perform detailed studies for evidence of life. Subsurface material is a natural source of information[11].

II. SOIL PH

Soil acidity measure is a measurement of the subsurface material's acidity or alkalinity. It is also referred to as a "subsurface material reaction." The acidity measure of the subsurface material affects nutrient solubility. It also has an impact on the activity of microorganisms that break down organic matter & most chemical transformations in the subsurface material[12]. Thus, subsurface material acidity measure influences the availability of various plant nutrients. Because most plant nutrients are readily available in this range, a acidity measure range of 6 to 7 is generally most favorable for plant growth. However, some plants require subsurface material acidity measure levels that are higher or lower than this. Calcium, magnesium, & phosphorus availability is generally low in subsurface materials with a acidity measure below 5.5. Aluminium, iron, & boron are very soluble at these low acidity measure levels[13].

Many distinct factors can contribute to the acidity or alkalinity of subsurface materials. Mineralogy, climate, & weathering all have an impact on the acidity measure of natural systems[14]. Because of acid-forming nitrogen fertilisers or the removal of bases, subsurface material management frequently modifies the natural pH. When exposed to air, subsurface materials containing sulphur-forming minerals may become extremely acidic. The subsurface material is drained in these areas, which are frequently found in coastal flats or closer to recent mining activities. Before making management choices that rely on the acidity measure of the subsurface material, it is usually advisable to test the acidity measure of the subsurface material[15].

Soil salinity measurement

It gauges the amount of soluble mineral content of the subsurface material. Neutral soluble salts in excess, primarily calcium, magnesium, sodium chloride & sulphates are what distinguish salt-affected subsurface materials from other types. In general, these "holomorphic subsurface materials" are divided into saline & alkaline subsurface materials based on the type of soluble salts they contain[16]. In general, these "holomorphic subsurface materials" are divided into saline & alkaline subsurface materials based on the type of soluble salts they contain. Saline subsurface materials are primarily found in dry & semi-arid areas & are characterized by the presence of white patches of salt crust on the surface[17]. The expansion Excessive soluble salts have a negative impact on the growth of most crop plants. Salt builds up on the subsurface material's surface in arid & semi-arid locations because of excessive subsurface material moisture evaporation & capillary migration upward[18]. Saline subsurface materials frequently display a white efflorescence of salts on their surface during dry periods. They are also sometimes referred to as "white" or "white alkali subsurface materials" for this reason. Na+ can enter solution & generate Na_2CO_3 & $NaHCO_3$ when significant quantities of Na+ are present on exchange sites. The deflocculating of clay & organic matter particles is due to the high subsurface material acidity measure & the presence of comparatively low salt concentrations. As a result, the subsurface material structure becomes unstable. The subsurface materials are frequently referred to as "black alkali subsurface materials" & are black because of the distributed humic particles[11].

Soil Structure

Regarding, its physical composition, subsurface material is a mixture of abiotic particles, decomposing organic matter, air, & water. Abiotic particles of varying sizes (s&, silt, or clay percentage) usually cluster together to produce complex & uneven patterns of secondary particles known as aggregates or pads. These fundamental soil particles & derived aggregates are arranged into a specific structural pattern, which is referred to as the "soil structure"[19]. Subsurface material structure plays a vital role in governing numerous physical functions of the subsurface material, such as water movement & retention, porosity & airflow, & heat transfer. Agricultural practices—like tillage, cultivation, use of fertilizers & organic manures, the application of subsurface material amendments (such as lime or gypsum), & irrigation—can all alter the subsurface material structure. These structural changes, in turn, affect key subsurface material functions, influencing root development, nutrient & water absorption, & ultimately, crop performance & yield [20].

The formation of stable aggregates, particularly granular & crumb types, is largely influenced by the presence of organic matter. Root exudates & other organic compounds contribute significantly to the stabilization of these aggregates.

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Soil Bulk Density:
The definition of bulk density in subsurface material is its oven dry weight per unit volume, which is typically given as g or Mg. A silty loam subsurface material typically has a bulk density of about 1.33 g [21]. The bulk density of the subsurface material is determined with its subsurface material particle composition, mineral matter density, organic content, & compacted. Organic matter-rich subsurface materials have a lower bulk density, & as the layer of sub subsurface material increases, the bulk density gradually rises. In comparison to light Subsurface material particle composition s&y subsurface material, compact subsurface materials like clayey subsurface material have a higher bulk density[6]. The bulk density of a subsurface material affects a number of significant subsurface material characteristics that are connected to the health of the rhizosphere &, as a result, to plant growth. If it is greater than 1.6 g/cm^3 [22], it can prevent roots from growing properly.

