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# Assessment of nutrient quality status by interrelationship between Physical traits macronutrients of agricultural land in Baliapur, Dhanbad, Jharkhand

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**Abstract-** To analyse physical and macronutrient factors of agricultural soil to help farmers determine crops for better yield. Mrida Parikshak conducted the analysis of the soil sample, organic carbon estimated by Walkley and Black organic carbon method. The recorded mean soil pH 5.66 indicates acidic nature. The average organic carbon content 0.2734% falls within low range on soil fertility standards. The average value of available Nitrogen is 118 kg/ha$^{-1}$, Phosphorus 17.260 kg ha$^{-1}$, Potassium 117.63 kg ha$^{-1}$ and Sulphur 51.62 mg/kg. Corn, oats, barley, and potatoes favour pH ranges between 5.5 and 6.5. Relatively low organic carbon content suggests a potential need for organic matter amendments to improve crop fertility and long-term sustainability. Positive relationship implies that higher organic carbon levels enhance nitrogen availability, supporting plant growth and productivity. Positive correlation of available sulphur with nitrogen and potassium indicates potential synergistic effects or co-occurrence of these nutrients, for beneficial crop nutrient uptake and soil fertility management. Available phosphorus and potassium show negative relationship implying competitive interactions making nutrient management crucial to optimize crop yield potential, avoiding deficiencies. Negative correlation between available phosphorus and sulphur suggests potential antagonistic effects that may influence nutrient availability for plant uptake.

**Key words: Crop selection, Macronutrient, Nutrient analysis, Physical properties and Their co-relationship**

## INTRODUCTION

In order to keep trophic levels in terrestrial ecosystems stable, the pedosphere is responsible for maintaining production. The significance of biotic and abiotic components in ecosystems is use to examine the role that abiotic resources or components (soil), play in maintaining the biotic component (plants) and how the organic matter, mineral matter, air and water that make up soil, contribute to the survival of producers and microorganisms. Three fundamental criteria are used to classify the nutrients in the soil, including Physical and Chemical attributes respectively like how the potential hydrogen ion concentration defines pH. The term pH refers to the concentration of basic and acid ions in soil. Plants in soil with low pH levels will not flourish, and many minerals will not breakdown and reach the plant.[1] The pH of the soil affects the process of bioavailability, nutrient absorption, and microbial activity.[2] The bulk of

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micronutrients (B, Cu, Fe, Mn, Ni, and Zn) are more accessible within a pH range of 5 to 7, whereas macronutrients (N, K, Ca, Mg, and S) are more available within a pH range of 6.5 to 8.[3] There are four primary activities that soil microorganisms carry out in the cycling of organic matter in the soil.

The breakdown of organic wastes, the mineralization of nutrients, the movement of nutrients and organic carbon from one SOM pool to another, and the continuous release of carbon dioxide ($CO_2$) via microbial respiration and chemical oxidation are the first four processes.[4] On the other hand, the number of non-specific ions present in the soil is indicated by electrical conductivity. It shows salinity, nutrients, and the ability to exchange ions. Non-specific ion concentration in the soil is indicated by waterflow, soil texture, bulk density, organic matter, organic carbon, and conductivity. It shows salinity, nutrients, and the ability to exchange ions. soil structure, bulk density, organic carbon, organic matter, water movement and its effect chemical properties of soil.[5,6] Macronutrients, such as available nitrogen. The lithosphere, atmosphere, hydrosphere, and biosphere are all rich in nitrogen (N). Unlike potassium (K) and phosphorus (P), the other two key plant nutrients, rock deposits of nitrogen (N) in the lithosphere do not exist, thus air dinitrogen ($N_2$), which is unreactive, is converted to reactive forms of N to make fertiliser N. It is remarkable how little of this N-roughly in the first metre of the earth's crust-is found in the soil, primarily in biological forms. Typically, surface mineral soils have a total N concentration of 0.05 to 0.2 percent.[7] Another crucial function is that they serve as constraints for plants and because pH affects how well plants absorb nitrogen.[8,9] Second most essential nutrient is phosphorus it helps to develop growth of plant, healthy growth flower and vegetable. In soil phosphorus occur as orthophosphate and polyphosphate which are use in development of DNA and RNA respectively. Mycorrhiza fungi help to fixed Phosphate enzyme respectively.[10,11] Soil contains potassium in the form of the $K^+$ ion. The seventh most prevalent element in the crust of the planet, with an average concentration of 2.6%. Potassium is transported to the root via the soil's surface and subsurface layer, where it facilitates the growth of plant roots, improves grain production, and is required for seed formation.[12] The secondary macronutrient is sulphur, important for growth and development.[13]

