Analysis Of Soil Samples For Physico - Chemical Parameters From Kurai And Region Near Pench National Park Seoni (M.P.)

Dr Shruti Awasthi (Assistant Professor)
Department of Chemistry Government, College Kurai Dist. Seoni (M.P) India
Corresponding Author Email: shrutikameshwar@gmail.com

Abstract: Soil is a significant component for all times on earth as both flora and fauna depends directly on soil. But with increasing artificial practices the environment is getting polluted excessively which affects the soil also. During this paper the soil samples are investigated for its physico-chemical parameters analysis. This study helps in determining the supply of macro, micro and secondary nutrients by which the quality of soil and its impact on flora and fauna are often observed, in present study the Physio- chemical analysis of soil is preferred for which twenty samples (representative samples) were collected from Kurai Tehsil and Pench Tiger Reserve nearby areas, analyzed for its pH, EC, OC, Nitrogen, Phosphorous, Potassium, Sulphur, Zinc, iron, Manganese, copper, Boron and Sulphur.

Keywords:

Soil, pH, minerals, OC, EC, zinc, iron, minerals, Micro – nutrients, Macronutrients, Secondary- nutrient

I Introduction

Soil is the complex Mixture of Organic and inorganic components filled with microorganisms which help in maintaining the health and fertility of soil are often considered as an ecosystem[1] The Physical characteristics of soil[2] includes the feel,colour and size of the mineral particles in alongside the opposite particles like sand,silt,clay and humus. The qualities of soil are considered as chemical characteristics[3] are already familiar to us as the soil testing laboratory provides qualitative results of soil with the quantity of components present in soil samples. Soil testing mainly shows the pH,electrical conductivity(EC), Organic carbon(OC) alongside the presence of nutrients like nitrogen, phosphorus, potassium and organic matter.Testing also looks for other nutrients necessary for the plant production such as sulphur and zinc.

Biological characteristics [4,5] of the soil includes diversity of the microorganism's population present in the soil. Previous studies show that in one gram of soil there are one billion living organisms, consisting of approximately ten thousand species out of which most includes single-celled bacteria with a very diverse population. The NRCS defines soil health as "The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans." It will contain the status of soil with respect to 12 parameters, namely N, P, K (Macronutrients); S (Secondary- nutrient); Zn, Fe, Cu, Mn, Bo (Micro - nutrients); and pH, EC, OC (Physical parameters). [6]

II.Materials and methods: -

The Area chosen for study is **Kurai** in **Seoni district** [7] is a tribal belt covered with dense forest and a hot spot for biodiversity for flora and fauna It is located 35 KM towards South from District headquarters Seoni. It is a Tehsil headquarter in southern part of **Madhya Pradesh** (India) lies between latitudes 21.8107° N, and longitudes 79.5069° E. with total geographical area 47347 ha. (1,431 km²).out of which 3878 ha.is covered with the forest **Pench river** bisects the national park into nearly two equal halves **the tiger reserve** is divided in three forest ranges- Karmajhiri, Gumtara and **Kurai**. [8] there are 171

villages in Kurai Tehsil in which 5330 ha. Land is available for agricultural purposes. The Average rainfall reported is 1505mm with the highest maximum temperature recorded was 45.0°C it shows layered black soil.

2.1. Sample Collection

Samples were collected from different areas of Kurai Tehsil and areas near Pench Tiger reserve by Random Sampling in which uniform fields were randomly sampled throughout the entire field and these points were marked with the geo reference with global positioning system (GPS) and the soil samples of approx. 500 g were collected from the depth of 15 - 45 cm and soil collected were placed in zip-locked polyenes and marked according to the names of areas of sample collection**.**

2.2. Parameters

2.2.1.pH:

pH of Soil can be measured by using a device called Ion electrode. This device is inserted in the mixture of soil and water (1:5) Scientists dealing with acid soils with pH less than 5 prefer to measure soil pH using soil in calcium chloride solution. But the same medium is not suitable for soils with a pH greater than 5. In soil with pH more than 5 some of the ions in like bicarbonate and carbonate get bound to the calcium and are removed from solution, which then causes an inaccurate pH reading, so in such case water should be used to measure pH. [9,16]

Figure 1: pH of Soil and nutritional deficiency

2.2.2.EC: Electrical Conductivity

Another important property by which quality of soil can be determined. It is also known as salt test or Salinity test the value increases as the number of ions increases in the soil which indicates the low microorganism activity. This shows the amount of dissolved nutrients in water available for absorption by a plant. EC will be registered only when inorganic ions such as N, P, K, Ca, Mg, etc are present in the soil. Urea which is an organic molecule, will not contribute to the EC of a soil, high EC in root zone -small size and low yield of fruits high EC in fruits better quality and high yield.[10,11,16]

2.2.3. OC: Organic Carbon

It shows the presence of Organic carbon in the soil. By this test we get the information about nutrient holding capacity of soil and its fertility and low atmospheric CO_2. OC indicates the plant and animal residues in the soil. Improving soil structure can increase the amount of OC in the soil indicates improved soil quality. Typically, the organic carbon content of agricultural soils is between 0.7% and 4% although OC can be as low as 0.3% for

desert soils and as high as 14% for intensive dairy soils. Most organic matter is located near the soil surface, about 60% of organic matter in the top 30 cm of soil is located in the top 10 cm. [11,12,13,14,15,16]