Soil particle composition:
In particular, coarse s& (2.0-0.2 mm), fine s& (0.2-0.02 mm), silt (0.02-0.002 mm), & clay are the four main particle size fractions that form subsurface material. Subsurface material particle composition refers to the relative amount of these fractions (less than 0.002 mm)[23]. The most common way to describe a subsurface material's physical composition & how it affects behaviour is by describing its subsurface material particle composition, which is thought of as a permanent natural property of the subsurface material. S&-based subsurface materials are more prone to drought because s& particles can't hold much water. The component that most affects the behaviour of the subsurface material is clay because it has a negative charge & more surface area per unit mass [24]. When subsurface material is wet & then dried, the subsurface material grows & shrinks as a result of the water getting collected by the clay mineral & being hydrated. Normal farming practices usually do not affect the subsurface material's subsurface material particle composition at all. However, regular flooding of l& & the consumption of substantial amounts of inorganic amendment materials (e.g., coal ash) also significantly change subsurface material particle composition [25].

Soil Color:
Subsurface material color can serve as a quick indicator of a subsurface material's condition & several key characteristics. For instance, darker surface subsurface materials tend to absorb more sunlight than lighter ones, resulting in faster warming. Color is frequently used as a distinguishing factor in subsurface material classification systems & plays a role in interpreting subsurface material profiles. It can also reflect the influence of other factors, such as salt accumulation or erosion. To determine subsurface material color accurately, the widely accepted 'Munsell' color chart is commonly used as a st&ardized reference [26], [27].

Soil thermal condition
Soil thermal condition is primarily governed by the balance between the energy it absorbs & the energy it releases. Typically, subsurface material subsurface material thermal conditions can range from -20°C to 60°C. This parameter is considered one of the most important subsurface material characteristics, as it significantly influences the chemical, physical, & biological processes essential for plant development. Factors such as seasonal variation, time of day, & local climate conditions all contribute to fluctuations in subsurface material subsurface material thermal condition [28]–[30].

Soil Chemical Properties
Subsurface material chemical properties encompass the concentrations of various substances, including nitrogen, phosphorus, carbon, essential cations like calcium, magnesium, potassium, & sodium, as well as sulphur, trace elements, cation exchange capacity (CEC), base saturation, salinity, sodium adsorption ratio (SAR), & certain enzymes. These chemical attributes play a key role in numerous subsurface material processes, influencing erosion rates, biological activity, subsurface material development, the movement of pollutants, & the cycling of nutrients[31]–[37].

III. NITROGEN

Nitrogen is a vital nutrient required by plants for growth & development, & its availability in the subsurface material often limits plant productivity. Although nitrogen constitutes roughly 80% of the Earth's atmosphere, it is not directly accessible to most plants in its gaseous form. Certain organisms, such as blue-green algae (cyanobacteria), are capable of "fixing" atmospheric nitrogen by converting it into ammonia, which dissolves in water & becomes available for biological use. Moreover, both ammonia & other forms of inorganic nitrogen can enter aquatic environments through various pathways. As a result, nitrogen is often present in abundance in lakes & streams, making it easily accessible within these ecosystems[38], [39].

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IV. PHOSPHORUS

In every living cell, phosphorus is a crucial component. It is a crucial macronutrient for the development of plants. The majority of the time, phosphorus serves as an energy storage & limits the amount of nutrients that remain in plant nucleus. Because plants require a significant quantity of phosphorus for growth, phosphorus is a necessary element. All oils, sugars, starches, & other organic compounds are formed as a result of photosynthesis, which is another crucial step in the process [40]. In addition to being prevalent in seeds & plant fruits, phosphorus is essential for several physiological processes in plants. Similar to this, Wagh & Sayyed claimed that phosphorus is important for blooming & the development of fruit & that its lack causes purple stems & leaves & low fruit production [28]. The subsurface material in the topographic position had a higher accessible phosphorus content than subsurface materials in lower topographic positions [40]. For plant absorption, subsurface materials with a high proportion of organic matter provide greater organic phosphate supplies than subsurface materials with a lower proportion of organic matter [41]. Plants develop more quickly & reach maturity faster when there is enough phosphorus available to them. When compared to subsurface material that has experienced the most leaching, subsurface material with less leaching is known to possess a higher concentration of phosphorus. For crop productivity, all of the subsurface material samples showed phosphorus concentrations greater than 10 mg/kg [42].

