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Original Article

"Spatial Distribution of NPK Nutrients in Agricultural Soils of Omerga Taluka: A Soil Test-Based Study."

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Abstract

The present study entitled "Spatial Distribution of NPK Nutrients in Agricultural Soils of Omerga Taluka: A Soil Test–Based Study" aims to analyze the availability and spatial distribution of major soil nutrients—Nitrogen (N), Phosphorus (P), and Potassium (K)—in the agricultural soils of Omerga taluka.

A total of 64 soil samples were collected from different villages through field surveys and analyzed using standard laboratory techniques. The results revealed that a significant proportion of soils is deficient in nitrogen (78.13%) and phosphorus (53.11%), indicating these nutrients as major limiting factors for crop productivity. In contrast, potassium was found to be sufficiently available, with 92.18% of samples falling under the very high category.

The study highlights the imbalance in soil nutrient status and emphasizes the need for integrated nutrient management practices. The findings will be useful for farmers, agricultural planners, and policymakers in improving soil fertility and enhancing sustainable agricultural production in the study area.

Keyword: *Soil Fertility, NPK Nutrients, Nitrogen Deficiency, Phosphorus Deficiency, Potassium Status, Soil Testing, Spatial Distribution.*

Introduction

Soil is one of the most important natural resources that plays a vital role in agricultural productivity. The fertility status of soil largely depends on the availability of essential nutrients, particularly Nitrogen (N), Phosphorus (P), and Potassium (K), which are considered primary macronutrients required for plant growth.

In recent years, continuous cropping, excessive use of chemical fertilizers, and improper nutrient management practices have led to the depletion and imbalance of soil nutrients.

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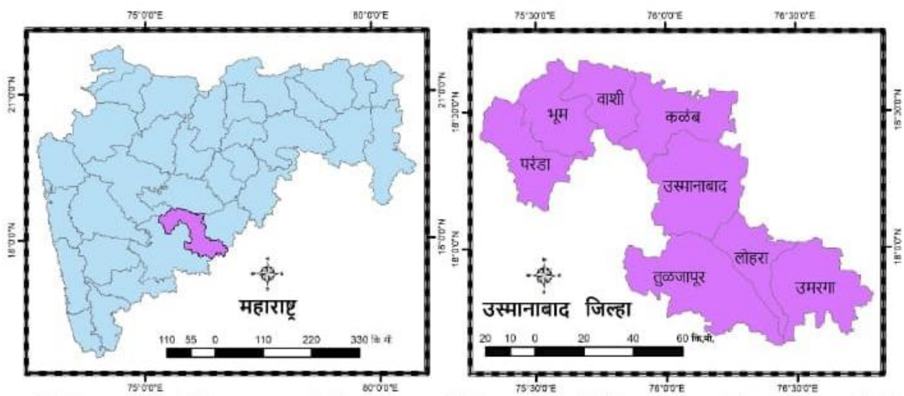
This imbalance adversely affects crop yield and soil health.Therefore, soil testing has become an essential tool to assess nutrient availability and to recommend appropriate fertilizer application.The present study focuses on the spatial distribution of NPK nutrients in the agricultural soils of Omerga Taluka. By analyzing soil samples collected from different villages, the study aims to understand the nutrient status and identify major deficiencies. This will help in suggesting suitable soil fertility management practices for sustainable agriculture.

Area of the Study

Omerga Taluka is located in the southeastern part of Maharashtra, on the border of Maharashtra and Karnataka.The taluka of omerga lies between 17°38' 32" North latitude to 18°02'10" north latitude and 76°24'30" east longitude to 76°47'17" east longitudes.It has a total area of 998.63 sq kms.Omerga Taluka is well inhabited and total population is 269519 (215671Rural+53848 urban) in 01 urban centre and 96 villages.Omergataluka has an average height of 591.05 meters above sea level. Omerga taluka is bordered by Ausataluka to the north, Nilangataluka to the northeast, Basavakalyan (Karnataka) to the east, Aland taluka (Karnataka) to the south and Lohara taluka to the west.



Objectives of the Study

1.To analyze the availability of Nitrogen (N), Phosphorus (P), and Potassium (K) in the soils of Omerga Taluka.

2.To study the spatial distribution of NPK nutrients in agricultural soils of the study area.

3.To identify the fertility status of soils based on soil testing results.

4.To suggest appropriate soil fertility management practices for improving agricultural productivity.