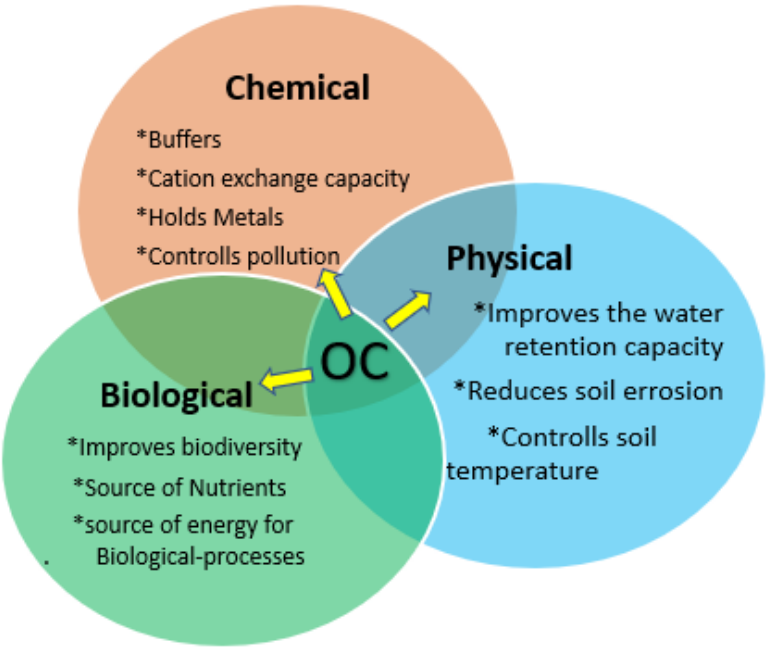

Figure :2 Organic carbon impact on various parameters of soil

2.2.4.Phosphorous

Phosphorus is one of the important micronutrients required for normal growth and function of a living cell. It is one of the important components of NPK fertilizers which helps in the growth of plants. In living organisms ATP/ADP is the most important component in energy transport. In soil about 30 to 65 percent is not available for plants as it is in organic form while 35 to 70 percent of phosphorus is in the inorganic form which actually helps in the plant growth. [16]

2.2.5. Nitrogen

Nitrogen concentration is very important for the healthy crop it helps the plant in growth of healthy leaves as provide support in formation of chlorophyll the green pigment responsible for trapping sunlight during photosynthesis Its deficiency causes retarded growth along with yellowish leaves along with reduced fruits and flowering [16,17]

2.2.6. Potassium

Potassium is one of the three macronutrients required for plant growth and high crop yield. It regulates the opening and closing of stomata, proper intake of water by plants and helps in enzyme activity as well as formation of ATP. It also helps in absorption of other ions like NO_3^- Major impact of Potassium deficiency is plants becoming susceptible to various diseases. It is found that the cation exchange capacity (CEC) is higher in Heavy Clay Soil in comparison to sandy and light soil which are usually acidic in nature. [16,18,19,20]

2.2.7. Sulphur

Sulphur is a secondary nutrient, it is considered as soil conditioner which is required in very less amounts but its deficiency can cause diseases in plants. This nutrient is mainly required to maintain enzymatic activity in the plants and salinity. Most of the sulphur present in soil is obtained by organic matter and the ratio of sulphur to nitrogen in plant cell is 1-part sulphur for every 15 to 20 parts nitrogen values are reported in kg S ha^{-1} [16,21,22,23]

2.2.8. Zinc

Zinc is an important micronutrient as it is a part of many enzymes which help in metabolic activities and growth of the plant. Its deficiency causes decreased concentration in protein carbohydrates and also in chlorophyll concentrations.[16]

2.2.9.Iron

Iron is another micronutrient present in the soil which provides yellow colour or red colour due to the presence of Ferric oxides which is necessary for the synthesis of chlorophyll and carry out normal life cycle in plants[16,24,25]

2.2.10. Manganese

Mn is a micronutrient which helps in development and to sustain metabolic roles within different plant cell compartments. It is needed in the photosynthesis in the form of cofactor in OEC i.e. Oxygen evolving complex by splitting the water molecule. Soil with low pH (below 5.5)can causeMn toxicity in the plants and its deficiency causes pale coloured leaves near veins. It is in the form of $\mathbf{Mn^{2+}}$, $\mathbf{Mn^{3+}}$and $\mathbf{Mn^{4+}}$ but absorbed by roots in the form of $\mathbf{Mn^{2+}}$in the plants.[26,27]

2.2.12. Copper

An important micronutrient which is the in divalent state (Cu-II)is needed in development of plant as it is an essential component of many enzymes and useful in seed and chlorophyll production [28]

2.2.13. Boron

Boron is an important micronutrient which soil must have as it has various functions in the plant growth such as formation of cell wall and stability. Boron also helps in movement of sugar in the growing parts of plants, and helps in the process of pollination and seed setting. In legumes an adequate amount of Boron is required for effective nitrogen fixation and nodulation. Its deficiency can cause empty pollen grains, poor pollen vitality and decreased flowers on plants.[29]