V. POTASSIUM

One of the essential elements for the development of the plant, potassium plays a significant part in a variety of physiological processes in plants. The creation of plant sugars, which are utilized for a variety of plant metabolic processes, as well as the regulation of photosynthesis & the generation of lignin & cellulose, which are used to construct the structural components of cells, are all engaged in this process [31], [43]–[45].

VI. SOIL ORGANIC MATTER

All subsurface materials contain organic elements, which are inherent & crucial. It is the essential element in subsurface material that enables all life & transforms subsurface material into a dynamic living organism. The growth of bacteria & other creatures in the subsurface material, the storage of nutrients for higher plants like nitrogen, phosphorus, & sulphur, & the enhancement of the chemical & physical properties of the subsurface material all depend on subsurface material organic matter (SOM) [12], [46]. The importance of subsurface material organic matter (SOM) can be summed up as follows: (i) it sustains subsurface material flora & fauna (ii) it serves as a reservoir for higher plants' needs for nitrogen, phosphorus & sulphur & (iii) it enhances a number of the subsurface material's chemical & physical properties. Additionally, the toxicity of many organic & inorganic pollutants that enter agricultural l& as a consequence of human activity is severely reduced by subsurface material organic matter[47], [48].

VII. REVIEW OF PAST WORK

Proloy Deb, Prankanu Debnath [49]; Accurate estimation of subsurface material properties & subsurface material water holding capacity (WHC) is essential for effective crop planning & irrigation management. Traditionally, WHC is estimated using pedo-transfer functions (PTFs), but such models are often lacking or unavailable in many developing regions, including parts of the Himalayan l&scape. In light of this limitation, a study was conducted to evaluate the influence of elevation on surface subsurface material physicochemical properties within an Indian river basin located in the Himalayan region. The study also involved the development of regression models to predict maximum WHC across various agro-ecological zones (AEZs). A r&om subsurface material sampling (juvenile) was done in three AEZs (sub-tropical zone, temperate zone & trans-Himalayan zone) & 129 subsurface material samples were collected. These samples were submitted to laboratory analyses, pH, organic carbon (OC%), particle size distribution (PSD), particle density, bulk density (BD), subsurface material water (air-dry), total porosity (TP) & maximum WHC. We conducted correlation analysis to determine the relationships among various subsurface material property(ies), & stepwise (forward) multiple linear regression (MLR) models for WHC using important subsurface material attributes. It was evident that significant variability existed in various subsurface material properties—pH, OC, s&, & silt content BD, & WHC—across the three AEZs. WHC was significantly correlated with BD, TP & subsurface material water in all zones. Stepwise MLR analysis proved to be highly efficient in the prediction of WHC with the inclusion of appropriate subsurface material variables, with adjusted R^2 of 87, 82, & 78% in subtropical, temperate, & trans-Himalayan zones, respectively. The variation in subsurface material properties along the AEZs of the Himalayas are substantial, this is the major conclusion from the study. Furthermore, since many subsurface material properties are strongly correlated with

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each other, simple multiple regression models can be used as a convenient way to estimate WHC values in regions where PTFs are not available. These results are useful as a guideline to crops suitability & WHC estimates in dat ga-scarce areas.

