The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 2 | Issue 8 | August 2024
ISSN: 2583-973X (Online)
Website: www.theacademic.in

Study on Physico-Chemical Properties of Soil and Their Effect on Wheat Production

Dr. Rekha Israni[1], Suresh Kumar Joshi[2]
[1]Associate Professor Bhagwant University, Ajmer, Rajasthan, India
[2]Research Scholar ,Bhagwant University ,Ajmer ,Rajasthan ,India
joshisuresh237@gmail.com

ARTICLE DETAILS

Research Paper

Keywords:
Physico-Chemical, Wheat Cultivation, Crop, Fertilization.

ABSTRACT

Soil plays a fundamental role in global agriculture, particularly in the cultivation of staple crops like wheat, rice, pulses, sugarcane, vegetables, and fruits. Indian agriculture, renowned for its global cultivation of these crops, temperature, organic matter, and nutrient availability (like nitrogen, phosphorus, and potassium)—are pivotal factors influencing agricultural management decisions. For wheat, the second most important staple food globally after rice, soil quality significantly impacts its production. Wheat serves as a vital calorie and protein source for over 4.5 billion people in developing countries, providing 21% of food calories and 20% of dietary proteinunderscores the critical importance of soil's physical and chemical conditions in achieving productive yields. The physico-chemical properties of soil—such as pH levels, electrical conductivity, texture, moisture content. Understanding and managing soil properties are essential for optimizing wheat cultivation practices, including crop selection, fertilization strategies, irrigation management, and overall land stewardship. Informed decisions based on soil analysis ensure sustainable farming practices that contribute to food security and economic stability worldwide. Advances in soil science and agronomy continue to refine our understanding of how soil properties affect crop performance, enabling farmers to adapt to varying environmental conditions and enhance wheat yields. Therefore, the study and application of soil physico-chemical properties are indispensable for the future of global agriculture, ensuring continued food production to meet the needs of a growing population.

INTRODUCTION

Agriculture refers to an art of raising plants from the soil and is one of the most economical factors from human beings· But the intensive use of agrochemicals may lead to soil degradation, residues of agrochemicals in crop or ground water includes negative effects on the health of agricultural workers, especially in intensive commercial horticulture, particularly in vegetable production· Soil fertility is an important factor, which determine the growth of plant. It is depends on the concentration of N,P, K organic and inorganic materials, micronutrients and water. In general soil chemical fertility and in particular lack of nutrient inputs is a major factor in soil degradation· The deficiency of nutrients has become major constraint to productivity, stability and sustainability of soils. A soil aggregate status usually deteriorates rapidly if soil is repeatedly cropped with annuals that supply little organic matter to the soil, require extensive cultivation and provide minimal vegetativecover· There are various ways of addition and losses of nutrients as take place in soil.These nutrient cycling make the balance of organic and inorganic soil constituents.

In recent years organic and inorganic fertilizers and pesticides are being widely used by farmers in agriculture to increase the yield and production of cultivable plants. The yield and quality of crop depends upon the fertilizers and presence of micronutrients. The soil condition is of great importance because it is a universal medium for plant growth, which supllies essentials nutrients to the plants. But due to excess use of fertilizers, the physico-chemical status in soil is being changed. The increasing use of chemical fertilizers to the soil, it is difficult to control the side effect of the chemicalsto the soil, plant animals and human beings. Soil farming factors interaction resultsinto the properties of soil. Physico chemical and biochemical characteristics of different soils vary in space and time due to variation in topography, climate, physical weathering processes, vegetation cover, microbial activities, and several other biotic and abiotic variables. Different factors create different type of soil.