III. Result and Discussion

We collected soil samples from various areas of Kurai and the region near Pench Tiger reserve for physico-chemical analysis of soil which are tabulated in Table.1 and analysed in figs.1 to10 as discussed below

Table 1: Physico – chemical parameters and area of sample collection

S. No.	Areas of sample collection	Physical parameter		Macro- Nutrients				Secondary Nutrient (kg S ha-1)	Micro-Nutrients (ppm)				
		pH	EC	OC	N (kg/ha)	P (kg/ha)	K (kg/ha)	S	Zn	Fe	Cu	Mn	B
I	1.Kurai Parisar	5.1	1.2	0.3	143	37	336	5	0.5	6	0.3	4	0.8
	2.Boremara	6.2	0.5	0.45	207	35	358	4	0.7	8	0.5	4	0.4
	3.Buffer Zone Pench	6.2	0.4	0.3	143	26	314	4	0.7	5	0.6	6	0.6
	4.Patan	5.8	0.4	0.3	143	11	325	4	0.5	6	0.7	4	0.5
	5.Rampuri	6	0.7	0.3	143	41	302	4	0.5	6	0.5	5	0.6
II	6.Butte	8.4	1.9	0.6	240	65	258	22	0.5	9	0.7	5	0.9
	7.Jilapur	7.9	1.9	0.9	315	46	314	5	0.7	7	0.5	6	0.5
	8.Karajmaramal	7.6	1.6	0.9	315	52	358	4	0.8	6	0.5	8	0.6
	9.Chikhlapani	5.9	0.9	0.3	143	43	381	6	0.5	6	0.7	4	1.0
	10.Salhe	6.9	1.9	0.6	240	40	302	13	0.8	4	0.7	6	0.8
III	11.Bichuwa	7.8	1.8	1.05	327	47	302	13	0.5	8	0.1	5	0.4
	12.Murjhour	7.7	1.9	1.2	360	44	314	21	0.5	9	0.7	7	0.6
	13.Bhilma	7.6	1.4	0.45	207	47	291	33	0.5	7	0.5	3	0.8
	14.Sawari Reeth Ryt	6.9	1.9	0.75	285	26	325	17	0.9	9	0.7	4	0.8
	15.Dhanoli	7.8	1.9	1.05	327	43	302	18	0.7	8	0.3	6	0.6
	16.Rukhad Gate	6.5	1.9	0.3	143	40	302	6	0.9	4	3	0.7	0.7
IV	17.Turaia gate	7.5	1.6	0.9	315	42	336	6	0.7	6	4	0.8	0.4
	18.Bormara	6.9	1.6	0.6	240	10	280	4	0.5	9	6	0.4	0.6
	19.Seoni	6.9	1.6	0.6	240	32	302	6	0.4	5	3	0.7	0.9
	20.Bichuwa	6.9	1.7	0.75	285	43	336	4	0.5	5	4	0.4	0.8

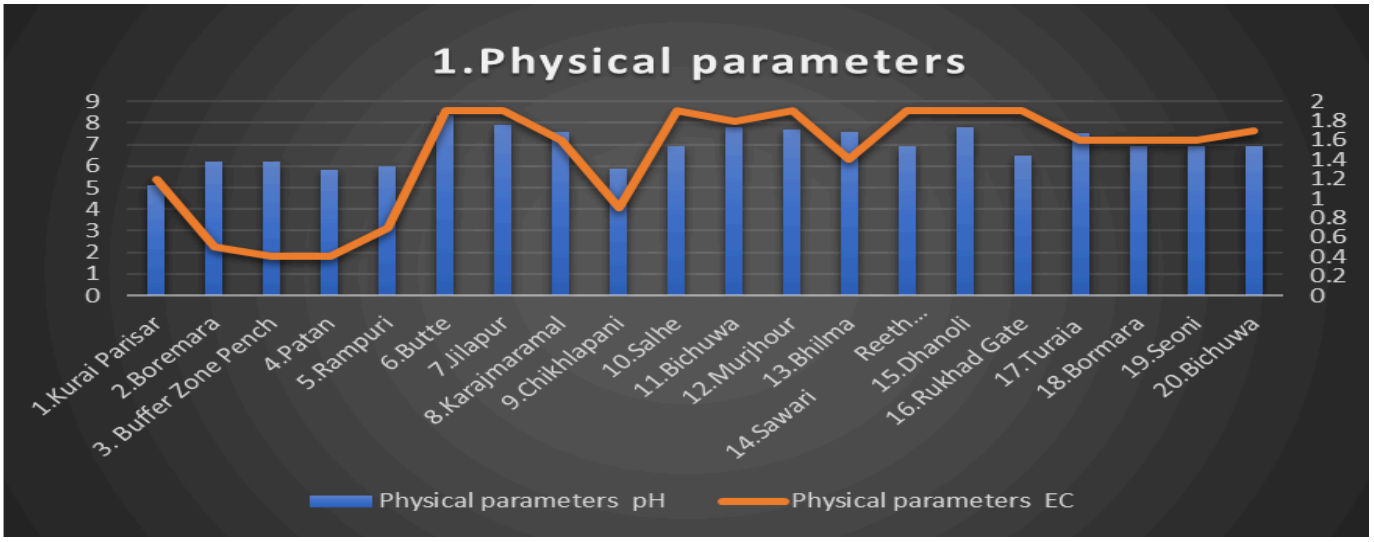

Figure 3: Physical parameters pH and EC (Electrical conductivity)

