Assessment of Physical Properties of Soil from Different Villages of Devikulam Block of Idukki District of Kerala, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Assessment of Physical properties of soil from Different villages in the Devikulam block of idukki district of Kerala was carried out in 2022-23. The study was conducted with the objective of evaluating the physical characteristics of soil, over various soil depths in the Devikulam block. Nine sampling locations were selected for the study. A total of 27 soil samples were taken at depths of 0-15 cm, 15-30 cm and 30-45 cm respectively. The result indicated that the soil of Marayoor, Kanthaloor and Keezhanthoor villages were sandy clay loam in texture. The bulk density and particle density did not vary much with increasing soil depth. The particle density remained constant because the total amount or chemical composition of the soil mineral particles remains unaltered. Water Retaining Capacity of these villages was found to be good. The pore space was found to be higher than water retaining capacity in all the villages. For sustainable soil use and agricultural

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Production, the physical characteristics of the soil are crucial. The movement of air and water/dissolved chemicals through soil, as well as conditions affecting germination, root growth, and erosion processes.

Keywords: Devikulam block; Idukki district; Kerala; physical properties.

1. INTRODUCTION

Soil is necessary for the development of most plants which provides physical support as well as nutrients. Plants are bound in the soil by their roots. Nutrients dissolve in soil water, which is required for plant development. Soils contain a various of organic matters, including minerals from dead and decayed plants and animals, as well as organisms that choose to live in soil. Soil is a store of various nutrients such as carbon and nitrogen which plays an important role in the global nutrient cycles in biogeochemical cycles and atmospheric system [1].

Soil fertility is influenced by a variety of factors, including soil depth, soil texture, soil structure, soil pore space, soil temperature, soil compaction and tillage, soil response, nutrient content, humus content, humic and non-humic substances. In order to determine soil fertility, it is required to study both the physical and chemical properties of the soil. The productivity of soil is dependent on soil fertility.

The physical properties of soil influence the plant's capacity to extract water and nutrients. High-quality soils not only provide more food and fiber, but also aid in the establishment of natural ecosystems and the improvement of air and water quality. The physical properties of soil are determined by its amount, shape, structure, size, pore spaces, organic content, and mineral composition. Particle density plays an important role in the determination of other physical properties, including bulk density and porosity. The dry weight of soil per unit volume of soil is referred to as bulk density. Bulk density can be increased by tillage because it breaks down aggregates and enables soil separates to pack more tightly. Adding organic material decreases bulk density because organic material has a lower bulk density. Bulk density is crucial because it provides information about a soil's porosity. Depending on the size and aggregation of the particles, porosity varies. The physical properties of the soil are crucial for agricultural production and soil sustainability [2].

2. METHODOLOGY

Kerala has a tropical warm humid environment with an average annual rainfall of 3000 mm. The coordinates of the Devikulam Block are 10° 4′ 0.12″ N, 77° 6′ 26.28″ E. The place has an area of 215 km^2. The Devikulam Block economy is mostly focused on agriculture. Idukki is Kerala's second largest district, covering an area of 4358 square kilometer s and constituting 11.2% of the state's total area. There are four major soil types present in the district, which include forest loams, lateritic soils, brown hydromorphic soils, and alluvial soils. Around 60% of the region is covered in forest loams, which are the result of weathering of the rock under forest cover. They have a very rich organic matter surface layer The soils in Idukki district are formed as a result of transportation and sedimentation of materials from adjoining hill slopes and are brownish black in colour. Alluvial soils are seen as narrow strips along the banks of rivers in the district. They are more common along the banks of Thodupuzha River. Devikulam Taluk in Kerala's Idukki district is situated on the eastern slopes of the Western Ghats. Kanthaloor village in the Devikulam block is regarded as the "Vegetable Bowl of Kerala"

Soil samples were collected from three different villages in the Devikulam block of Idukki district of Kerala. They are Marayoor Kanthaloor and Keezhanthoor. Soil samples were taken using a khurpi, spade, and meter scale. In each village, three sampling locations were chosen, and soil samples were collected from three depths: 0-15 cm, 15-30 cm, and 30-45 cm. Soil samples were mixed properly and were removed of foreign materials like roots, stones, pebbles and gravels. The bulk was then reduced to half by quartering. And the samples were then analyzed for various physical properties. The data was recorded during the course of investigation were subjected to statistical analysis by analysis of Completely Randomized Design (CRD) as per the method of "Analysis of Variance" (ANOVA) technique.

Table 1. Procedure used for physical analysis of soil

S. No.	Parameter	Scientist
1	Soil Textural Class (Sand, Silt, Clay)	Bouyoucos, (1927)
2	Bulk Density (Mg m^{-3})	
3	Particle Density (Mg m^{-3})	
4	Pore Space (%)	Muthuvel et al. [3]
5	Water Holding Capacity (%)	

3. RESULTS AND DISCUSSION

3.1 Soil Texture

The Soil Textural classes identified was Sandy Clay Loam. The proportion of the different soil separates in a soil determines its texture. The sand, silt and clay percentage varied from 62.49% to 70.11 %, 8.38% to 13.19% and 20.16 to 24.32%.

3.2 Bulk Density (Mg m^{-3})

Bulk Density varied from the 1.28 Mg m^{-3} to 1.49 Mg m^{-3}. Bulk density was found to increase with the increase soil depth due to increase in compaction in the subsurface comparatively. Similar results were found by Swathi et al. [4] in southern Kerala.

