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Comparative Assessment of Soil Quality in Neemuch District of Madhya Pradesh

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Abstract: **Soil health management for sustaining crop productivity is a major challenge of recent years to meet the food demand and nutritional security of increasing population. Nutrient are chemical elements that are essential for the growth of plants as well as fertility of soil. The beneficial role of various elements added to soil for the improvement of plant growth has been known in agriculture for more than 2000 years. For effective management of soil quality, assessment of soil health and periodic monitoring is foremost important step. The mineral composition of various plants growing in soil cannot always be used as criterion for establishing the essential or non-essential nature of an element. The plant nutrients are divided into macronutrients and micronutrients. The essentiality of micro nutrient is proved long before the role in crop production was recognized.**

In this connection, the soil quality status of Neemuch district of Madhya Pradesh was assessed. The developed soil qualityassessment protocol is very simple and can be easily adoptable. Periodic monitoring and assessment of (at least once in five years) of soil quality status can be very useful for enhancing crop productivity and sustaining soil health of the region.

Keywords: **Soil quality, Nutrient, Soil health.**

1. INTRODUCTION

Neemuch has unique geographical features that has ever influenced the climate of the region. The total geographic area of Neemuch district is 40 km2 (20 sq mi). It is located between the parallels of latitude 24.45°N 74.87°E. Neemuch shares its border with Rajasthan in the west and north and by Mandsaur district in the east and south. There are mainly four types of soil found in the Neemuch district. These are Medium Deep Black cotton soil, Red loamy soil, Laterite soil, and Alluvial soil. Though most of the district is mainly covered by Medium Deep Black cotton soil. All the soils found in Neemuch District are known for making the land immensely fertile and invariably helping in the growth of the agricultural sector.

Nowadays soil quality deterioration is becoming a major issue for declining crop productivity. Nutrient present in the soil along with other physical properties, chemical process, and biological activities governs soil health and crop productivity. Plants required a total of 18 nutrient elements in their life cycle. Plants have limited capability for a slept update of those minerals, which are essential for their growth. They also take up minerals that are not necessary for growth and which may even be toxic. Introduction of high yielding varieties and inadequate supply of fertilizer nutrient causes mining of nutrients from soil particularly potassium (Pathak et al., 2010; AICRP-LTFE, 2013). Therefore, Soil testing is needed to provide balanced fertility, that is profitable, efficient, and environmentally friendly.

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Fig 1: Map of District Neemuch

2. MATERIALS AND METHOD

The study area covers different five villages in the district Neemuch.

Materials required

Spade or auger, Khurpi, Core sampler, Sampling bags, and Plastic tray or bucket

Procedure

Divide the field into different homogenous units based on the visual observation and farmer's experience then remove the surface litter at the sampling spot. Drive the auger to a plough depth of 15 cm and draw the soil sample, at least 10 to 15 samples are collected from each sampling unit and placed in a bucket or tray. If the auger is not available, make a 'V-shaped cut to a depth of 15 cm in the sampling spot using a spade, thick slices of soil removed from top to bottom of the exposed face of the 'V-shaped cut and placed in a clean container, the bulk is reduced to about half to one kilogram by quartering or compartmentalization.

- Quartering is done by dividing the thoroughly mixed sample into four equal parts. The two opposite quarters are discarded and the remaining two quarters are remixed and the process is repeated until the 500 gm sample size is obtained

- Compartmentalization is done by uniformly spreading the soil over a clean hard surface and dividing it into smaller compartments by drawing lines along and across the length and breadth. From each compartment, a pinch of soil is collected. This process is repeated till the 500 gm quantity of sample is obtained.

After that, the sample is collected in a clean cloth bag. Then beg is labeled with information like the name of the farmer, location of the farm, survey number, the previous crop grown, date of collection, name of the sampler, etc.

