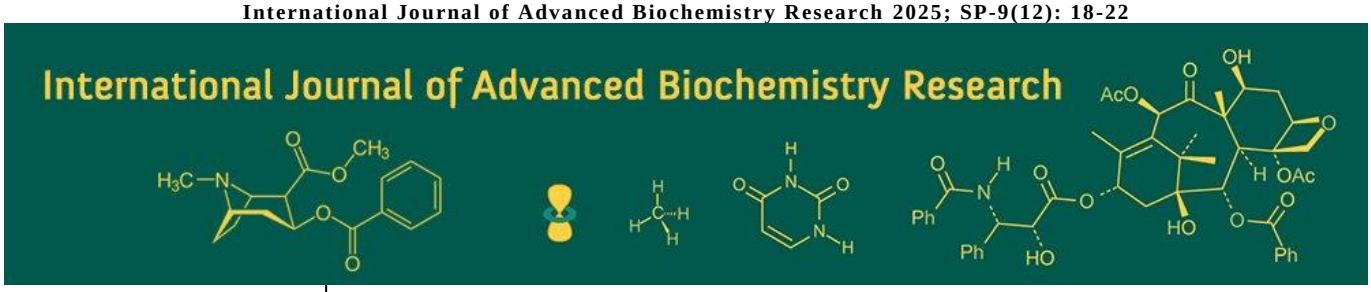

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Assessment of soil chemical properties in Tapi command area of Dhule district

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Abstract
The investigation was carried out on 'Assessment of soil chemical properties in Tapi command area of Dhule district' during the year 2024-25 with the objectives to characterize the chemical properties of soils in the Tapi command area and to categorize the soils in Tapi command area based on soil chemical properties. A systematic survey was carried out and surface (0-22.5 cm depth) soil samples were collected from 100 different sites of 20 villages from Tapi command area i.e. Shirpur and Sindkheda tehsil of Dhule district. The exact sample location was recorded using a GPS. Samples were analysed for soil chemical properties using standard procedures. The data thus obtained was interpreted with their relative properties and categorized as per ratings of soils. In Tapi command area, about 20% samples were slightly alkaline and 80% samples were moderately alkaline. Regarding electrical conductivity, 84% samples were normal and 16% samples were under category of poor seed emergence. About 60% samples were low in organic carbon content in soil. Regarding $CaCO_3$ content, about 54% samples were high and 13% samples were very high category.

Keywords: Tapi command, soil chemical properties

Introduction
Soil quality play's crucial role in agricultural productivity, environmental sustainability and ecosystem services. It is a dynamic property that integrates physical, chemical and biological components all of which contribute to the soil's ability to perform important ecological functions like plant growth, regulating water flow and sustaining microbial activity. Soil productivity mainly depends on various factors like soil fertility, climate and management practices which can be managed (Gosavi, 2015) [6].

Chemical properties determine the availability of essential elements to plants as well as the soil's ability to buffer against harmful substances. Soil organic matter is a critical biological property that influences nutrient cycling, microbial diversity and overall soil fertility. Research has been shown that soils with high organic matter levels exhibit improved soil structure, better moisture retention and enhanced nutrient availability (Lal, 2004) [10].

Rivers are main source of irrigation water in Maharashtra. Krushna, Bhima, Godavari, Tapi, Nira, Painganga are some main rivers spreads all over the Maharashtra. Tapi, Panzara, Kan, Arunavati and Amravati are some major rivers spread through the Dhule districts. These rivers play crucial role in providing irrigation water to Dhule district. In early days farmers facing lots of problems regarding quality of river water for irrigation which may be due to release of toxic substances by industries and injudicious use of fertilizer and pesticide by farmer. Soil alkalization, salinization, loss of soil fertility, waterlogging and nutrient depletion are the major problems regarding to the soil now a days. Soil productivity depends on nutrient content, management practices and climate (Anonymous, 2018) [1].

The primary objective of the study is to assess the soil quality within the Tapi river command area by analysing key soil properties, including pH, EC, organic carbon content, calcium carbonate and the availability of essential nutrients. By examining these parameters, the study aims to provide a comprehensive understanding of the current state of soil health in the region and to identify specific areas of concern that may require remedial action.