The Physical parameters such as **pH and EC (**Electrical conductivity**)** of the soil, the pH of soil is in the range of **5.8 to 7.9** according to table **1 and fig.3** Which indicates that nature of soil ranges from **weakly acidic, neutral to alkaline.** The EC value observed is from **0.4 to 1.9** (normal EC ranges from 0.02 to 2.0 (milliSiemens/cm) which shows that **the salinity of soil is low** or comparatively **non-saline** nature of soil.

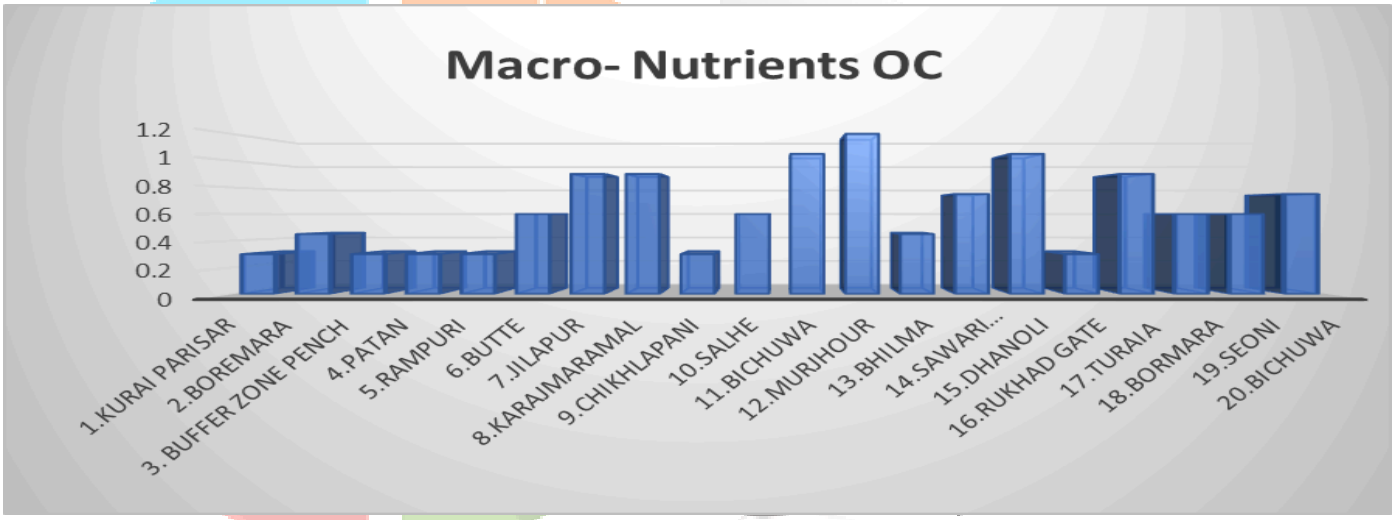

Figure 4: Macro- nutrient OC (Organic Carbon)

The most important macronutrient is **OC (Organic Carbon**) in this region was found in **the range of 0.3 to 1.05 (**Topsoil normal range of OC from 0.5% to 3.0%) the maximum value for OC was observed in **Murjhour (1.2) Bichuwa and Dhanoli (1.05)** which shows that the soil is rich in microbes, the soil is aerated with high water retention capacity which helps in storage of nutrients with **improved quality of soil.**