Methodology

The present research paper is based on both primary and secondary data sources. Primary data were collected through field visits and soil sample collection from different villages of Omerga Taluka. During the field visits, farmers were guided about the proper procedure of soil sampling. After explaining the standard method, a total of 64 soil samples were collected from agricultural fields of different villages with the help of farmers.

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The collected soil samples were brought to the soil testing laboratory and processed for analysis. The samples were first air-dried, crushed, and sieved to obtain a fine and uniform texture suitable for laboratory testing. The preparation of soil samples was carried out following the standard procedures adopted by Prerana Laboratories Hinjewadi, Pune.The analysis of essential soil nutrients Nitrogen (N), Phosphorus (P), and Potassium (K)—was conducted at the Soil Testing Centre of the college using standard soil testing techniques. Based on the laboratory results, the NPK nutrient levels were classified into different fertility categories such as Very Low, Low, Medium, High, and Very High, according to standard soil fertility rating criteria. After classification, the analyzed data was systematically organized and presented in the form of tables, graphs, and thematic maps to understand the spatial distribution of soil nutrients in the study area. Furthermore, to ensure that farmers understand the results of their soil samples, a farmers' guidance camp was organized. During this program, farmers were provided with Soil Health Cards, and the results of soil testing were explained along with suitable recommendations for nutrient management and fertilizer use.Thus, the methodology involved collection of 64 soil samples, laboratory analysis of NPK nutrients, classification of soil fertility levels, preparation of soil testing reports, and dissemination of results to farmers, which formed the basis of the present research paper.

Nitrogen (N)

Nitrogen is one of the essential micronutrients required for plants growth. It stimulates growth of plants and produces the rich green colour that is the characteristic of healthy plants, as Nitrogen is essential for plant life. about 78% of the atmosphere is consists of molecular Nitrogen ($N2$); this form of Nitrogen cannot be used by animals. The rate of plant growth is proportional to the rate of nitrogen supply. If the soil is deficient in Nitrogen, the plants become stunted and pale. However, an excess of Nitrogen can damage the plants just as over-fertilizing the lawn can burn and damage the grass.

TableNo.01&Graph No.01
Nitrogen (N)

Sr.n.	Nitrogen (kg/ha.)	Available Nitrogen.	quantitative analysis	Percentage %
01	Very Low	Below 140	26	40.63
02	Low	140-280	24	37.50
03	Medium	281-420	12	18.75
04	Medium High	421-560	01	1.56
05	High	561-700	01	1.56
06	Very High	700	-	-

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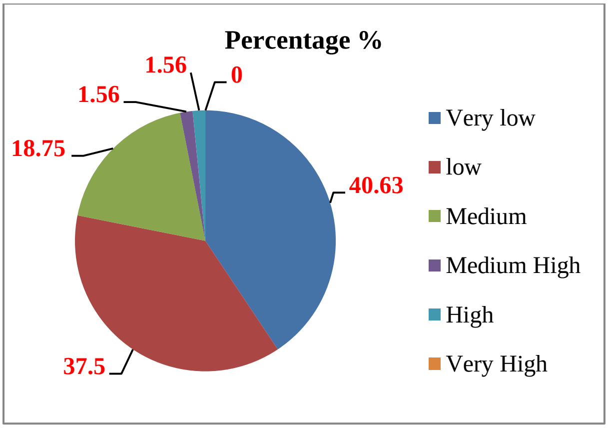

Source: -Based on collected soil samples

As observed from Table No. 1 and Graph No. 1, a total of 64 soil samples were collected from different village in Omerga taluka. These soil samples were analyzed and classified into six categories based on the availability of nitrogen. The analysis reveals that a significant proportion of the samples falls under the lower nitrogen categories. The Very Low category accounts for 40.63% of the samples, followed by the Low category with 37.50%. Together, these two categories constitute 78.13% of the total samples, clearly indicating that the soils in the study area are largely nitrogen deficient. The Medium category (18.75%) represents soils with moderate nitrogen availability, which may support average crop growth but still require nutrient supplementation for higher productivity. On the other hand, only 1.56% of samples fall under Medium High and 1.56% under the High category, indicating that very few soils have sufficient nitrogen content.It is also important to note that no samples were recorded under the Very High category, which suggests that there is no risk of excessive nitrogen or nutrient toxicity in the study area.