Young leaves with interveinal cholorosis (green veins with yellow spaces in between) are affected by a manganese shortage. It is affected by low moisture content, high pH (greater than 6.5), and organic matter in the soil.[14]

**Study Area**

The research region is the Dhanbad district in the state of Jharkhand, which is located between 23°37'30''N-24°56'N latitude and 86°8'23''E-86°50'18''E longitude, as seen in Figure 1. Baghmara, Baliapur, Dhanbad, Govindpur, Jharia, Nirsa, Topchanchi, and Tundi are the eight blocks that make up the Dhanbad district. The region is covered in the Survey of India (1:50,000 scale) toposheet numbers 73 I/1, 73. I/2, 73 I/5, 73 I/6, 73 I/7, 73 I/9, 73 I/10, 73 I/13, and 73 I/14. The Barakar River surrounds the district, northern boundary, while the Damodar River forms its southern boundary. It is on these rivers that two significant reservoirs-Maithon and Panchet-are situated. Soil Samples were collected from Pilani Village of Baliapur region Dhanbad Five samples were collected from different sampling location at depth of 15 to 20 cm.[15]

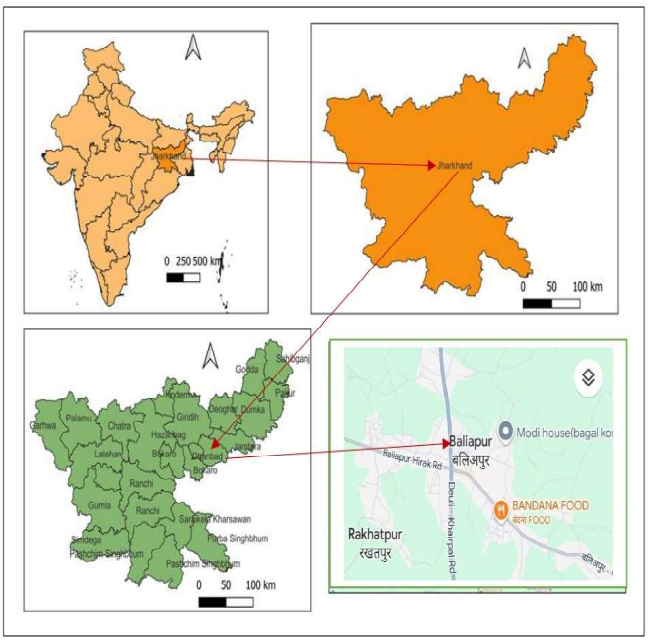



**Fig 1: Shows sample area (Baliapur)**

## METHOD & METHODOLOGY

Mrida Parikshak conducted the analysis of the soil sample. And organic carbon estimated by Walkley and Black organic carbon method.[16,17]

## RESULT & DISCUSSION

**Table 1- Shows the Minimum and Maximum Range of soil Parameters**

| S.No | Parameter | Min. | Max. |
|---|---|---|---|
| 1. | pH | 5.51 | 6.12 |
| 2. | Organic carbon (%) | 0.231 | 0.290 |
| 3. | Available Nitrogen (kg/ha$^{-1}$) | 110.2 | 122.96 |
| 4. | Available Phosphorus (kg/ha$^{-1}$) | 14.59 | 20.94 |
| 5. | Potassium (kg/ha$^{-1}$) | 86.52 | 92.12 |
| 6. | Sulphur (mg/kg) | 37.22 | 66.29 |