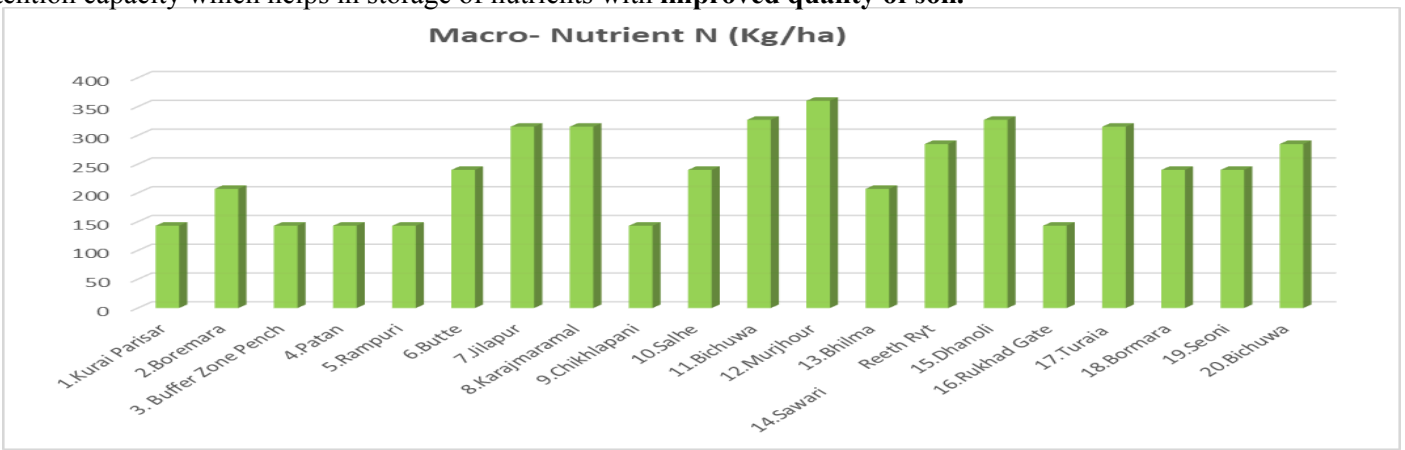

Figure 5: Composition of Macro nutrient Nitrogen in soil samples

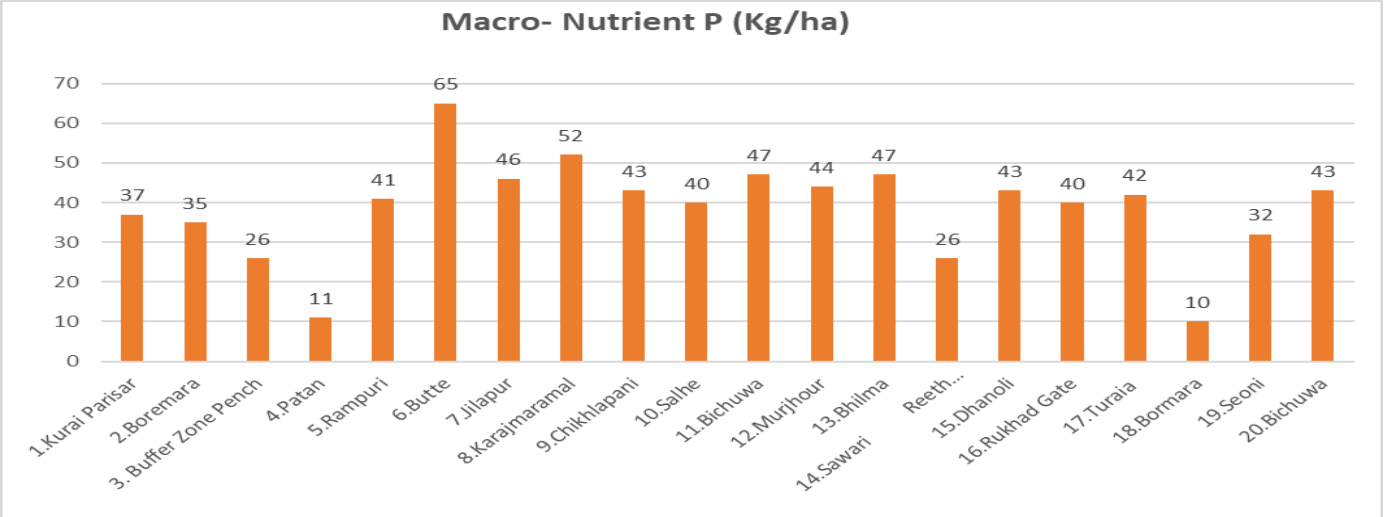

Figure 6: Composition of Macronutrient phosphorus in soil samples

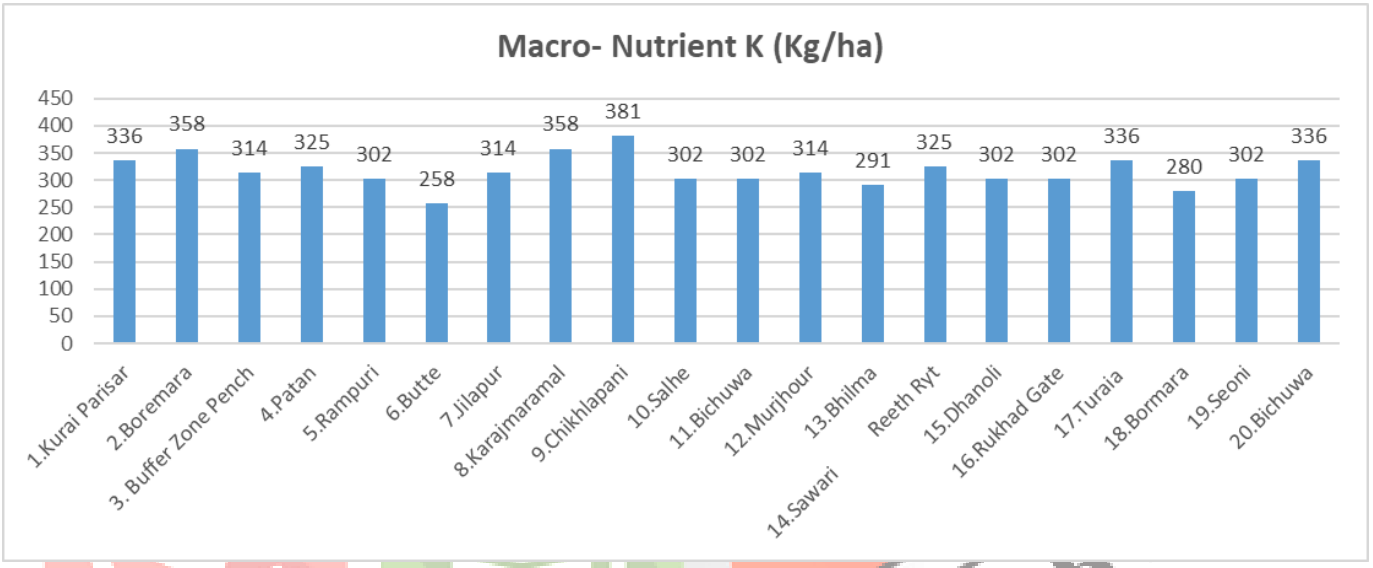

Figure 7: Composition of Macro nutrient potassium in soil samples

Other macronutrients are N, P, K in which Nitrogen ranges from 143 to 360 (normal range 240- 480 kg/ha) according to the data given in table 1 and Fig.5 out of which maximum content of Nitrogen was observed in Murjhour (360 Kg/ha). The composition of Phosphorus ranges from 10 to 65 (normal range 11 – 22 Kg/ha) in which maximum value was observed in Butte (65 Kg/ha) which is too high as per data described in table 1 and

Fig.6. The value given in table 1 and Fig.7, Potassium ranges from 258 to 358 (normal range 110- 280 kg/ha) in which maximum value was observed in Karajmaramal (358 Kg/ha). Bhima shows high concentration of Sulphur (33 kg S ha^{-1}) in comparison to the other soil samples**.**