Phosphorus (P)

Phosphorus is one of the major plant nutrients in the soil. It is a constituent of plant cells, essential for cell division and development of the growing tip of the plant. For this reason, it is vital for seedlings and young plants. Without phosphorus, plant growth is retarded. Plants have stunted roots, and are stunted and spindly. Deficiency symptoms also include dull greyish-green leaves and red pigment in leaf bases and dying leaves. Phosphorus deficiency is difficult to diagnose, and by the time it is recognised it may be too late to do anything. If plants are starved of phosphorus as seedlings, they may not recover when phosphorus is supplied later.

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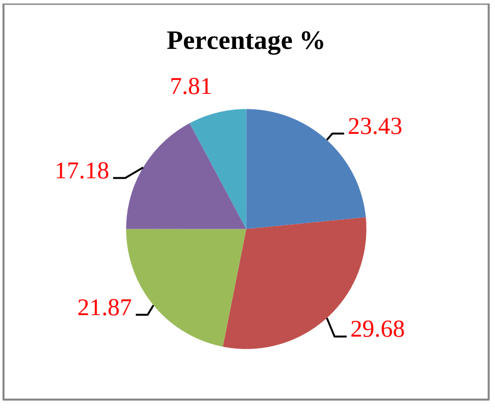
TableNo.02&Graph No.02
Phosphorus (P)

Sr.N.	Available phosphorus	Available phosphorus (P)Kgs/ha	quantitative analysis	Percentage %
01	Very Low	07	15	23.43
02	Low	14	19	29.68
03	Medium	21	14	21.87
04	Medium high	28	11	17.18
05	High	35	05	7.81



Source: -Based on collected soil samples

As observed from Table No. 2 and Graph No. 2, the phosphorus content in the soils of Omerga taluka shows considerable variation across different categories. The available phosphorus in the collected soil samples was classified into five groups: Very Low, Low, Medium, Medium High, and High.

The results reveal that the Low category accounts for the highest proportion (29.68%), followed by the Very Low category (23.43%). Together, these two categories constitute 53.11% of the total samples, indicating that a majority of the soils are deficient in available phosphorus.

The Medium category (21.87%) represents soils with moderate phosphorus availability, which may support average crop growth but still require additional nutrient inputs for optimum productivity. In addition, 17.18% of samples fall under the Medium High category, suggesting relatively better phosphorus levels in certain areas.

Only 7.81% of the samples were found in the High category, indicating that a very small proportion of soils possess sufficient phosphorus content.

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Potassium (K)

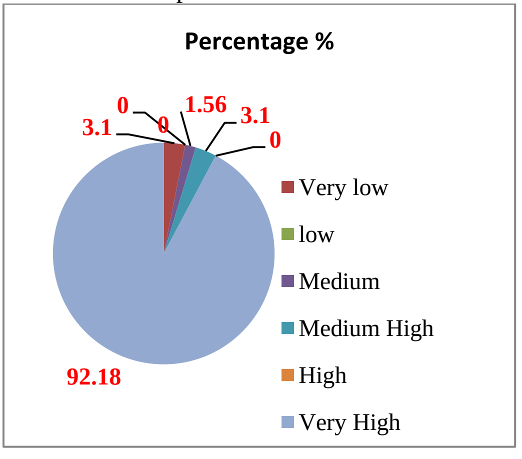
Potassium increases yields and improves the quality of agricultural produce. Potassium also enhances the ability of plants to resist diseases, insect attacks, cold and drought stresses and other adverse conditions. It helps in the development of a strong and healthy root system and increases the efficiency of the uptake and use of nitrogen and other nutrients. In addition, potassium has an important role in livestock nutrition. The importance of potassium stems from its multiple roles in the plant: it is involved in the activation of more than sixty enzymatic systems in the plant cell, and in the synthesis of proteins, vitamins, starch and cellulose which ensure normal plant metabolism, plant growth and formation of strong tissues. Potassium helps photosynthesis, the process through which the sugars and energy that the plant needs for its development are formed and converted. Potassium also controls the opening and closing of the leaf stomata, which regulate the water status in the plant.

TableNo.03&Graph No.03

Potassium (K)

Sr.No	**Available Potassium**	**K Potassium (kg/ha.)**	**quantitative analysis**	**Percentage %**
01	Very Low	100 Less than	02	3.1
02	Low	100-150	-	-
03	Medium	151-200	01	1.56
04	Medium High	201-250	02	3.1
05	High	251-300	–	–
06	Very High	300 more than	59	92.18

Source: -Based on collected soil samples



As observed from Table No. 3 and Graph No. 3, the available potassium content in the soils of Omerga taluka was analyzed and classified into six categories: Very Low, Low, Medium, Medium High, High, and Very High.