**Table 2- Shows the standard range of soil parameters.[18]**

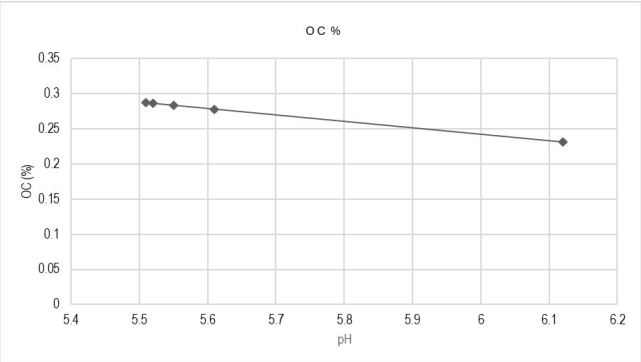
| S. No. | Parameter | Low | Medium | High |
|---|---|---|---|---|
| 1. | O.C (%) | <0.5 | 0.5-0.75 | >0.75 |
| 2. | Available Nitrogen (kg/ha) | <280 | 280-560 | >560 |
| 3. | Available Phosphorus (kg/ha) | <12.5 | 12.5-25 | >25 |
| 4. | Available Potassium (kg/ha) | <135 | 135-335 | >335 |
| 5. | Available Sulphur (kg/ha) | <10 | 10-20 | >20 |

**Table 3- Shows the relationship between various parameters**

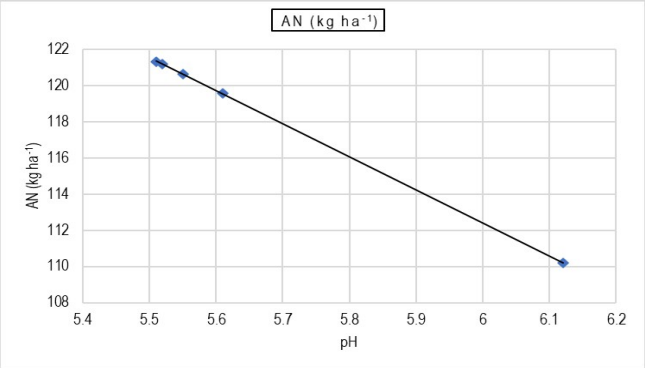
| | OC | AN | AP | AK | AS |
|---|---|---|---|---|---|
| pH | -0.9972 | 0.79054 | 0.7905 | 0.9775 | 0.7249 |
| OC | 1 | 0.8649 | -0.7812 | -0.9795 | 0.7280 |
| AN | --------- | 1 | 0.9130 | 0.6886 | 0.9247 |
| AP | --------- | -------- | 1 | 0.7589 | -0.9753 |
| K | ---------- | -------- | --------- | 1 | 0.6081 |

**Table 4- Shows the regression equation between various parameter**

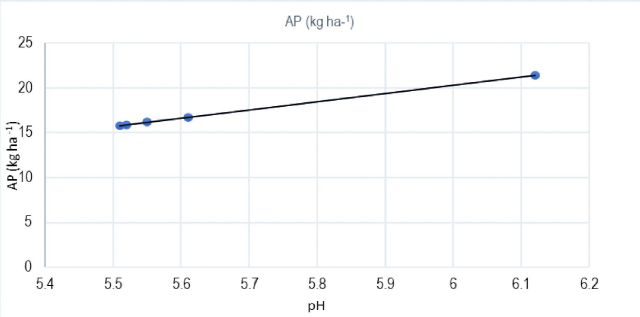
| S.NO | Regression equation |
|---|---|
| 1. | OC=-0.0925 pH + 0.7971 |
| 2. | AN =17.7328 pH + 219.0771 |
| 3. | AP= 9.1651 pH + 34.6867 |
| 4. | AK = 8.8628 pH + 37.8129 |
| 5. | AS= 36.7192 pH +156.2621 |
| 6. | AN= 191.8958 OC + 65.1737 |
| 7. | AP =-97.5326 OC + 9.4594 |
| 8. | AK =-95.6297 OC + 90.05 |
| 9. | AS = 354.4102 OC + 46.4537 |
| 10. | AP= 0.5137 AN + 43.2246 |
| 11. | AK = 0.3029 AN + 52.3615 |
| 12. | AS = 2.2730 AN -215.7491 |
| 13. | AK = 0.5646 AP + 78.4795 |
| 14. | AS= -0.2232 AP – 5.6796 |
| 15. | AS= 3.3972 AK -247.2912 |