The properties of soil along with its type have a great importance in agriculture· Soil physico chemical properties deteriorates to the change in land use especially from agriculture and forest. The change in physico chemical properties of soil leads to infertile or barren soil that does not support normal growth of vegetation for years. Sustainable development is the one that meets the needs of the present generation without compromising the ability of future generations to meet their own needs, the basic principle of sustainable development is to be all the activities in an environmentally acceptable way with minimum utilization of resources. Conservation of resources and preserving our valuable assets for the next generations is our duty and responsibility. After the Green Revolution in the 1970s, India experienced a remarkable increase in wheat production, becoming a global leader in both cultivation area and total output among cereals, as noted by the Food and Agriculture Organization (FAO) in 2003. The introduction of high-yielding varieties from 1965 onwards led to a substantial leap in wheat productivity, with India producing 94 million metric tonnes of wheat in 2011-12, accounting for 13.53% of the world's production. Productivity rose from 2.60 tonnes per hectare in 2004-05 to 3.14 tonnes per hectare recently, particularly in states like Haryana, Punjab, and Uttar Pradesh, known as the wheat belt.

At independence, India's total food grain production was a mere 50 million tonnes, which rose to 206 million tonnes by 2000, achieving self-sufficiency in food production. However, future targets remain ambitious, with estimated food demand expected to reach 265 million tonnes by 2030. Wheat, contributing significantly to India's food grain production, plays a crucial role in national economy and food security. The transformation from a net wheat importer to self-sufficiency underscores India's agricultural advancement, spurred by strategic initiatives post-independence and the transformative Green Revolution policies.

Wheat, a remarkably adaptable crop, thrives across a broad spectrum of climates but flourishes under specific conditions. It exhibits robust adaptability, flourishing from high altitudes beyond 60 degrees north to temperate and frigid northern regions, as well as in tropical and subtropical zones. The crop withstands extreme cold and snowfall, initiating growth with the onset of warmer spring weather. It is cultivated up to 3300 meters above sea level, illustrating its versatile nature.

Optimal growing conditions for wheat involve cool, moist weather during much of the growing season, transitioning to dry, warm conditions during grain ripening. While wheat seeds can sprout in temperatures ranging from 3.5 to 35 degrees Celsius, the ideal germination temperature ranges from 20 to 25 degrees Celsius. However, rains immediately after sowing can hinder germination and lead to seedling blight. Wheat does not thrive in warm, humid climates, as these conditions are unsuitable for its growth.During critical growth stages like heading and flowering, wheat is sensitive to drought, extreme heat, and low temperatures. Cloudy, damp, and cold weather encourages rust attacks, impacting crop health. For optimal grain development and filling, an average temperature of 14–15 degrees Celsius during ripening is ideal. High temperatures exceeding 25 degrees Celsius during grain filling can lead to reduced grain weight and lower yields due to increased transpiration and reduced energy allocation.

In terms of soil requirements, wheat prefers clay loam or loam soils with good structure and moderate water-holding capacity. Soil pH should be neutral, and the soil should be well-drained but not excessively porous. Heavy soils with poor drainage are unsuitable due to the risk of waterlogging, which adversely affects wheat growth. Conversely, light soils can support wheat cultivation if they are able to retain adequate water and nutrients.In India, wheat is predominantly cultivated as a rabi (winter) season crop, aligning with its preference for cooler temperatures during initial growth and warmer conditions during grain ripening. This seasonal adaptation ensures optimal growth and yield potential in regions where temperature and moisture conditions align with its requirements.

REVIEW OF LITRATURE

The literature on soil Chemistry :

The scope and limits of crop Sustainability affect all fields of human activity, but are particularly felt in science and technology.

A.Anita Joshi Raj, V Umayoru Bhagan analysed the fluoride concentration and some other important physicochemical parameters of 51 surface soil samples and 51 underground Union, South India. In all the fluorotic areas the surface soil samples were having fluoride levels greater than the underground water samples. The fluoride concentration in the soil was ranging between 2 to 3.5 ppm and in the water samples it was ranging between 1.3 to 2.7 ppm. Both the levels were found to be above the permissible limit. Other parameters such aspH, alkalinity, total hardness, calcium, magnesium, chloride, salinity and sodium werealso measured. Alkalinity and pH were found to be higher than the permissible limit inall the soil and water samples at various seasons. Finally, it was predicted that leachingof minerals from the soil is responsible for the high fluoride content in water samples and this in turn is responsible for the prevalence of fluorosis in the study area.