Materials and Methods

A systematic survey was carried out and surface (0-22.5 cm depth) soil samples were collected from 100 different sites of 20 villages of Shirpur and Sindkheda tehsil of Dhule district and sample's locations are showed in Fig. 1. Details regarding the site of sampling were noted as under: name of farmers, name of village, GPS location, latitude, longitude and vegetation. The soil samples from each village were collected from field using hand auger. The exact sample location was recorded using a GPS. After sampling, samples were air dried, ground and sieved through 2 mm sieve to obtain 500 gram size of each sample. For certain characteristics like organic carbon the sample was screened through 0.5 mm (100 meshes) (Jackson, 1973) [7]. Soil samples were analysed for pH and electrical conductivity in 1:2.5 soil suspension (Jackson, 1973) [7], organic carbon by wet oxidation (Nelson and Sommers, 1982) and $CaCO_3$ by acid neutralization method (Piper, 1966) [15].

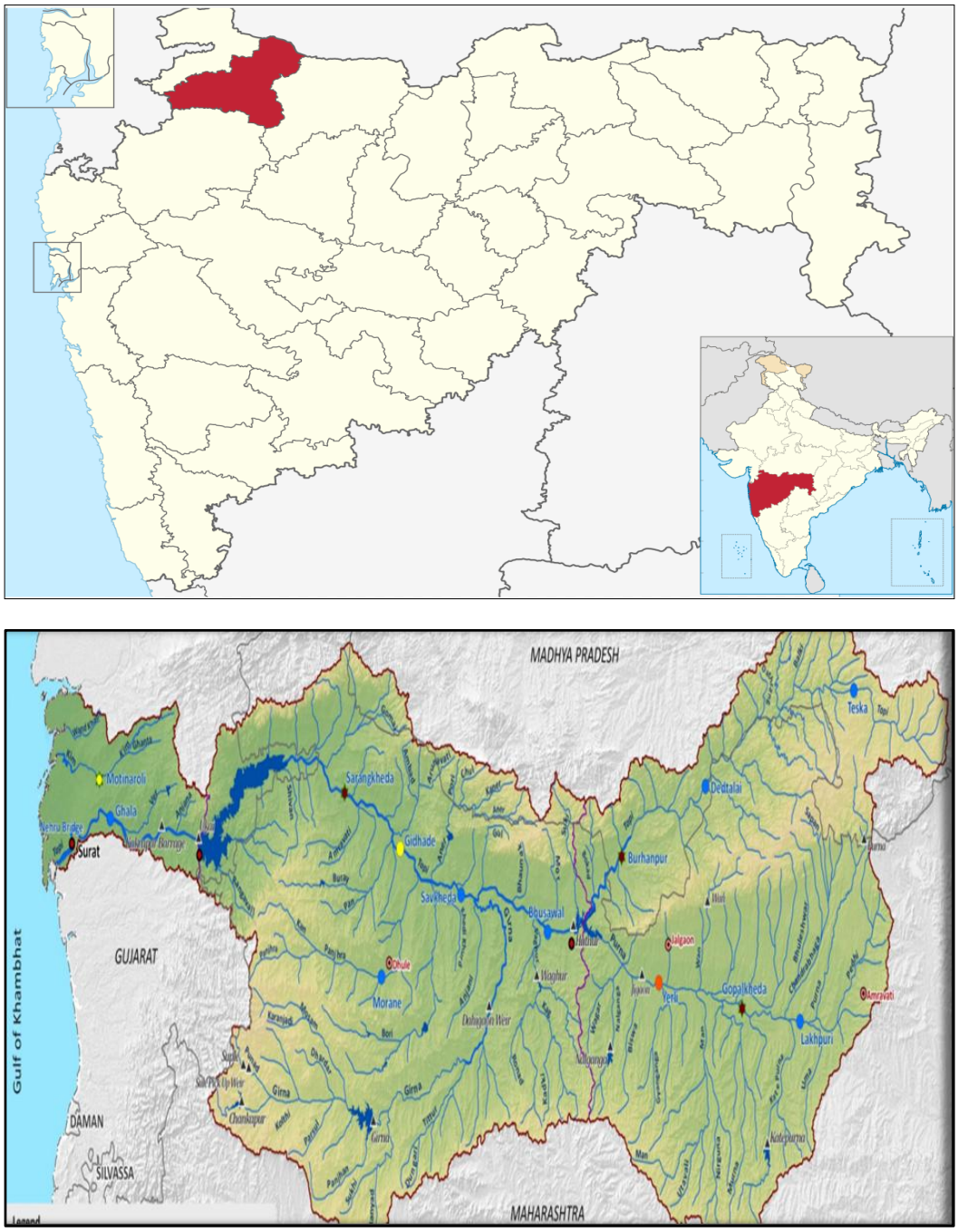

Fig 1: Location Map of Tapi Command Area

Results and Discussion

Chemical characteristics in soil

Soil pH

The soil pH values of soil samples from the command area ranged from 7.30 to 8.57 with an average of 8.21. Among the 100 soil samples tested, 20% samples were slightly alkaline and 80% samples were moderately alkaline in the Tapi command area as per the categorization given by Patil and Mali (1990) [14]. In Shirpur tehsil, the pH of soil samples ranged from 7.61 to 8.57 with mean 8.22 and in Sindkheda tehsil the pH of soil samples was ranged from 7.30 to 8.53 with mean value 8.20. In Tapi command area, the highest pH of soil sample (8.57) was observed at Jaitpur village of Shirpur tehsil and the lowest pH of soil samples (7.30) was observed at Tavkheda village of Sindkheda tehsil of Dhule district. In command area, the slight alkalinity may be due to

the medium-deep black soils under irrigation, which have increased in alkalinity as a result due to their origin from basaltic rock in the command area. Also the most common reason for alkalinity was due to use of chemical fertilizers *i.e*. long term use of chemical fertilizer use without organic inputs might have raised pH in Dhule soils. Semi-arid areas, where rainfall is less than the yearly rate of evapotranspiration rates, limited water availability hinders the leaching of calcium's insoluble bicarbonates and carbonate that is the higher pH could be due to increase in accumulation of exchangeable sodium and calcium carbonate (Krishnaveni *et al*., 2012) [9]. Similar results were also found by Gokule (2022) [5] and Maddheshiya *et al*. (2025) [11].