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The analysis clearly indicates that the majority of soil samples fall under the Very High category (92.18%), which represents a dominant proportion of the total samples. This suggests that the soils of the study area are rich in potassium content.

Only a very small proportion of samples fall under the Medium (1.56%) and Medium High (3.1%) categories, indicating limited variation in moderate potassium levels. The Very Low category accounts for 3.1%, while no samples were recorded in the Low and High categories.

Conclusion

The present study on the spatial distribution of NPK nutrients in the agricultural soils of Omerga Taluka reveals a significant imbalance in soil fertility status. The analysis of soil samples indicates that a large proportion of soils are deficient in nitrogen and phosphorus, which are essential macronutrients for plant growth and development. This deficiency is likely to adversely affect crop productivity and overall soil health in the study area.

The results show that approximately 78.13% of the soil samples fall under very low to low categories of nitrogen, while 53.11% of the samples are deficient in phosphorus. These findings clearly establish nitrogen and phosphorus as the major limiting nutrients in the region. The deficiency of these nutrients may be attributed to continuous cropping, excessive use of chemical fertilizers, and lack of balanced nutrient management practices. In contrast, the study reveals that potassium is sufficiently available in most of the soil samples, with 92.18% falling under the very high category. This indicates that potassium is not a limiting factor for crop production in the study area. However, excessive or unnecessary application of potassic fertilizers should be avoided to maintain nutrient balance and prevent resource wastage. Overall, the study highlights the urgent need for adopting integrated nutrient management practices, including the use of organic manures, biofertilizers, and balanced chemical fertilizers based on soil test results. Regular soil testing, awareness among farmers, and proper implementation of soil health management strategies are essential for improving soil fertility, enhancing crop yield, and ensuring sustainable agricultural development in Omerga Taluka.

Recommendations

Based on the findings of the present study, the following recommendations are proposed for improving soil fertility and ensuring sustainable agricultural productivity in Omerga Taluka:

1. Nitrogen Management

Nitrogen deficiency being a major constraint, the application of nitrogenous fertilizers such as urea should be used in split doses to enhance nutrient use efficiency.

Increased use of organic manures such as farmyard manure (FYM), compost, and vermicompost is recommended to improve soil structure and nitrogen availability.

Crop rotation with leguminous crops (e.g., soybean, gram, pulses) should be adopted to naturally enhance nitrogen fixation in the soil.

2. Phosphorus Management

Phosphatic fertilizers such as Single Super Phosphate (SSP) and Di-Ammonium Phosphate (DAP) should be applied based on soil test recommendations.

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Phosphorus should be applied at the time of sowing to ensure proper root development and early plant growth.

Practices to reduce phosphorus fixation in soil, such as maintaining optimum soil pH and use of organic matter, should be encouraged.

3. Potassium Management

Since potassium is sufficiently available in most soils, excessive application of potassic fertilizers should be avoided.

Potassium fertilizers should be applied only when required, based on soil testing results.

Balanced nutrient application should be maintained to avoid nutrient imbalance and antagonistic effects.

4. Integrated Nutrient Management (INM)

A balanced combination of organic and inorganic fertilizers should be adopted to maintain soil health.

Promotion of green manuring practices (e.g., sunhemp, dhaincha) is recommended to improve soil fertility.

Use of biofertilizers such as Rhizobium and Azotobacter should be encouraged to enhance nutrient availability.

5. Soil Health Improvement and Awareness

Regular soil testing should be conducted to monitor nutrient status and guide fertilizer application.

Distribution of Soil Health Cards to farmers should be strengthened for better decision-making.

Farmer awareness programs, training camps, and workshops should be organized to promote scientific nutrient management practices.

References

1. Analysis of soil samples for its physico – Chemical parameters: - (july 2017) Kamlesh Shah
2. Soil Testing in India (Methods Manual): - (January, 2011), Department of Agriculture & Cooperation Ministry of Agriculture Government of India
3. Importance of soil testing and techniques of soil sampling: (August 2014), Rajan Bhatt
4. Fundamentals of Soil Science - (PB 2018) ShivanandTolanur
5. मृदा परीक्षण आणि खतांचा वापर -पा.म. जोशी पायल प्रकाशन नागपूर (1974)
6.माती परीक्षण संच; प्रेरणा लॅबोरेटरी, पुणे
7. मृदा भूगोलाची ओळख- प्रा. डाॅ. एम. एन. सुरवसे
8. जमिनीची भूक भाषा - क.वी. जोशी (पुणे१)