Saroj Mahajan and Dilip Billore Carried out work on the study of physicochemicalparameters like pH, specific conductivity, chloride, total alkalinity, calcium, magnesium nitrate, sulphate, phosphate sodium and potassium from July 2008 to June2009. During the study year fluctuation was observed in several parameters. Investigation results showed that the soil alkaline throughout the study year. The productivity of an ecosystem depends upon the quality of soil.Some parameters were above permissible limit and some below the permissible limit which affects the qualityand productivity of pond soil.

Anu, Upadhyaya S.K, Bajpai Avinash , studied that Soil gets polluted due to dumping of waste. Solid waste is garbage, refuse, sludge, and other discarded materials(including solids, liquids and contained gases) resulting from industrial,commercial, mining, and agricultural operations, and from community operations. The soil samples were taken from Shahpura Lake of Bhopal to assess the soil quality. During the study period physic-chemical parameters viz pH, Moisture content, Bulk Density, Chloride of soil was assessed as per the standard methods. High chloride value indicates pollution of soil sediment due to urbanization, industrialization and modernization in agricultural system results in extensive use of chemical fertilizers and pesticides.

Osakwe, SA.Studied that the physicochemical properties of soils from natural flood disaster affected areas of the Isoko Region of Delta State, Nigeria, wereinvestigated. The results indicated that there was an overall reduction in soil pH (5.425± 0.313), phosphorus (7.47±6.34mgkg-1), and nitrate (0.34±0.07mgkg-1) contents as well as exchangeable calcium1.97±0.31mgkg-1 potassium (0.09±0.01mgkg-1), and effective cation exchange capacity (5.076±1.532 (cmolkg-1) and related parameters with 3.87±0.21, 77.57±5.83 and 7.99±2.72 for Base Exchange Capacity, Base Saturation and Soil Buffering capacity respectively. There was, however increased in the values of exchangeable magnesium (1.50±0.25mgkg- 1),exchangeable sodium (0.28±0.004mgkg-1) and also the exchangeable acidity with the values 0.43+0.08 and 0.42±1.02mgkg-1 for Hydrogen and Aluminium respectively.There was no appreciable change in the values of Total Organic Carbon (0.40±0.096%), Total Nitrogen (0.025±0.035%) and Sulphate (0.10±0.02mgkg-1). The overall results indicate that the flood increased soil acidity and decreased the ability of the soils to adsorb metals, but did not have an appreciable effect on the biodegradable and compostable materials. Government should be proactive and devise measures to prevent further flood disaster in the country.

Kiran G. Chaudhari studied that the physicochemical study of soil is based on various parameters like total OrganicCarbon, Nitrogen (N), Phosphorus (P_2O_5), Potassium (K_2O),pH and Conductivity. This study leads us to the conclusion ofthe nutrient's quantity present in the soil of Bhusawal, District Jalgaon (Maharashtra). Results show that all the eight selected places of Bhusawal have medium or high mineral content. In order to study the effect of phosphate fertilizer, phosphorus, and application of nitrogen to increase percentage yield of crops. This information will help farmers to solve the problems related to soil nutrients, amount of which fertilizersto be used to increase the yield of crops.

Rajesh P. Ganorkar and P.G.Chinchmalatpure carried out work on soils with physical properties, chemical properties and micronutrients of soils have been done. Soil samples were collected from six different locations covering Rajura Bazar, in Warud Tahsil in Amravati District (Maharashtra) India. The soil parameters like soil moisture, pH, EC, Carbon, Calcium carbonate, TDS, Magnesium, Calcium, Nitrogen,Copper,Potassium and Phosphorous content, were analyzed in the month of February2013. The values of pH indicated that all samples of the soils are alkaline, all samples were containing moderate amounts of available micronutrients**.**

Joel O.F, Amajuoyi C.A studied some selected physicochemical parameters and heavy metals in a drilling cutting dump site. Test results indicated that some of the heavy metals like copper, iron and calcium showed a high level of contamination in most of the plotsunder the study area. Iron had a value as high as 880mg/kg, copper 84mg/kg and calcium 12560 mg/kg. These values were above target values as specified by the regulatory body, Department of Petroleum Resources (DPR). Moreover, the oil and grease indicated a high level of contamination, with a concentration of up to 840 mg/kg in one of the plots. This was evident in lack of plant growth noticed in the study area as a result of depletion of NPK values below to specify the value by USDA Standards for plant growth. The highest level of contamination of some of the physicochemical parameters and heavy metals as seen in this project underscores the need for due diligence in managing drilling cutting discharges from drilling activities.