Electrical conductivity

The soil electrical conductivity (EC) of soil samples from the command area ranged from 0.26 to 1.19 dS m^{-1} with an average of 0.67 dS m^{-1}. As per the categorization given by Patil and Mali (1990) [14], among the 100 soil samples tested, 84% samples were normal and 16% samples were under category of poor seed emergence in the Tapi command area. In Shirpur tehsil, soil samples were ranged from 0.40 dS m^{-1} to 1.19 dS m^{-1} with mean 0.69 dS m^{-1} and in Sindkheda tehsil, soil samples were ranged from 0.26 dS m^{-1} to 1.11 dS m^{-1} with an average 0.64 dS m^{-1}. The highest EC (1.19 dS m^{-1}) was noticed at Manjrod village of Shirpur tehsil and the lowest EC of soil samples (0.26 dS m^{-1}) was observed at Longhane village of Sindkheda tehsil of Dhule district. Thus, in Tapi command area all the soil samples analyzed were non-saline and few were under category of poor seed emergence, deemed suitable for supporting healthy plant growth. Most of the samples exhibited normal salinity levels (EC less than 1). Therefore, based on salinity, the soils are considered appropriate for the productive cultivation of a wide range of plants. The normal of EC was recorded for upstream and topographically higher areas, can be attributed to the rolling topography relatively higher gradient, seasonal irrigation and alternating cropping pattern. Similar findings were observed by Kantharaj *et al*. (2015) [8] and Samreen (2022) [16].

Organic carbon

The organic carbon content in soil samples from Tapi command area ranged from 0.29 to 0.78% with an average of 0.39%. As per the six tier system given by Bangar and Zende (1978) [2], out of 100 soil samples analysed, 60% samples were in low, 31% samples were moderate and 9% samples were under moderately high category. In Shirpur tehsil, soil samples were ranged from 0.31 to 0.78% with mean 0.41% and in Sindkheda tehsils samples were ranged from 0.29 to 0.75% with mean 0.38%. Maximum organic carbon content (0.78%) was observed in samples from Babhulde village of Shirpur tehsil and the lowest organic carbon of samples (0.29%) was observed at Akadse village of Sindkheda tehsil of Dhule district. Organic carbon content in soils of Tapi command was low. As compare to soils of Shirpur tehsil, Shindkheda tehsil had low organic carbon which may be due to low inputs of FYM and crop residues and coarse textured soil is also responsible for low organic carbon. Burning of sugarcane trash in the area might be one of the reasons to lower down the organic carbon content. Similar results for soil organic carbon content were also reported by Das *et al*. (2018) [4] and Mullick *et al*. (2024) [12].

