PHYSICO-CHEMICAL CHARACTERIZATION OF SOIL SAMPLES FROM PUSAD TEHSIL, YAVATMAL DISTRICT, MAHARASHTRA

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Abstract
The present study focuses on the assessment of physico-chemical characteristics of agricultural soils from Pusad Tehsil, District Yavatmal (Maharashtra) to evaluate their fertility status and suitability for crop cultivation. Five representative soil samples were collected from different agricultural fields and analyzed for parameters such as color, pH, electrical conductivity (EC), organic carbon (OC), and available macronutrients—nitrogen (N), phosphorus (P), and potassium (K). The results revealed that the soils were predominantly black to faint black, characteristic of black cotton soils rich in clay and minerals. The pH values ranged from 7.00 to 8.24, indicating neutral to moderately alkaline conditions, while EC values (0.30–0.65 dS/m) confirmed non-saline nature of the soils. Organic carbon content varied from 0.28% to 0.52%, reflecting moderate fertility, whereas available nitrogen, phosphorus, and potassium levels exhibited noticeable variation across samples. The findings indicate that the soils of the Pusad region are moderately fertile, suitable for major crops like soybean, cotton, and tur, but require balanced nutrient management through integrated use of organic matter and biofertilizers to sustain productivity and soil health.
Keywords: *Physico-chemical parameters, Soil fertility, Pusad Tehsil, Yavatmal District, Soil quality.*

Introduction

Soil serves as a fundamental component of sustainable agriculture, acting as the primary medium for plant growth and nutrient cycling. Its physico-chemical attributes—such as pH, electrical conductivity, and nutrient content—are critical in determining soil fertility, nutrient dynamics, and overall crop yield potential [1, 2]. Regular assessment of these properties is essential to understand the influence of both natural processes and human interventions on soil health, thereby guiding the implementation of effective land management practices [3]. Pusad Tehsil, located in Yavatmal District of Maharashtra, is a prominent agricultural region within the Vidarbha belt [4]. It is widely recognized for cultivating crops like soybean, cotton, and pigeon pea (tur). The predominant soil type in this area is black cotton soil (regur), which originates from basaltic rock and is typically rich in clay and iron. However, its nutrient profile can vary significantly due to factors such as intensive farming, over-reliance on chemical fertilizers, and minimal incorporation of organic amendments.

Given these challenges, a detailed evaluation of the soil's physico-chemical parameters is necessary to determine its current fertility status and identify areas requiring corrective measures. This study focuses on analyzing key soil indicators—including pH, electrical conductivity, organic carbon, nitrogen, phosphorus, and potassium—from various agricultural sites across Pusad Tehsil. The findings aim to support the development of targeted soil management and fertilization strategies that promote long-term productivity and ecological sustainability in the region.

Material And Methods

Study Area

Pusad Tehsil is located in Yavatmal District of Maharashtra State, India, as illustrated in Figure 1. It forms part of the Vidarbha region under the administrative jurisdiction of Yavatmal Division. This area is agriculturally significant, primarily known for the cultivation of soybean, cotton, and pigeon pea (tur). The predominant sources of irrigation in the region include wells and tube wells, which support the agricultural activities throughout the year.