Abdulmajeed Mlitan, Abdullah Abofalga, and AbdelazizSwalem investigated the effect of treated wastewater on soil chemical and physical properties. A field experiment was conducted in the Misurata region in central Libya with water treatments of wastewater. The Soil physicochemical parameters such as pH, water content, total soluble salts,Cadmium, Zinc, Lead, Copper and Iron of soil added treat industrial waste water. The results reveal that the some sampling sites were affected by industrial waste water pollution. Soil water content ranged from 7.68 to 19.56%. Total soluble salts ranged from 272.6 to 300 ppm and soil pH ranged from 7.7 to 8.0. and showed no appreciable differences within localities. The all tested metals increased from first location to the third location except Iron. The irrigation system had a significant effect on Total soluble salts and microbial flora. Isolated microbial flora consists of 4 fungal genera belonging to, Aspergillus, Penicillium, Rizopus and Fusarium.The latter and one of the Aspergillus spices (Aspergillus sp3) may consider one of the resistance fungi in industrial waste water due to its large colony numbers isolated from the water contaminated metals area.

Sanjoli Mobar, Pallavi Kaushik and Pradeep Bhatnagar carried out work on impacted and non-impacted soil of two areas i.e. Sanganer and Durgapura respectively, of Jaipur district. The soil quality was analysed by estimation of physicochemical parameters such as pH, electricalconductivity (EC), water holding capacity, texture analysis,organic carbon, organic matter, total hardness, sodium, potassium concentration, sodium adsorption ratio (SAR), cation exchange capacity (CEC) using standard protocols. Theresults showed a significant difference between pH, EC, Water holding capacity, total hardness, SAR, CEC of both the soil, inferring the impact of industrial effluent on the quality of soil. Thus, to protect the deterioration soil quality, control of such industrial pollution assumes greater significance which can be assuredby planned industrialization.

Prakash L. Patel, Nirmal P. Patel, Prakash H. Patel, AnitaGharekhan correlated thechemical parameters of agricultural soil of different villages of Kutch district of Gujarat state in Western India**.** Their primary focus was to study mung bean crop based on randomly selected 30 mediumblack soil samples. Under the Soil Health Card Program of Government of Gujarat, soil samples were collected by authorized locally trained farmers and brought for analysis to Soil Test Laboratory, Bhuj. Standard Methods were used for the soil quality analysis. The objective of this work is to studyand evaluate relation between soil properties and macronutrients(P, K, C and S) by using *c*orrelation analysis. Present study concludes that the statistical method 'correlation analysis' can provide a scientific basis for controlling and monitoring theagriculture soil fertility management.

A.M. Shivanna and G. Nagendrappa carried out work on the soil fertility status of selected command areas of three lakes- Eachanur, V. Mallenahalli and Halkurke in Tiptur Taluk. The variables tested included pH, EC, OC, N, P, and K.The study revealed that the pH of the soil samples ranged from 7.07 to 7.87 and was on slightly alkaline side but within the limit of 6.5-8.5 which is optimum for crops. EC values ranged from 0.26dSm-1 to 0.485dSm-1 and were within the limit of 0.8dSm-1 indicating low salinity status of the soils. OC content rangedfrom 0.50% to 0.67% and all the samples were of medium rating. Available nitrogen ranged from 54.825kg/ha to 85.72kg/ha; available phosphorous ranged from 5.33kg/ha to 10.79kg/ha and samples were nitrogen and phosphorous deficient. Potassium ranged from

156.18kg/ha to 434.38kg/ha and samples were of medium rating except one sample of high rating with respect to potassium.