S. S. Dhaliwal, R. K. Naresh, Agniva M&al [50]; Integration of organic manure & chemical fertilizers is important to enhance subsurface material physicochemical properties & to affect distribution & transformation of macro- & micro-nutrients in different cropping systems. Various manure & fertilizer application rates were utilized in a crop rotation context with the objective of increasing subsurface material health. The overall objective was to find the best combination of organic & inorganic nutrient sources that would maintain sustainable crop yields throughout the years. Extensive growing has resulted in the loss of important nutrients like nitrogen (N), phosphorus (P), potassium (K), zinc (Zn), copper (Cu), iron (Fe), manganese (Mn) in the upper & sub-surface layers of subsurface material. Manure has the ability to effectively replace these nutrient losses when used as part of a fertilizer system. Furthermore, this integrated strategy helps in regulating key subsurface material properties such as acidity measure & electrical conductivity (EC), which in turn enhances physical properties such as bulk density, particle density, porosity, & water-holding capacity. The interaction between fertilizers & manures plays an important role in macro- & micronutrient dynamics & availability in the subsurface material matrix. These modifications will increase the amount of nutrients in subsurface material solution & water soluble fractions &, thus, will be more available to plants. Normally, increase in subsurface material acidity measure with depth & reduction in organic matter content in the deeper layers account for decrease in DTPA-extractable micronutrients such as Zn, Cu, Fe & Mn in subsubsurface material as compared to surface subsurface material. Furthermore, the application of manures can lower the accumulation of residual nutrients, inducing a more equilibrium in those nutrient cycling process. Driving the trend today is the concept of Integrated Nutrient Management System (INMS) to preserve subsurface material fertility in the long run. This is against the balanced & complementary use of organic manures & chemical fertilizers to promote sustainable agriculture production system in the country.

Zeynep Demir [51]; This research was conducted to investigate the effects of vermicomposts (VCs) treatments on the physicochemical properties of a s&y clay loam subsurface material & the growth of lettuce [Lactuca sativavar. crispa) in the greenhouse, with different subsurface material water availability in subsurface material. A pot experiment was performed with three rates of VC application (0%, 2.5% & 5% by wt.), three irrigation levels (100%, 50%, & 25% of FC). Subsurface material samples were taken after being harvested & assayed their change in physical & chemical characteristics. The maximum organic matter was 2.19% recorded in 5% VC treatment with full irrigation (100%) & minimum 0.19% in control with lowest irrigation (25% field capacity). The physical attributes of subsurface material improved due to vermicompost application in all moisture conditions. Horticultural performance On average the highest lettuce crop (per plant), of 178.7 g, was obtained with the 5% VC under full irrigation & the lowest average yield (94.0 g) was for the control at 25% irrigation. Therefore, the use of vermicompost under different water application conditions could be considered as an appropriate practice for improvement in subsurface material quality & for increasing the yield of lettuce, & may prove to be a feasible method for sustainable cultivation of this crop.

Tingshuo Zhu, Tianyun Shao, Jingyi Liu [52]; Subsurface material salt becoming serious issues gradually, subsurface material salt hazards already became a major threat to ecological agriculture development high yield, high efficiency, the flow is sustainable. In this study, residues of J. artichoke was added to three types of subsurface materials with different salt contents, & the changes in the physicochemical properties & microbial communities of subsurface materials were measured over time. After for 200 days of residues applied, the subsurface material acidity measure varied from 6.8 to 8 & was maintained close to neutrality, with significant reduction of subsurface material salinity. There were significant increases of TN, & SOM initially increased to a peak & then decreased. Richness & diversity of subsurface material microbes populations also increased & an increase in moderate halophilic & cellulose degrading bacteria was observed. Microbial groups adapted to low salinity had higher abundance & diversity than those associated with medium/high salinity environment. This breakdown of organic residues followed the trend, the rate of organic decomposition being highest for cellulose & lowest for lignin, with increasing days of incubation. In conclusion, the addition of Jerusalem artichoke residues can improve the subsurface material physical & chemical properties & microbial composition of the peanut field. It would be of great significance to reclaim saline-alkali subsurface materials, promote the efficient utilization of crop residues & sustainable development of modern agriculture.

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VIII. CONCLUSION

Preservation or improvement of subsurface material quality is a fundamental issue for assessing subsurface material ecosystem functions & sustainability. However, the establishment of a consistent & readily underst&able justification for the assessment of l& quality is still a difficult job. This complexity is due to the multitude of the roles & values of the subsurface material ecosystem that vary widely & are mediated through a dynamic balance of the physical, chemical, & biological properties of the subsurface material. These relationships, along with human perceptions & interpretations, may significantly differ in diverse spatial & temporal scales.

Selecting a limited number of subsurface material properties as reliable indicators of subsurface material quality is a complex task & probably differs if subsurface material is another type of system. Reviewing various literature reviews, one can see that a number of parameters are provided to evaluate subsurface material quality. Nevertheless, several of these parameters appear to be either higher or lower than the desirable level. Thus, it is important to limit or avoid human activities that negatively affect subsurface material quality so that subsurface material ecosystems will be functional and 'healthy' for a long time.

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