Calcium carbonate

The calcium carbonate content in soil samples from Tapi command area ranged from 1.50 to 12.00% with an average of 6.16%. In Tapi command area, out of 100 soil samples analysed, 9% samples were moderate, 24% samples were moderately high, 54% samples were high and 13% samples were very high as per the categorization given by Patil and Mali (1990) [14]. In Shirpur tehsil the calcium carbonate content in soil samples ranged from 1.50 to 11.25% with mean 5.91% and in Sindkheda tehsil the calcium carbonate content in soil samples ranged from 1.75 to 12.00% with mean 6.42%. The highest calcium carbonate content (12.00%) was observed at Takarkheda village of Sindkheda tehsil and the lowest calcium carbonate content (1.50%) was observed at Bhortek village of Shirpur tehsil in Dhule district (Table 1). Soils from area are formed from basaltic and alluvium lithology under semi-arid climatic condition, characterized by low precipitation and high rate of evaporation favouring more accumulation and precipitation of $CaCO_3$. Shirpur tehsil has moderate rainfall which causes partial leaching of carbonates and better drainage leading to less precipitation of $CaCO_3$, while in Sindkheda tehsil comparatively high $CaCO_3$ content might be due to poor drainage causing carbonate deposition in root zone. Soils derived from basaltic rocks in semi-arid areas, where low rainfall and high evaporation rates prevail, often show significant accumulation and crystallization of $CaCO_3$ (Singh and Kundu, 2010) [17]. Similar research findings were also reported by Gokule (2022) [5] and Bhalekar (2024) [3].

Table 1: Categorization of soil pH in Tapi command area

Category	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample No.	**1-50**	**51-100**	**(% samples)**
Extremely acidic (<4.5)	0	0	0
Strongly acidic (4.6-5.5)	0	0	0
Moderately acidic(5.6-6.5)	0	0	0
Slightly acidic (6.6-6.9)	0	0	0
Neutral (7.0)	0	0	0
Slightly alkaline (7.1-8.0)	8	12	20
Moderately alkaline (8.1-9.0)	42	38	80
Strongly alkaline (9.1-10.0)	0	0	0
Very strongly alkaline (10.1-11.0)	0	0	0

Table 2: Soil pH in Tapi command area

Particulars	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	1-50	51-100	1-100
Minimum	7.61	7.30	7.30
Maximum	8.57	8.53	8.57
Mean	8.22	8.20	8.21
SD	0.19	0.23	0.21
CV (%)	2.31	2.79	2.55

Table 3: Categorization of soil electrical conductivity (dS m^{-1}) in Tapi command area

Category	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	**1-50**	**50-100**	**(% samples)**
Normal (0-1)	40	44	84
Poor seed emergence (1.1-2)	10	6	16
Harmful to some crops (2.1-3)	0	0	0
Harmful to Most of the crops (>3)	0	0	0

Table 4: Soil Electrical conductivity (dS m^{-1}) in Tapi command area

Particulars	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	1-50	51-100	1-100
Minimum	0.40	0.26	0.26
Maximum	1.19	1.11	1.19
Mean	0.69	0.64	0.67
SD	0.22	0.22	0.22
CV (%)	31.88	34.37	32.83

Table 5: Categorization of soil organic carbon (%) in Tapi command area

Category	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	**1-50**	**50-100**	**(% samples)**
Very low (< 0.20)	0	0	0
Low (0.21-0.40)	31	29	60
Moderate (0.41-0.60)	14	17	31
Moderately high (0.61-0.80)	5	4	9
High (0.81-1.0)	0	0	0
Very high (> 1.0)	0	0	0

Table 6: Organic carbon (%) content in Tapi command area

Particulars	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	**1-50**	**51-100**	**1-100**
Minimum	0.31	0.29	0.29
Maximum	0.78	0.75	0.78
Mean	0.41	0.38	0.39
SD	0.10	0.08	0.09
CV (%)	24.39	21.05	23.07

Table 7: Categorization of $CaCO_3$ (%) content in Tapi command area

Category	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample no.	1-50	50-100	(% samples)
Very low (< 0.5)	0	0	0
Low (0.51-1.00)	0	0	0
Moderate (1.10-2.00)	7	2	9
Moderately high (2.10-5.00)	12	12	24
High (5.10-10.0)	25	29	54
Very high (> 10.0)	6	7	13