AREA OF STUDY

Masuda, located in Rajasthan's Ajmer district, offers significant research opportunities in agricultural and environmental sciences. Key areas include enhancing crop productivity through soil fertility and efficient irrigation for crops like wheat, barley, and mustard. Research on sustainable water management and adapting to climate change with drought-resistant crops is crucial. Exploring rural livelihoods, biodiversity conservation in the Aravalli Range, and promoting renewable energy adoption are essential for sustainable development. Analyzing cultural heritage impacts on local tourism, assessing educational infrastructure, and understanding urbanization trends contribute to balanced rural-urban development. These efforts aim to foster resilience and improve livelihoods amidst environmental and socio-economic challenges in Masuda.

RESEARCH MATERAILS AND METHODS:

Soil samples were methodically collected from nine villages in Masuda block, Ajmer district, Rajasthan. Each village provided samples from two depths: 0-15 cm and 15-30 cm, totaling eighteen soil samples. To ensure thorough sampling, various tools were employed, including the Khurpi, a traditional handheld tool widely used in rural India, and a Spade for deeper and broader coverage. The depth of each sample was precisely measured using a meter scale.This systematic approach aimed to capture variations in soil characteristics across different depths and locations within Masuda block, Ajmer district. Such comprehensive sampling is crucial for understanding the physical and chemical properties of the soil, which are essential for agricultural productivity and environmental management.By collecting samples from multiple villages and depths, the study aims to generate a robust dataset that can guide agricultural practices, soil conservation efforts, and land management strategies tailored to the diverse soil profiles and farming practices specific to the region.

TABLE – 1- CHEMICAL PROPERTIES AND WHEAT PRODUCTION

PARAMETER	Soil pH (1:2)			Electrical conductivity(1:2)			Organic Carbon			Organic matter		
VILLAGE	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN
LODIYANA	7.12	7.31	7.215	0.34	0.39	0.365	0.47	0.25	0.36	1.11	0.97	1.04
RAMGARH	7.34	7.42	7.38	0.56	0.62	0.59	0.82	0.69	0.755	1.73	1.61	1.67
KIRAP	6.81	6.95	6.88	0.82	0.89	0.855	0.52	0.38	0.45	1.43	1.29	1.36
AASAN	7.23	7.36	7.295	0.74	0.79	0.765	0.45	0.31	0.38	1.21	1.11	1.16
SATHANA	7.31	7.39	7.35	0.47	0.52	0.495	0.63	0.52	0.575	1.34	1.19	1.265
DEVMALI	6.92	7.01	6.965	0.41	0.47	0.44	0.67	0.59	0.63	1.57	1.41	1.49
NAGAR	7.05	7.12	7.085	0.63	0.7	0.665	0.73	0.61	0.67	1.62	1.49	1.555
DEWAS	7.15	7.22	7.185	0.53	0.59	0.56	0.57	0.47	0.52	1.43	1.19	1.31
JALLIA-ll	7.24	7.39	7.315	0.48	0.53	0.505	0.43	0.31	0.37	1.79	1.53	1.66

TABLE – 2- CHEMICAL PROPERTIES AND WHEAT PRODUCTION

PARAMETER	Available potassium			Exchangeable calcium			Available Sulphur			Exchangeable magnesium		
VILLAGE	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN
LODIYANA	389.12	362.85	375.985	7.04	6.8	6.92	2.85	2.39	2.62	15.04	14.79	14.915
RAMGARH	262.08	253.18	257.63	8.32	8.21	8.265	2.16	1.78	1.97	15.85	15.69	15.77
KIRAP	362.01	350.04	356.025	6.54	6.32	6.43	3.46	3.15	3.305	14.39	14.21	14.3
AASAN	322.8	322.01	322.405	6.92	6.81	6.865	3.52	2.37	2.945	13.63	13.31	13.47
SATHANA	234.78	219.02	226.9	8.56	8.12	8.34	2.81	2.45	2.63	12.01	11.78	11.895
DEVMALI	251.18	239.23	245.205	7.42	7.14	7.28	2.69	2.01	2.35	13.69	13.42	13.555
NAGAR	413.04	397.86	405.45	7.89	7.53	7.71	3.01	2.67	2.84	14.35	13.93	14.14
DEWAS	331.82	317.32	324.57	8.16	7.98	8.07	2.61	2.41	2.51	12.61	12.32	12.465
JALLIA-ll	455.82	440.08	447.95	8	7.68	7.84	2.84	2.63	2.735	13.41	13.21	13.31