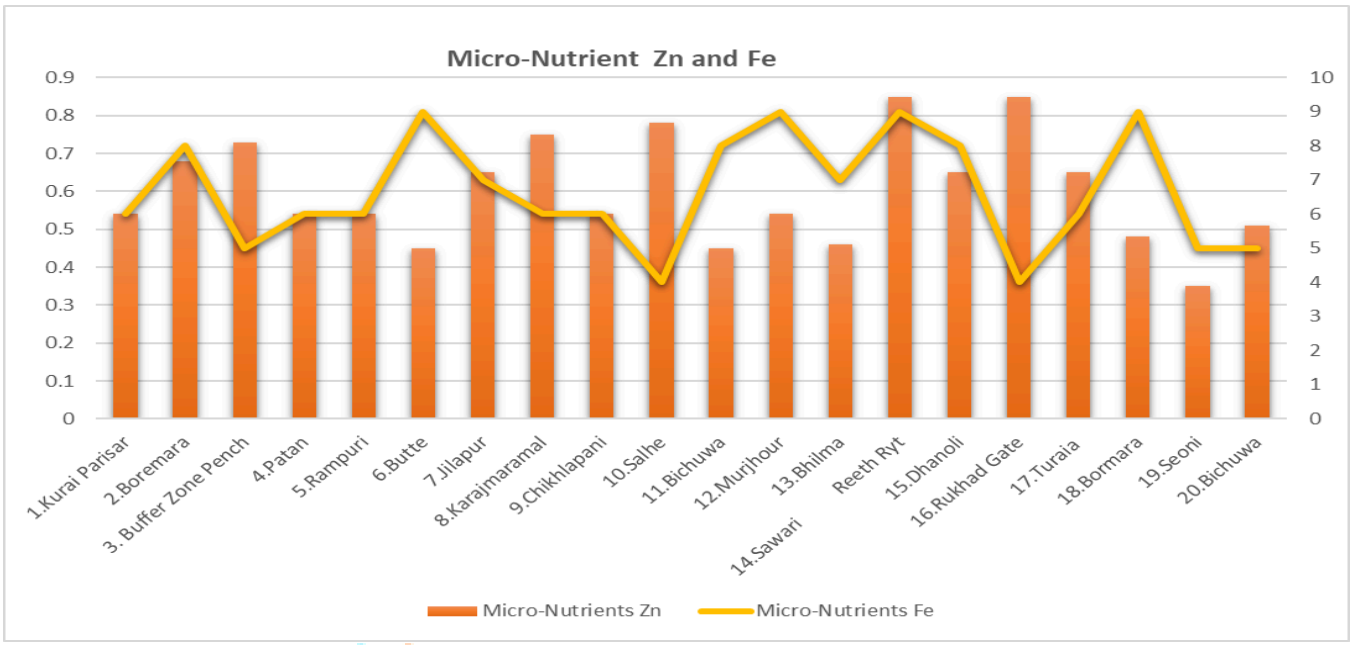

Figure 8: Composition of Micro nutrient Zinc and Iron in soil samples

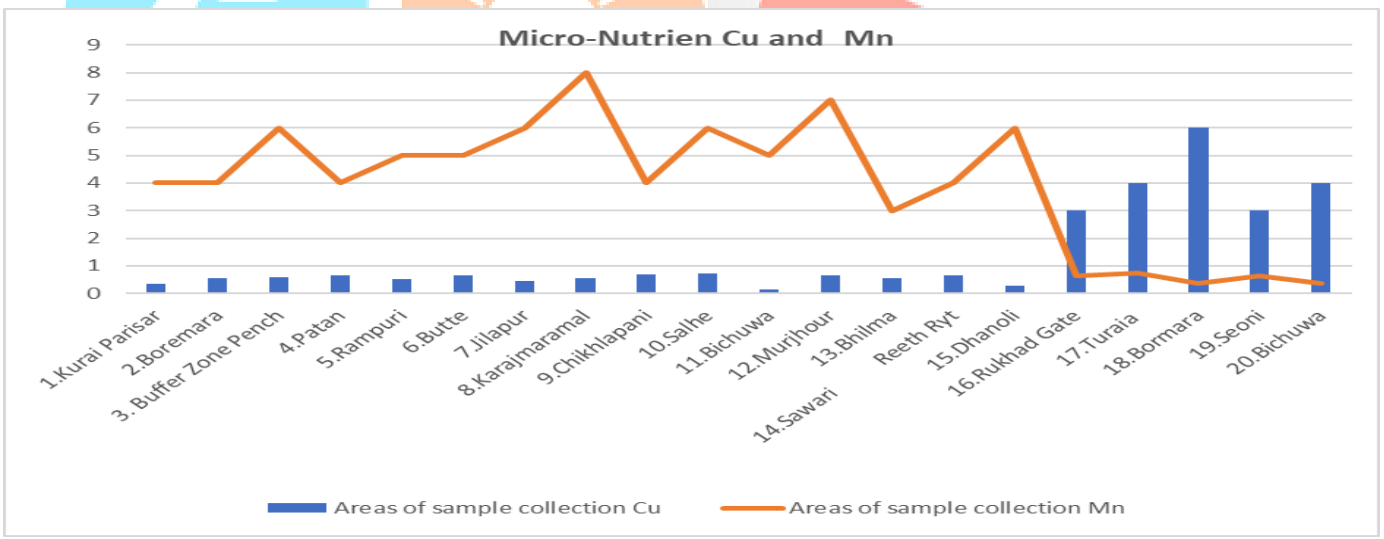

Figure 9: Composition of Micro nutrient Copper and Manganese in soil samples

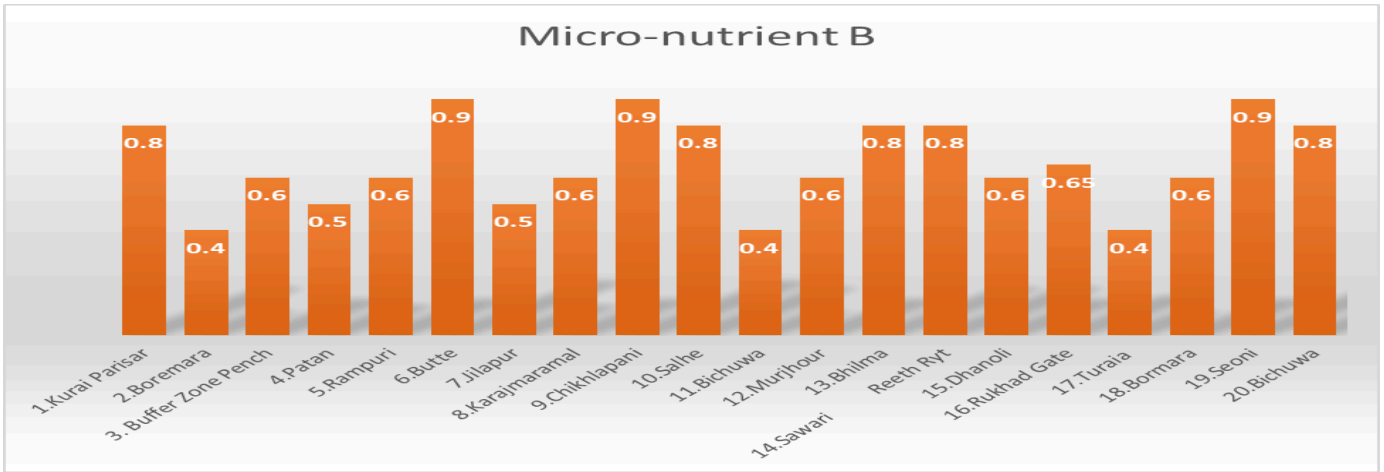

Figure 10: Composition of Micro nutrient Boron in soil samples

Micro- nutrients The Samples collected from Sawari Reeth Ryt and Rukhad gate show maximum concentrations of Zn (0.9 ppm) while Bormara, Sawari Reeth Ryt, Murjhour and Butte have high values of Fe (9 ppm). Mn is needed in the average range of 20 to 300 ppm (0.002 to 0.30 %), Karajmaramal shows maximum concentration of Mn (8 ppm) while Bormara shows maximum of Copper (6 ppm), Chikhlapani shows high concentration of Boron (1.0 ppm) in comparison to other sample areas.

The Result of the study reveals that different areas of soil have different values of the physico-chemical parameters. These observed parameters explain the health of soil in a particular area which is an important aspect for the farmers to decide the type of crop and yield possibilities. This study is useful for the agriculture chemists as they can evaluate the nature of soil and how to improve the quality of soil. In this study the area selected is in Pench National Park which is a hotspot of biodiversity of the flora and fauna and nature of soil directly affects the flora and fauna of any region. It will also help in creating sustainability of the soil ecosystem.