3.3 Particle Density (Mg m^{-3})

The Particle Density varied from 2.43 Mg m^{-3} to 2.59 Mg m^{-3}. The mineral content of soil particles affects particle density. Similar results were found by Gopan et al. (2022) in Kollam district.

3.4 Pore Space (%)

The Pore Space (%) ranged from 40.96 % to 49.02 %. The pore space was found to decrease with increase in depth attributed to increase in compaction in the subsurface. Similar results were found by Nair et al. [5] in Attappadi region.

3.5 Water Retaining Capacity (%)

The Water Retaining Capacity (%) ranged from 37.23 to 44.31%. Factors like Clay type, Organic content, Soil structure etc. influence soil water retention. Similar results were found by Nair et al. [5] in Attappadi region [6-9].
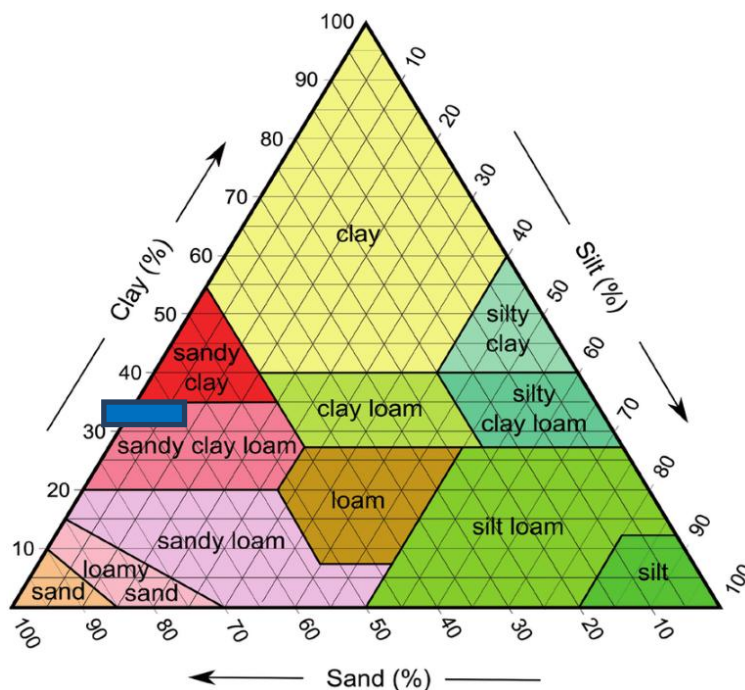

Fig. 1. Soil textural triangle (Sand, silt and clay %) by USDA

Table 2. Bulk density and Particle density (Mg m^{-3}) of soil in different villages of Devikulam Block at 0-15,15-30 and 30- 45 cm Depth

Farmer's Field	Bulk Density (Mg m-3)		Particle Density (Mg m-3)	
	Range	Mean	Range	Mean
Marayoor(V$_1$)				
F$_1$	1.36-1.38	1.37	2.45-2.48	2.46
F$_2$	1.32-1.34	1.33	2.53-2.55	2.54
F$_3$	1.41-1.43	1.42	2.51-2.54	2.52
Kanthaloor (V$_2$)				
F$_4$	1.28-1.31	1.29	2.50-2.54	2.51
F$_5$	1.33-1.35	1.34	2.47-2.50	2.48
F$_6$	1.34-1.36	1.35	2.56-2.59	2.57
Keezhanthoor(V$_3$)				
F$_7$	1.47-1.49	1.48	2.49-2.54	2.51
F$_8$	1.38-1.41	1.39	2.43-2.46	2.44
F$_9$	1.31-1.33	1.32	2.57-2.59	2.58

Table 3. Pore space and Water Retaining Capacity (%) of soil in different villages of Devikulam Block at 0-15,15-30 and 30- 45 cm Depth

Farmer's Field	Pore space (%)		Water Retaining Capacity (%)	
	Range	Mean	Range	Mean
Marayoor(V$_1$)				
F$_1$	42.35-44.48	43.40	39.35-41.48	40.40
F$_2$	44.45-47.82	46.30	40.45-42.82	41.63
F$_3$	41.09-44.22	42.78	39.01-40.22	39.74
Kanthaloor (V$_2$)				
F$_4$	47.81-48.81	48.41	42.18-44.31	43.27
F$_5$	43.81-46.15	45.04	40.72-42.51	41.62
F$_6$	45.49-47.65	46.72	41.48-43.12	42.52
Keezhanthoor(V$_3$)				
F$_7$	40.96-41.96	41.41	37.23-38.18	37.81
F$_8$	42.68-43.72	43.14	37.91-39.55	38.74
F$_9$	48.21-49.02	48.68	42.17-44.21	43.34

4. CONCLUSION

It can be concluded that the soil Textural class was identified as Sandy clay Loam. The bulk density of the soil was increased with increase in depth and the particle density also increased slightly with depth. The Water Retaining Capacity of the soil and the overall Physical condition of the soil was found good and supportive for plant growth. Proper management can be carried out by analysing these various test results. It was found that organic matter incorporation mulching, tillage practices, proper irrigation etc. can improve the soil conditions and thus improve farmer's yield.

ACKNOWLEDGEMENT

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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