TABLE – 3- CHEMICAL PROPERTIES AND WHEAT PRODUCTION

PARAMETER	Available nitrogen			Available phosphorus			Wheat Productions Using Fertilizer (N,P,K)			
VILLAGE	0-15 CM	15-30 CM	MEAN	0-15 CM	15-30 CM	MEAN	15 Kg/Ha	30 Kg/Ha	45 Kg/Ha	60 Kg/Ha
LODIYANA	219.12	208.95	214.035	11.1	10.85	10.975	1439	1689	1750	1820
RAMGARH	255.21	241.08	248.145	11.85	11.29	11.57	1672	1736	1800	1889
KIRAP	288.03	269.84	278.935	12.34	11.98	12.16	1572	1876	1920	1998
AASAN	210.82	201.01	205.915	12.89	12.29	12.59	1440	1610	1720	1810
SATHANA	234.75	224.82	229.785	13.82	13.22	13.52	1481	1572	1632	1688
DEVMALI	259..04	248.21	248.21	10.34	10.06	10.2	1531	1679	1704	1785
NAGAR	273.21	261.82	267.515	13.74	13.05	13.395	1682	1810	1875	1945
DEWAS	269.81	258.73	264.27	12.56	11.86	12.21	1359	1489	1560	1601
JALLIA-ll	254.83	244.23	249.53	12.34	11.74	12.04	1471	1589	1620	1675

These were the results after doing the test :

Analyzing the comprehensive dataset provided for soil parameters, nutrient content, and crop productivity across different villages offers valuable insights into agricultural practices and potential improvements. This detailed examination helps in understanding the interplay between soil characteristics, nutrient availability, and their impact on crop yields.

Soil Parameters Analysis:

1. Soil pH: Soil pH is a crucial factor influencing nutrient availability to plants. The pH values across villages range from 6.81 to 7.38, indicating slightly acidic to neutral conditions. Generally, crops thrive best in slightly acidic to neutral pH ranges, as seen in most of the villages. Proper pH management is essential for optimal nutrient uptake and microbial activity in the soil.

2. Electrical Conductivity (EC): EC measures the soil's ability to conduct electricity, which correlates with the soil's salinity level. The values range from 0.34 to 0.89, indicating varying levels of salinity across the villages. High EC values can affect plant growth by limiting water uptake and causing nutrient imbalances. Effective irrigation practices and soil amendments are necessary to manage soil salinity.

3. Organic Carbon and Organic Matter: Organic carbon and organic matter are indicators of soil fertility and health. Organic carbon levels range from 0.38% to 0.89%, and organic matter ranges from 1.04% to 1.67%. Higher levels of organic matter improve soil structure, water retention, and nutrient holding capacity, promoting healthier plant growth and resilience to environmental stresses.

Macronutrients:

1.Available Potassium (K): Potassium is essential for plant growth, contributing to disease resistance and overall yield quality. Values vary significantly across villages, from 234.78 to 455.82 units. Proper management of potassium ensures optimal plant growth and stress tolerance.

2.Available Nitrogen (N) and Phosphorus (P): These nutrients are crucial for plant growth stages, including vegetative growth, flowering, and fruit development. Nitrogen levels range from 210.82 to 288.03 units, while phosphorus levels range from 10.06 to 13.82 units. Balancing these nutrients through fertilization practices enhances crop productivity and quality.

3.Available Sulfur (S): Sulfur is vital for protein synthesis in plants. The values range from 2.35 to 3.52 units across villages. Sulfur deficiencies can impair plant growth and yield, highlighting the importance of adequate sulfur supplementation in agricultural practices.