3. RESULT AND DISCUSSION

The most important criterion for a soil test is that it should measure the nutrient in the soil that is available to the plant. Many times, nutrients in the soil are held tightly and are unavailable. N, P, K are the main elements in most fertilizers. The plant needs other nutrients like Fe, Ca, Cl etc. Different opinion in threshold level of Cobalt, Nickle, and Chlorine has been observed. In different crops, these have different effects.

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Table 1: Physical and chemical properties of soil

SOIL TESTING RESULTS							
			VILLAGE				
S.No.	PARAMETERS	UNIT	Kachouli	Jeeran	Nayagaon	Kachariya Dev	Cheetakheda
1	pH		7.42	7.28	7.62	7.22	7.63
2	Ec	(mili mhos/cm)	0.31	0.37	0.27	0.28	0.41
3	Organic Carbon (OC)	Percent (%)	0.84	0.59	0.96	0.82	0.96
4	Available Nitrogen (N)	(Kg/Hectare)	294	231.5	321	287	321
5	Phosphorus (P)	(Kg/Hectare)	11.61	8.63	15.63	17.67	14.41
6	Potassium (K)	(Kg/Hectare)	382	602	401	725	389
7	Sulphur (S)	(ppm)	19.92	9.61	11.73	17.6	6.61
8	Zinc (Zn)	(ppm)	0.48	0.69	0.73	0.74	0.94
9	Iron (Fe)	(ppm)	4.02	2.6	3.62	3.11	3.6
10	Magnese (Mn)	(ppm)	14.72	14.38	14.73	18.74	14.73
11	Copper (Cu)	(ppm)	1.92	1.63	2.6	0.98	1.72
12	Boron (B)	(ppm)	0.64	0.92	0.43	0.61	0.69

Table 2: Physical and chemical standard levels of soil

Parameters	Standard Level		
pH	Acidic- Below 6.5	Normal- 6.5 - 8.2	Basic- more than 8.2
Ec	Normal- Below 1	Medium- 1-3	Harmful- more than 3
Organic Carbon (OC)	Low- Below 0.5	Medium- 0.5-0.75	High- more than 0.75
Available Nitrogen (N)	Low- Below 280	Medium- 280-560	High- more than 560
Phosphorus (P)	Low- Below 10	Medium- 10-20	High- more than 20
Potassium (K)	Low- Below 140	Medium- 140-280	High- more than 280
Sulphur (S)	Low- Below 10	Sufficient- More than 10	
Zinc (Zn)	Low- Below 0.6	Sufficient- More than 0.6	
Iron (Fe)	Low- Below 4.5	Sufficient- More than 4.5	
Magnese (Mn)	Low- Below 2.0	Sufficient- More than 2.0	
Copper (Cu)	Low- Below 0.2	Sufficient- More than 0.2	
Boron (B)	Low- Below 0.5	Sufficient- More than 0.5	

Role of Nutrients

Suitable proportions and adequate amount of potassium, calcium and magnesium plays an important role in soil fertility and plant growth.

1. **pH** is a measure of the acidity and alkalinity in soils. The optimal pH range for most plants is between 5.5 and 7.0. pH levels control plant nutrient availability – it is vital to maintain proper levels to reach their high yield potential [M.Ray Tucker, 1999]. The pH level was found 7.28, 7.62, 7.22, 7.63 and 7.42 in Jeeran, Nayagaon, Kachariya Dev, Cheetakheda and Kacholi villages respectively.