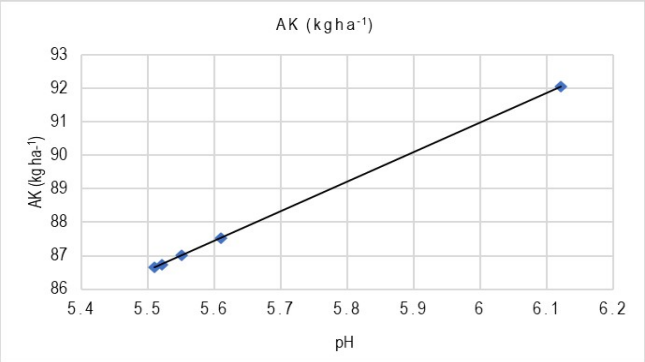

**Graph 1: Shows Co- relationship between pH and OC**



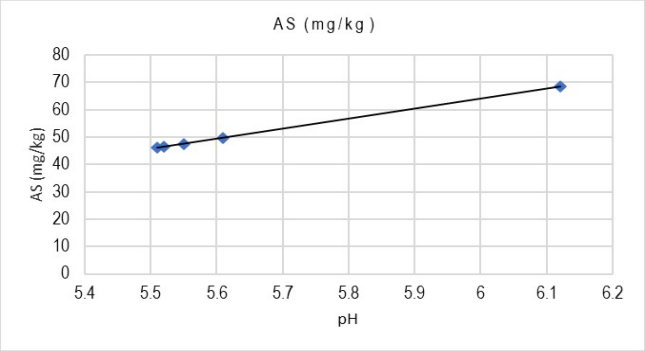

**Graph 2: Shows co-relationship between pH and Available Nitrogen**



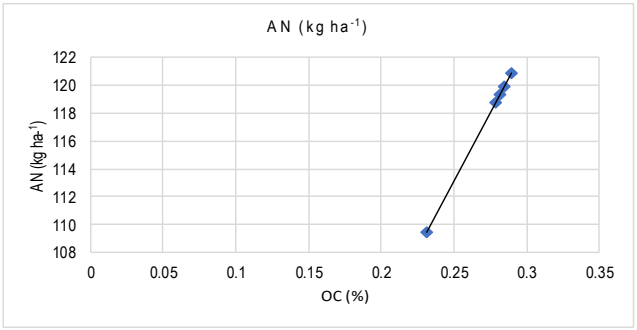

**Graph 3: Shows co-relationship between pH and Available Phosphorous**



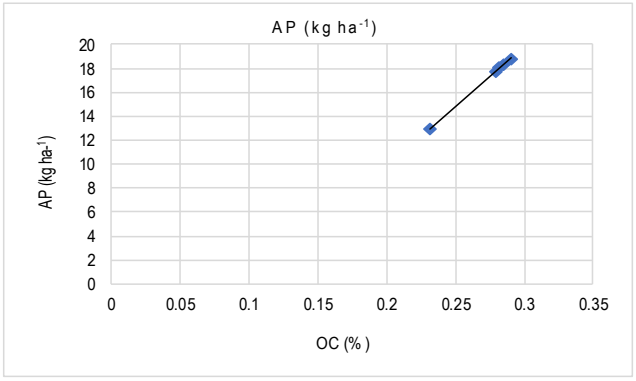

**Graph 4: Shows co-relationship between pH and Available Potassium**



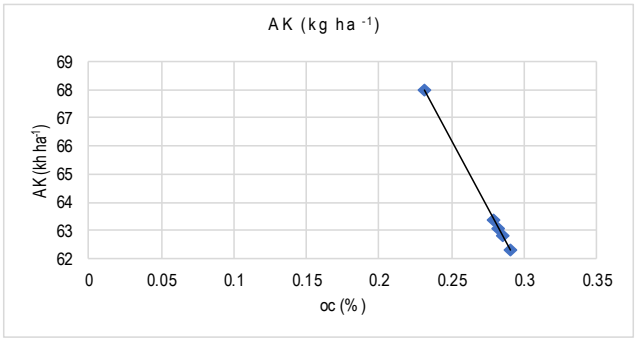

**Graph 5: Shows co-relationship between pH and Available Sulphur**



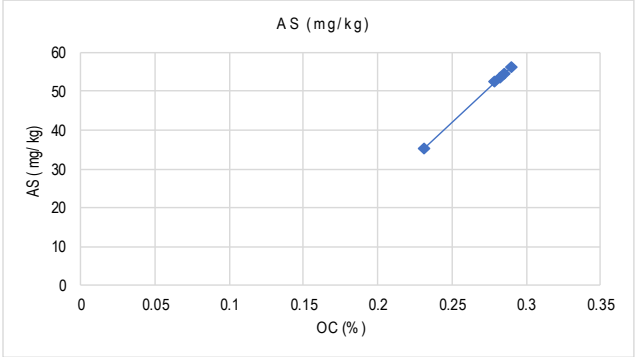

**Graph 6: Shows co-relationship between Organic Carbon and Available Nitrogen**



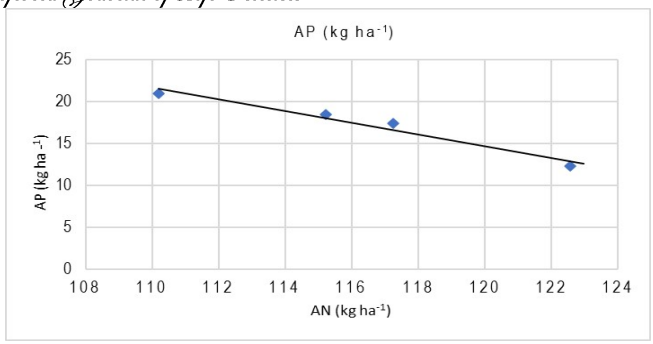

**Graph 7: Shows co-relationship between Organic Carbon and Available Phosphorous**



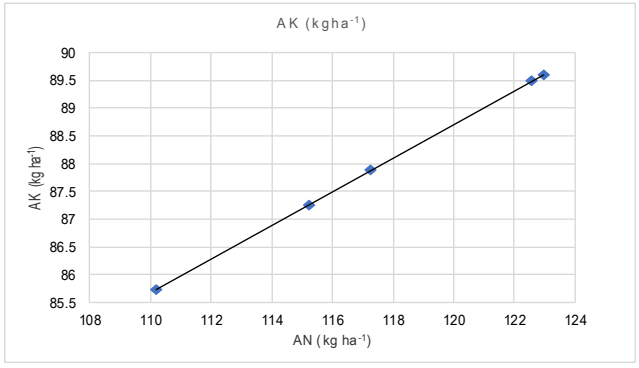

**Graph 8: Shows co-relationship between Organic Carbon and Available Potassium**



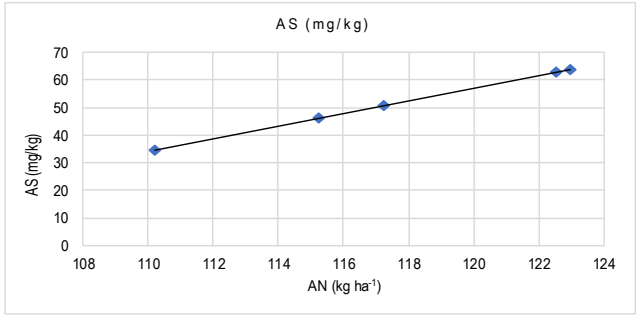

**Graph 9: Shows co-relationship between Organic Carbon and Available Sulphur**



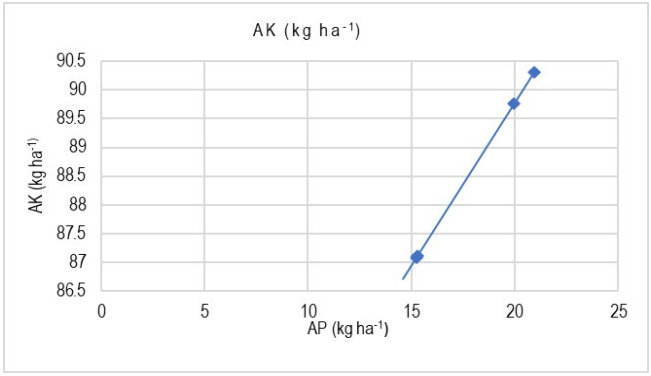

**Graph 10: Shows co-relationship between Available Nitrogen and Available Phosphorous**



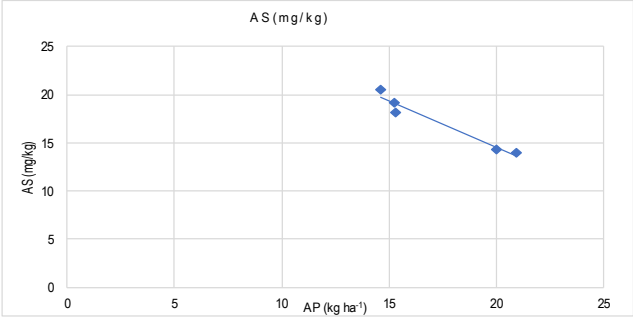