4.Exchangeable Calcium (Ca) and Magnesium (Mg): These nutrients contribute to soil structure and plant nutrient uptake. Calcium levels range from 1.78 to 3.52 units, and magnesium levels range from 11.78 to 15.85 units. Maintaining balanced levels of Ca and Mg promotes soil health and crop productivity.

Crop Productivity:

Crop productivity data under different fertilizer applications (15 Kg/Ha to 60 Kg/Ha) provide insights into yield responses to nutrient management strategies. The wheat production metrics reveal how varying levels of nitrogen, phosphorus, and potassium affect yield outcomes. Higher fertilizer application rates generally result in increased yields, emphasizing the importance of nutrient management in achieving optimal crop production.

Village-wise Insights:

Each village exhibits unique soil characteristics and nutrient profiles, influenced by local geology, climate, and agricultural practices. For example:

Lodiyana and **Ramgarh** show relatively higher nutrient levels, potentially indicating better soil fertility and management practices.

Kirap and **Sathana** exhibit moderate nutrient levels, suggesting opportunities for targeted nutrient supplementation.

Devmali and **Dewas** demonstrate varied nutrient profiles, reflecting diverse agricultural practices and soil conditions.

Nagar and **Jallia-ll** also display distinct nutrient patterns, influencing crop growth and productivity.

Agricultural Implications and Recommendations:

Precision Agriculture: Utilize soil testing and data-driven approaches to tailor nutrient applications based on specific soil nutrient profiles and crop requirements.

Soil Health Management: Enhance organic matter content through cover cropping, crop residue incorporation, and composting to improve soil structure and fertility.

Nutrient Management: Implement balanced fertilization strategies to optimize nutrient uptake efficiency and minimize environmental impacts.

Water Management: Efficient irrigation practices, coupled with soil salinity monitoring, mitigate water stress and maintain crop productivity.

Crop Rotation and Diversity: Integrate crop rotation and diversification to enhance soil health, reduce pest pressures, and sustain long-term agricultural productivity.

CONCLUSION:

The comprehensive analysis of soil parameters, nutrient content, and crop productivity across villages underscores the critical interplay in agricultural systems. Variations in soil pH (6.81 to 7.38), electrical conductivity (0.34 to 0.89), and organic matter (1.04% to 1.67%) highlight diverse soil health conditions influencing crop yields. Macronutrient levels such as potassium (234.78 to 455.82 units), nitrogen (210.82 to 288.03 units), phosphorus (10.06 to 13.82 units), sulfur (2.35 to 3.52 units), calcium (1.78 to 3.52 units), and magnesium (11.78 to 15.85 units) indicate varied nutrient availability affecting agricultural productivity. Tailored nutrient management, precision agriculture, and sustainable practices are recommended to optimize crop production, soil health, and resilience to environmental challenges.

ACKNOWLEDGEMENTS

I am deeply grateful to Dr.Rekha Israni Ma'am for her exceptional guidance, unwavering support, and invaluable mentorship throughout this research. Her expertise and encouragement shaped the direction and methodology of this study. I also acknowledge the Chemistry Lab at Bhagwant University Ajmer for providing essential facilities, equipment, and technical support crucial for experiments and analysis. The lab's resources significantly contributed to the successful completion of this research. This study would not have been possible without Dr. Rekha Israni Ma'am guidance and the support of the Chemistry Lab and its staff, whose contributions were pivotal in achieving our research objectives.

REFERENCES:

1 > Anu Upadhyaya SK, Bajpai Avinash. Seasonal Analysis of Soil Sediment of Shahpura Lake of Bhopal (M.P.). **International Journal of Environmental Science and Development. 2010 Oct;1:4**

2 > Chaudhari K G.2013. Studies of the physicochemical parameters of soil **samples Advances in Applied Science Research ; 4(6):246- 248**

3 > Ganorkar R P, Chinchmalatpure PG 2013. Physicochemical Assessment of Soil in Rajura Bazar in Amravati District of Maharashtra (India**) International Journal of Chemical, Environmental and Pharmaceutical Research MayDecember. ; 4(2&3):46-49**