IV.*Conclusion*

From this study it is concluded that most of the physico-chemical parameters were not in the acceptable limits this is because of excessive human activities which is exploiting the soil by using artificial products .Excessive use of fertilizers causing imbalance in nutritive values and fertility of soil therefore the activities which degrades the quality of soil should be controlled organic methods and agro-products should be preferred as the physico-chemical parameters influences soil fertility which has direct effect on human health and the ecosystem of Pench National Park.

Acknowledgement

I would like to acknowledge my thanks to Devgan sir technician Soil Testing Lab Seoni (M.P) for providing the soil sample test reports. I extend my gratitude to respected **Prof. Dr. A. K. Bajpai** and respected **Dr. Vikrant Jain Sir** for the support and guidance whenever needed while writing this paper.

References: -

1. *https://www.britannica.com/science/soil*
2. *Phogat.V. K, TomarV.S.& Dahiya Rita Soil Physical Properties., https://www.researchgate.net/publication/297737054_Soil_Physical_Properties*
3. *FAO SOILS PORTAL https://www.fao.org/soils-portal/data-hub/soil-classification/numerical-systems/chemical-properties/en/*
4. *https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-biological-properties*
5. *Properties of Soil: Physical, Chemical & Biological – UPSC*

By Lotus Arise January 4, 202 https://lotusarise.com/properties-of-soil-upsc/

6. *Soil health https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health#:*
7. *Indian Village Directory https://villageinfo.in/madhya-pradesh/seoni/kurai.html*

8. https://en.wikipedia.org/wiki/Pench_Tiger_Reserve.

9. Ref:Ingram JSI and Fernandes ECM (2001) Managing carbon sequestration in soils: Concepts and terminology. Agriculture, Ecosystems & Environment. 87: 111-117.}

10. https://www.extension.purdue.edu/extmedia/HO/HO-286-w.pdf

11. Cavins, T.J., B.E. Whipker, W.C. Fonteno, B. Harden, I. McCall and J.L. Gibson. 2000. Monitoring and managing pH and EC using pour-thru extraction method. Horticulture information leaflet 590. NC State University.

12. Allison, LE in Black, CA et al. 1965, Methods of Soil Analysis, pp1372-1378.

13. Bartlett, GN, Craze, B, Stone, MJ & Crouch, R (ed) 1994, Guidelines for Analytical Laboratory Safety. Department of Conservation & Land Management, Sydney.

14. McLeod, S 1973, Studies on wet oxidation procedures for the determination of organic carbon in soils. CSIRO Division of Soils, Notes on Soil Techniques, pp73-79.

15. https://www.environment.nsw.gov.au/resources/soils/testmethods/oc

16. Kay BD and Angers DA (1999) Soil structure. In: Handbook of Soil Science. (Ed ME Sumner), pp A-229-276. CRC Press, Boca

17. Hoyle. F, Murphy D and Baldock G (2009) Soil organic carbon: Role in Australian farming systems. In: Rainfed Farming Systems. Springer, Chapter 14.}

18. Roles of potassium in plants | Guy Sela| Cropaia https://cropaia.com/blog/potassium-in-plants

19. Maathuis F.J.M Physiological functions of mineral macronutrients Curr. Opin. Plant Biol., 12 (2009), pp. 250-258.

20. G. Xu, X. Fan, A.J. Miller Plant nitrogen assimilation and use efficiency Annu. Rev. Plant Biol., 63 (2012), pp. 153-182.

21. Haneklaus, Bloem S. E., and Schnug E. 2007. Sulfur and Plant Disease.

22. Datnoff, L.E., W.H. Elmer, and D.M. Huber (eds.); APS Press, St. Paul, MN. Mineral Nutrition and Plant Disease.

23. https://www.phytojournal.com/archives/2020/vol9issue3/PartW/9-3-145-771

24. Heckman, J.R., R. Weil, and F. Magdoff. 2009. Practical Steps to Soil Fertility for Organic Agriculture. 33 pages. In C. Francis. (ed.). Organic Farming: The Ecological System. American Society Agronomy, Crop Science Society America, Soil Science Society America, 677 South Segoe Road, Madison, WI 53711, USA. Agronomy Monograph 54. Madison, WI.

25. Zuo Y and Zhang F (2011) Soil and crop management strategies to prevent iron deficiency in crops. Plant Soil, 339: 83-95.

26. https://www.alberta.ca/assets/documents/af-aesa-crop-micronutrients-factsheet.pdf

27. El-Jaoual T, Cox DA. 1998. Manganese toxicity in plants. Journal of Plant Nutrition 21: 353–386. [Google Scholar]

28. 2Bernier B, Brazeau M. 1988. Magnesium deficiency symptoms associated with sugar maple dieback in a Lower Laurentians site in south-eastern Quebec. Canadian Forest Research 18: 1265–1269. [Google Scholar]

29. https://www.cropnutrition.com/nutrient-knowledge/copper

30. Brown PH, et al. 2002: Boron in plant biology. Plant Biology, 4:205–223. Cakmak I. and Römheld V.1997: Boron deficiency-induced impairments of cellular functions in plants Plant Soil, 193:71–83.