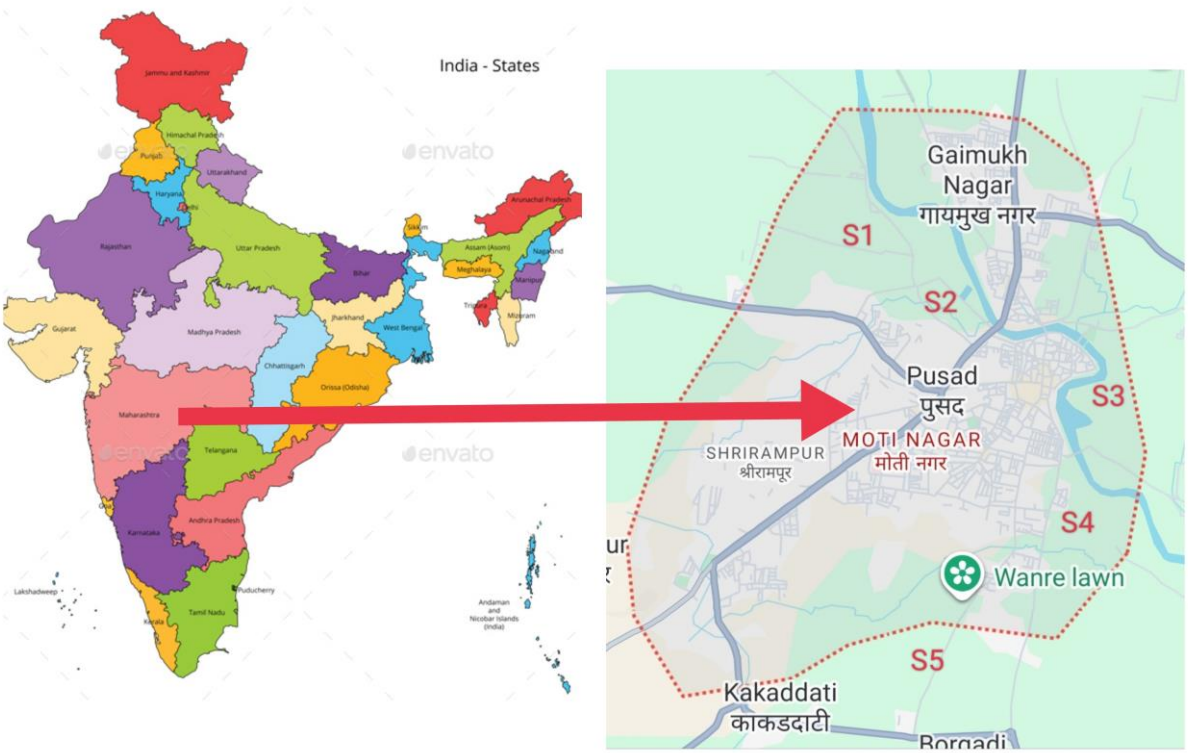


Figure 1: -Map of Study Area Pusad Tehsil, Yavatmal District (Maharashtra)

Sample Collection

In May 2025, soil samples were obtained from agricultural fields within the designated study area. Sampling was conducted randomly across five distinct plots, with five individual samples collected from each plot. The samples were taken from a depth of 0 to 15 cm, representing the surface soil layer most relevant to crop growth and nutrient interaction. Each sample was carefully placed in pre-sterilized polythene pouches to prevent contamination and ensure integrity during transport and analysis.

Physicochemical Analysis of Soil Samples-

The collected soil samples were air-dried for approximately 24 hours to eliminate moisture, then finely ground and sieved to ensure uniform texture suitable for analysis [5]. The physico-chemical parameters were determined using standard laboratory techniques [6]: soil pH was measured with a digital pH meter, electrical conductivity (EC) was assessed using a conductometer, and organic carbon (OC), nitrogen (N), and phosphorus (P) were estimated through titrimetric methods. Potassium (K) content was analyzed using flame photometry. These procedures provided reliable data for evaluating the fertility status and nutrient composition of the soil samples.

Result And Discussion

The Physico-chemical characteristics of five soil samples (S1–S5) were analyzed, and the results are presented in Table 1. The soil samples exhibited variations in color, pH, electrical conductivity (EC), organic carbon, and nutrient contents such as nitrogen (N), phosphorus (P), and potassium (K).

The color of the soils ranged from black to faint black, indicating the predominance of black cotton soil rich in clay and organic matter, typical of the Yavatmal region. Slight variations in color may be attributed to differences in organic carbon content and moisture levels.

The pH of the soils varied between 7.00 and 8.24, indicating that the soils are neutral to moderately alkaline in nature. Sample S3 showed the highest pH (8.24), suggesting the presence of free calcium carbonate and lesser leaching, while S1 and S2 were near neutral, suitable for most crops.

The electrical conductivity (EC) values ranged from 0.30 to 0.65 dS/m, indicating that all samples fall within the normal range (<1.0 dS/m), signifying non-saline soils suitable for agriculture. The highest EC value (0.65 dS/m) was recorded in S5, which may be due to higher soluble salt content.

The organic carbon (OC) content ranged from 0.28% to 0.52%. Sample S4 (0.52%) and S5 (0.51%) showed higher organic carbon values, suggesting better organic matter accumulation due

to possible biofertilizer use or crop residue management. In contrast, S2 showed the lowest OC (0.28%), indicating poor organic matter status and lower microbial activity.