2. **Nitrogen:** Of the three major nutrients N, P and K. Plants require nitrogen in the largest amounts. Nitrogen contributes to protein synthesis and in enzyme structure. phosphorus has an important role in plant growth and the production of fruits. Nitrogen and phosphorus recommendations are 280-560 ppm and 10-20 ppm respectively. While in our study in the Neemuch district Nitrogen levels were 231.5 ppm in Jeeran, 321 ppm in Nayagaon, 287 ppm in Kachariya Dev, 321 ppm in Cheetakheda, and 294 ppm in Kacholi villages. Nitrogen promotes rapid growth, increases leaf size and quality, hastens crop maturity, and promotes fruit and seed development, because nitrogen is a constituent of amino acids, which are required to synthesize proteins and enzymes, it plays a role in the metabolic process.[2]

3. **Potassium** is helpful in the metabolic processes of plant cells and has a significant role in influencing the uptake of other mineral elements, affecting the rate of transpiration and influencing the action of enzymes, regulating the rate of respiration, as well as in aiding the synthesis and translocation of carbohydrates. Potassium recommendations are 140-280 Kg per

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hectare. While in our study levels of Potassium were found 602 Kg/ hectare in Jeeran, 401 Kg/ hectare in Nayagaon, 725 Kg/ hectare in Kachariya Dev, 389 Kg/ hectare in Cheetakheda and 382 Kg/ hectare in Kacholi villages. In our study, the level of Potassium was found more than adequate.

4. **Phosphorus:** Normal plant growth cannot be achieved without Phosphorus. Phosphorus plays an important role in the constituent of nucleic acids, phospholipids, DNA, NADP, and ATP. It activates coenzymes for amino acid production used in the synthesis of proteins. The level of Phosphorus should be 10-20 Kg/hectare. In Jeeran, Nayagaon, Kachariya Dev, Cheetakheda and Kacholi villages 8.63, 15.63, 17.67, 14.41, and 11.61 Kg/hectare phosphorus are found respectively.

5. **Sulfur** is an essential component in the synthesis of amino acids, production of chlorophyll, and utilization of phosphorus and other essential nutrients. Sulfur is equally required as Nitrogen for optimizing crop yield and quality. The sulfur level recommendation is less than then10 ppm. Our study shows 9.61 ppm in Jeeran, 11.73 ppm in Nayagaon, 17.60 ppm in Kachariya Dev, 6.61 ppm in Cheetakheda and 19.92 ppm in Kacholi. Sulphur concentration varies from 6.61 to 19.92 ppm, which is either inadequate or toxic for plant growth.

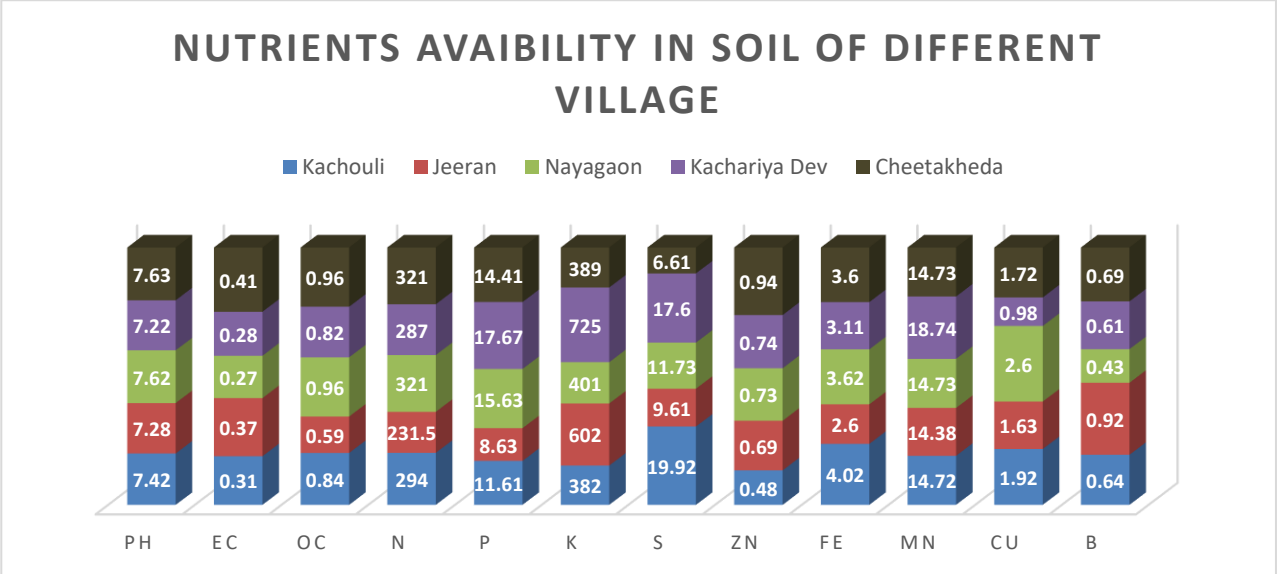
6. **Zinc:** Plants require Zinc for the activation of different enzymes. The recommendation level for Zinc is 0.6 ppm. While in our study the level was 0.69 ppm in a soil sample of Jeeran, 0.73 ppm in Nayagaon, 0.74 ppm in Kachariya Dev, 0.94 ppm in Cheetakheda and 0.48 ppm in Kacholi.