**Graph 12: Shows co-relationship between Available Nitrogen and Available Potassium**



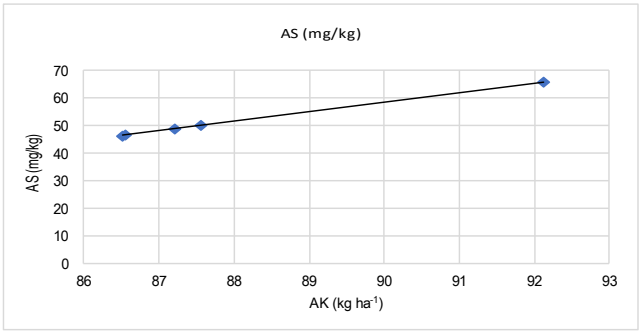

**Graph 13: Shows co-relationship between Available Nitrogen and Available Sulphur**




**Graph 14: Shows co-relationship between Available Phosphorous and Available Potassium**




**Graph 15: Shows co-relationship between Available Phosphorous and Available Sulphur**




**Graph 16: Shows co-relationship between Available Potassium and Available Sulphur**

The study revealed a low concentration level of available nitrogen, organic carbon, and potassium. The medium range of available phosphorous and available sulphur are high. The pH value of the soil sample is acidic in nature. By adding lime, it makes it a favourable condition for the cultivation of crops.[19] Urea is added to boost the available nitrogen content in the soil. The mean pH is 5.66, which is suitable for the cultivation of corn, oats, barely, and potatoes.[4] There is a significant negative co-relationship between soil pH and organic carbon.[19-21] And have a significant positive relationship with available nitrogen, available phosphorus[22], available potassium, and available sulphur.[23,24] The organic carbon mean value of 0.2734, which is low as per the standard range, can be improved by the addition of gypsum[25], because adding gypsum to soil reduces erosion by increasing the ability of the soil to soak up water after precipitation, thus reducing runoff. There is a significant positive relationship between soil organic carbon and available nitrogen and available sulphur[26] and a negative relationship between available phosphorus and available potassium. There is a significant positive relationship between available nitrogen, available phosphorus, available potassium, and available sulphur. There is a significant positive relationship between available phosphorus and available potassium. There is a significant negative relationship between available phosphorus and available sulphur. There is positive relationship between available potassium and available sulphur.[23]

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## AUTHORSHIP & CONTRIBUTORSHIP

Initial conceptualization idea or research hypothesis given by Dr. Lal Bihari Singh, the laboratory, and the methodology of the data guided by Dr. Adarsh Kumar Srivastava. Analysis of data, graph, and write-up prepared by Sonam Bharti.

## FUNDING SOURCE

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