The available nitrogen content ranged between 135 and 265 kg/ha. The highest nitrogen level was recorded in S1 (265 kg/ha), while the lowest was in S5 (135 kg/ha). This variation may be attributed to differences in organic carbon content and fertilizer application history. Nitrogen showed a positive correlation with organic carbon content, confirming that soils rich in organic matter retain more nitrogen.

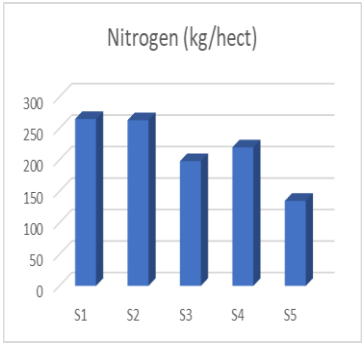
The available phosphorus ranged from 13.30 to 25.52 kg/ha. The highest value was recorded in S1 (25.52 kg/ha), followed by S4 (21.5 kg/ha). The relatively lower values in S2 and S3 might be due to phosphorus fixation in alkaline conditions or lower organic activity.

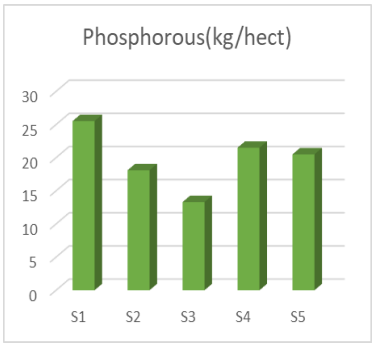
The available potassium content ranged widely from 211.3 to 498.22 kg/ha. The highest potassium value was observed in S3 (498.22 kg/ha), while the lowest was in S2 (211.3 kg/ha). The variation in potassium levels may be associated with soil mineral composition, particularly the presence of mica and feldspar minerals.

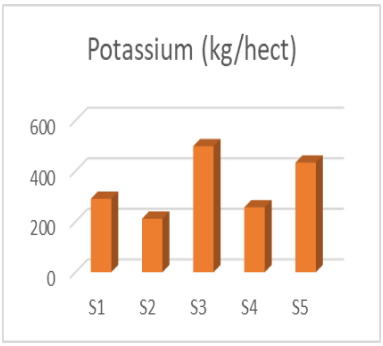
Overall, the results reveal that the soils of the study area are generally neutral to slightly alkaline, non-saline, and moderately fertile with respect to organic carbon and major nutrients. The variations among samples may be influenced by soil texture, organic matter content, and differential fertilizer management practices. Maintaining or increasing organic carbon through biofertilizer use and organic amendments could enhance soil fertility and nutrient availability in these soils.

Table 1: Physico chemicals parameters of soil samples.

Sr. No.	Parameters	S1	S2	S3	S4	S5
1	Colour	Black	Black	Faint Black	Black	Faint Black
2	pH.	7.00	7.20	8.24	7.40	7.25
3	EC	0.50	0.36	0.30	0.52	0.65
4	Organic Carbon (%)	0.40	0.28	0.35	0.52	0.51
5	Nitrogen (kg/hect)	265	263	198	220	135
6	Phosphorous(kg/hect)	25.52	18.10	13.30	21.5	20.5
7	Potassium (kg/hect)	290.34	211.3	498.22	256.5	433.2







Conclusion

The present investigation into the physico-chemical properties of agricultural soils from Pusad Tehsil, Yavatmal District, offers meaningful insights into the region's soil fertility and nutrient dynamics. The soils were predominantly black to faint black in color, characteristic of black cotton soils enriched with clay and mineral content. Analytical results indicated a neutral to moderately alkaline pH range (7.00–8.24) and low electrical conductivity (0.30–0.65 dS/m), confirming their non-saline nature and suitability for diverse crop cultivation. Organic carbon levels ranged from 0.28% to 0.52%, reflecting moderate organic matter content that plays a vital role in soil structure and nutrient retention. The concentrations of nitrogen, phosphorus, and potassium varied significantly across samples, likely due to differences in farming practices, fertilizer usage, and organic input levels. A positive correlation between nitrogen and organic carbon suggests that enhancing organic matter can improve nitrogen availability.

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