7. **Iron:** Micronutrients required in trace amounts for normal growth and development of plants such as Fe, Zn, Mn, Cu, Cl, B, Mo, and Ni. Since Iron is the most abundant element in the plant. Iron fertilizers are generally water-soluble substances, predominantly sprayed as foliar nutrients on the crop. Plants absorb iron in the form of Fe^{2+}. Iron is required for photosynthesis and chlorophyll synthesis. A deficiency of iron causes retarded growth, and interveinal chlorosis, the typical range of Fe concentration is 4.5 ppm. In the present study, iron deficiency was observed in all the soil samples of villages. Its range is 2.60 to 4.02 ppm.

8. **Manganese** (Mn) acts as an enzyme activator for the assimilation of Nitrogen. It is also essential for the synthesis of chlorophyll. Low plant Manganese, therefore, reduces the chlorophyll content causing Chlorosis. Manganese recommendation is 2 ppm. Levels of Mn in various samples of soil were 14.38 ppm in Jeeran, 14.73 ppm in Nayagaon, 18.74 ppm in Kachariya Dev, 14.73 ppm in Cheetakheda and 14.72 ppm in Kacholi.

9. **Copper** (Cu) is an enzyme activator which is involved in the synthesis of chlorophyll. Required amount of Cu should be 0.2 ppm. The soil sample shows the range of Cu ion is 0.98 to 2.60 ppm. The minimum level of Copper is found in Kachariya Dev and the maximum level is in Jeeran village.

10. **Boron:** The first visible symptom of Boron deficiency is the death of the growing tips. This disorder is generally followed by the growth of lateral shoots, the tips of which may also be deformed or die. The boron recommendation is 0.5 ppm. While in our study levels of Boron were 0.92 ppm in Jeeran, 0.43 ppm in Nayagaon, 0.61 ppm in Kachariya Dev, 0.69 ppm in Cheetakheda and 0.64 ppm in Kacholi.



Graph 1: Comparative analysis of different parameters of soil samples.

4. CONCLUSION

A comparison of soil samples of different villages under consideration is done and discussed, this study helps in determining the conditions of soil also helpful for farmers to take the planning selection of fertilizers to get a good yield of crops. This also helps in proper planning and approach to improve soil fertility.

In our findings, we observed that due to the excessive use of fertilizer, the soil became slightly toxic and deficient in some nutrients. We also find that levels of different micronutrients such as Zinc, Boron, and Copper were beyond the standard level. We conclude that farmers should use organic manure instead of chemical fertilizers, which will enhance soil fertility and crop yield.

The recommendation given by the Chemists, Laboratory of Neemuch District under Kisan Kalyan and Krishi Vikas Vibhag, Madhya Pradesh Shashan is to use 21 % of Zinc sulfate (25 kg/hectare), Sulfur 25 kg/hectare, 10.5 % Borax (10 kg/hectare) and 19 % ferrous sulfate (50 kg/hectare) in their soil.

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