4 > Joel OF, Amajuyoyi CA. 2009. Determination of Selected Physicochemical Parameters and Heavy Metals in a Drilling Cutting Dump Site at Ezeogwu–Owaza, Nigeria, J **Appl. Sci. Environ. Manage.; 13(2):27-31**

5 > Juhos, K.; Szabo, S.; Ladanyi, M.2016. Explore the influence of soil quality on crop yield using statistically-derived pedological indicators. **Ecol. Ind. , 63, 366–373.**

6 > Mahajan S., Billore D.2014. Assessment of PhysicoChemical characteristics of the Soil of Nagchoon Pond Khandwa, MP,India. **Res. J Chem Sci. ; 4(1):26-30.**

7 > Mlitan A .2015 . Impact of Treated Wastewater on Some Physicochemical Parameters Soil and Its Fungal Content. **International Journal of Environmental Science and Development. ; 6:5**

8 > Mobar S. 2015. Physicochemical comparison of textile effluent impacted and Unimpacted agricultural soil of Jaipur city, India**, International Journal of Recent Scientific Research Research. ; 6(3)3090-3093**

9 > Moshiri, M.; Shahabi, A.A.; Keshavarzi, P.; Khogar, Z.; Feyzi Asl, F.; Tehrani, M.M.; Asadi Rahmani, H.;Samavat, S.; Gheibi, M.N.; Sedri, M.H.; et al.2013. Guidelines for Integrated Soil Fertility and Plant Nutrition Management of Wheat; **Soil and Water Research Institute Press: Tehran, Iran, p. 73. (In Persian)**

10 > Neeta More, Mukul Barwant& Archana Hargude 2020. DETERMINATION OF SOIL COMPOSITION – WITH RELEVANCE TO THE PHYSICAL AND CHEMICAL NATURE OF BLACK SOIL SAMPLE. **International Journal of Applied and Natural Sciences (IJANS) Vol. 9, Issue 4; 1–14**

11 > Pramod N. Kamble, G, Anil R. Kurhe orakash M. Pondhe, Viswas B. Gaikwad, Erland Baath 2013. Soil Nutrient Analysis And Their Relationship With Special Reference To Ph In Pravaranagar Area, District Ahmednagar, Maharashtra, India. **INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 2, ISSUE 3, 216**

12 > Osakwe SA. 2014. Evaluation of Physicochemical Characteristics of Soils in the Flood Disaster Affected Areas of Isoko Region of Delta State, Nigeria**. IOSR Journal of Applied Chemistry (IOSR-JAC). Ver I.; 7(5):24-31**

13 > Prakash L, Patel.2014. Correlation Study of Soil Parameters of Kutch district Agriculture Land. **International Journal of Scientific and Research Publications. ; 4:5.**

14 > Raj A.J., Bhagan V.U. 2013.Comparative analysis of some important physicochemicalparameters of surface soil and underground water samples of fluorotic areas of Agastheeswaram Union, South India. **American Journal of Engineering Research; 02(06):55-59.**

15 > Sanjoli Mobar 2015 . Physicochemical comparison of textile effluent impacted and Unimpacted agricultural soil of Jaipur city, India, **International Journal of Recent Scientific Research Research. ;6(3)3090 -3093.**

16> Shivan A.M, Nagendrappa G.2014. Chemical Analysis of Soil Samples to Evaluate the Soil Fertility Status of Selected Command Areas of Three Tanks in Tiptur Taluk of Karnataka, **India Journal of Applied Chemistry. Ver. I. ; 7(11):01- 05**

17 > Upadhyay A. SK, Bajpai A. 2010. Seasonal Sediment of. Shahpura Lake of Analysis of Soil Bhopal (M.P.). **International Journal of Environmental Science and Development; 1:4**

18 > Yu, P.; Liu, S.; Zhang, L.; Li, Q.; Zhou, D. 2018.Selecting the minimum data set and quantitative soil quality indexing of alkaline soils under different land uses in northeastern China. **Sci. Total Environ. , 616, 564–571.**