Table 8: Calcium carbonate (%) content in Tapi command area

Particulars	Shirpur tehsil	Sindkheda tehsil	Tapi command area
Sample No.	**1-50**	**51-100**	**1-100**
Minimum	1.50	1.75	1.50
Maximum	11.25	12.00	12.00
Mean	5.91	6.42	6.16
SD	2.90	2.86	2.87
CV (%)	49.06	44.54	46.59

Conclusion

In Tapi command area, about 20% samples were slightly alkaline and 80% samples were moderately alkaline. Regarding electrical conductivity, 84% samples were normal and 16% samples were under category of poor seed emergence. About 60% samples were low in organic carbon content in soil. Regarding $CaCO_3$ content, about 54% samples were high and 13% samples were very high category. Soils from Shirpur tehsil were slightly healthier with balanced chemical properties as compared to Sindkheda tehsil in Tapi command area. From the experimental results it is concluded that, the soils from Tapi command area possess strong potential for sustainable agriculture, provided prejudicious use of organic sources including crop residue incorporation and green manuring for increasing organic carbon content in soil and encourage cultivation of tolerant crops under the condition of moderately alkaline pH and high calcium carbonate content.

References

1. Anonymous. GPS based soil fertility status of Dhule district. 2018.
2. Bangar AR, Zende GK. Evaluation of soil test for nitrogen. Journal of Maharashtra Agricultural University. 1978;3(1):58-59.
3. Bhalekar NN. Geospatial mapping of soil properties in Maheshgad watershed [PhD thesis]. Rahuri (India): Mahatma Phule Krishi Vidyapeeth; 2024.
4. Das A, David AA, Swaroop N, Thomas T, Rao S, Hasan A. Assessment of physico-chemical properties of river bank soil of Yamuna in Allahabad city, Uttar Pradesh. International Journal of Chemical Studies. 2018;6(3):2412-2417.
5. Gokule AS. Appraisal of water quality in relation to soil properties of Shegaon and Sangrampur tehsils of Buldhana district in Purna tract [MSc thesis]. Akola (India): Panjabrao Deshmukh Krishi Vidyapeeth; 2022.
6. Gosavi NI. GPS-GIS based soil fertility maps of Shirpur tehsil of Dhule district (Maharashtra) [MSc thesis]. Rahuri (India): Mahatma Phule Krishi Vidyapeeth; 2015.
7. Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; 1973.
8. Kantharaj T, Balanagoudar SR, Bhat SN, Vidyavathi GY, Kumar US, Rajesh NL. Characterization and land suitability evaluation of a micro-watershed in north-eastern district of Karnataka. Karnataka Journal of Agriculture. 2015;28(3):336-341.
9. Krishnaveni Y, Kumar KA, Devi UM, Reddy MD. Soil fertility mapping of Pillaipally Anicut command area, Musi river in Andhra Pradesh. Journal of Research, Acharya N. G. Ranga Agricultural University. 2012;40(3):127-131.
10. Lal R. Soil carbon sequestration impacts on global climate change and food security. Science. 2004;304(5677):1623-1627.
11. Maddheshiya SK, Jha M, Tignath S, Singh N, Deepak. Impact of degradation of riverine wetlands on soil quality in the interfluve of Ganga-Sai rivers, India. Discover Soil. 2025;2(1):54.
12. Mullick S, Bera M, Khoso I, Kothari SK. Nutrient status of coastal soils - 24 Parganas (South), West Bengal, India. International Journal of Plant and Soil Science. 2024;36(4):2320-7035.
13. Nelson DW, Sommers LE. Total carbon, organic carbon and organic matter. In: Page AL, Miller RH, Keeney DR, editors. Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. 2nd ed. Madison (WI): American Society of Agronomy and Soil Science Society of America; 1982. p. 539-579.
14. Patil VD, Mali CV. Fundamentals of Soil Science: A Textbook. Parbhani: Phoenix Publications; 1990. p. 109.
15. Piper CS. Soil and Plant Analysis. Bombay: Hans Publication; 1966. p. 368.
16. Samreen J. Effect of soil and water conservation on soil properties and preparation of action plan for Halayapura-1 micro watershed of Tumkur district using remote sensing and GIS techniques [MSc thesis]. Bangalore (India): University of Agricultural Sciences; 2022.
17. Singh R, Kundu DK. Physico-chemical and hydraulic characteristics of soils of major sub-groups of Eastern India. Journal of the Indian Society of Soil Science. 2010;58:267-278.