Short communication
J. Adv. Nutri. Sci. Technol. 2(1): 07-13, 2022 **DOI: 10.15228/ANST.2022.v02.i01.p02**

Physio-Chemical Properties of Some Eroded Soils of District Mansehra

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ABSTRACT
A field survey was conducted to assess some physio-chemical properties of eroded soils of District Mansehra. Composite soil samples with 0-20 cm depth were collected from 10 sampling plots. They were assessed for soil $pH_{(1:5)}$, $EC_{(1:5)}$, soil organic matter (OM), AB-DTPA extractable P, AB-DTPA extractable K, bulk density, lime, and saturation. The results showed that soil pH in the areas under investigation was almost alkaline, ranging from 7.1 to 7.8. The EC values ranged from 2.2 to 2.9 dS m^{-1} showing that the area under study had no sign of salinity. Soils having EC less than 0.7 dS m^{-1} may be applied for good crop yield**.** The data on OM showed that the soils under investigation were insufficient in OM contents. The OM contents in these soils ranged from 0.59 to 0.92 %. Results regarding the P content range from 3.4 to 4.45 mg $kg^{-1,}$ suggesting that some soils are adequate in P contents, but most soils are deficient. This study suggests the supplemental P application as fertilizer for profitable crop production. Furthermore, the addition of various organic fertilizers will improve the soil properties and fertility status of the soils. The soils in the area were also evaluated for K contents that range from 73.45 to 78.71 mg kg^{-1}, lime status ranging from 2.56 to 3.99 mg $kg^{-1,}$ which is slightly calcareous, bulk density content ranging from 1.23 to 1.38 mg kg^{-1}, saturation level occurred between 32.4 to 40.1 mg kg^{-1}. It was established that micronutrients for integrated nutrient management and fertilizer application would be required in the future.

Keywords: physio-chemical properties, pH, alkaline, organic matter, EC, lime, bulk density, saturation, and micronutrients.

Highlights:

- Evaluate the fertility status of soils of the eroded areas of the district Mansehra
- Analyze the physio-chemical parameters of soil

1. Introduction

The physio-chemical properties of the soil employed for agricultural output and forest preservation are both dependent on them. The soil condition affects necessary functionalities like water retention, biodiversity, agriculture support, flood, erosion, and landslide resistance (Cardoso *et al*., 2013). Understanding soil quality or how to maintain it is crucial to crop growth. The freshness and stature of crops cultivated on soil can determine its health. Farmers, on the other hand, have formed an overall evaluation. A complete physical, chemical, and biological investigation of soils can be used to make a systematic examination. To deliver the remaining amounts of needed plant nutrients, it is necessary to examine the capacity of a soil to absorb nutrients, such as micronutrients (B, Fe, Cl, Mn, Zn, Mo, Cu) and macronutrients (N, S, P, Mg, K, and Ca). The soil quality assessment includes investigating characteristics and events that influence soil's ability to function properly like a constituent of a healthy ecosystem (Ku *et al*., 2015).

Soil degradation is a severe risk to crop production Because it reduces soil fertility. Many researchers have found significant soil degradation in Khyber Pakhtunkhwa (Ahmad, 1990; Bhatti et al., 1997; Khan and Bhatti, 2000; Khan et al., 2001). As little more than a result, land management and soil degradation control techniques are required to maximize agriculture productivity while also preserving the area's land resources.

The Hazara Sector of Pakistan's Khyber Pakhtunkhwa province includes Mansehra city. The district's total land area is 10, 67,291 acres, with 2.58,99 acres cropped and 8, 08,292 acres of arid land due to the shortage of irrigation facilities, which has harmed soil productivity despite its fertility. Only 48,571 acres are irrigated. As a result, the land is not as productive as it once was. Monsoon rains mainly influence farming. Because of irrigation, the soil in the Pakhli plan is vibrant and productive. Wheat (total area 43,412 hectares, providing 67,735 tons in 1991), Maize (total area 76,606 hectares, yielding 1,19,615 tons in 1991), Rice (total area 6,203 hectares which produced 13,236 tons), Tobacco (total area 1,345 hectares with a yield of 5,4344 tons), Rape and Mustard (total area 959 hectares with an output of 467 tons), Barley and fodder (total area 3,358 hectares with a production of 467 tons), Vegetables, Soyabean and Pulses (total area 3,358 hectares with an output of 467 tons), Vegetables, Soyabean and Pulses (total area 1,288 hectares which produced 5,601 tons during

1991) are some of Mansehra's notable crops. Because of favorable climatic environments and conditions, tea cultivation trials have also been conducted in Ahal, Shinkiari, Ichrian, and Baffa. Such tests yielded positive results. Fruiting trees are another stream of revenue, particularly apple orchards, which come in different cultivars. Soil testing is essential to maintain sustainable crop production and the environment.

2. Materials and Methods

2.1 Location

An investigation was done to assess the fertility status of some eroded soils of District Mansehra. For this purpose, fields of every Tehsil were surveyed, and during the survey, general observations on the field were also recorded. Moreover, relevant information from concerned farmers was collected during soil sampling from each field.

2.2 Soil Sampling

The soil sample was collected randomly from 1-10 sites from 0-20cm depths with the help of a soil auger before sowing crops. Soil samples were prepared and labeled for laboratory analysis.

2.3 Analysis of Soil Sampling

In the lab, soil samples got dried partly in the air at a temperature of about 25-35°C and a humidity level of 20-60%. Stones and plant residues were scraped from the soil sample, which was crushed and sieved to a 2mm mesh size before being retained for lab testing.

2.4 Soil Analysis

Soil samples were examined for extractable Phosphorous P, extractable K, organic matter, pH, EC, lime, bulk density, saturation, and soil texture.

3. Physico-chemical Characteristics of Soil

3.1 Physical Properties

3.1.1 Soil Texture:

mA dispersion cup was filled with a dried soil sample (50) with distilled water. After that, 10ml of 1N Na_2CO_3 was applied. Then after the dispersal cup was left on the mixer for 5-10 minutes. The liquid of the dispersion cup also was poured into a 1000ml cylinder. For silt + clay and clay, the hydrometer readings were taken for 40 seconds and 2 hours, correspondingly. The textural triangle was used to compute and determine the texture of the soil (Koehler et al., 1984).

3.2 Chemical Properties:

The chemical properties of the collected soil samples from Tehsil Mansehra, including pH, EC, organic matter, P content, K content, lime, bulk density, and saturation, were analyzed

3.2.1 Soil pH and Electrical conductivity:

In a soil-water (1:5) solution, the pH and EC of the soil were evaluated. For this, soil (10 gm) was mixed with 50 ml of distilled water (50 ml) and agitated for 30 minutes. After filtration, the extract was tested for pH using a pH meter (InoLab pH level 1) and EC using a conductivity meter (DDC-308A) (Meclean, 1982; Richards, 1954).

3.2.2 Soil Organic Matter:

The Walkley-Black technique, as reported by Nelson and Sommers (1996), was used to determine the organic matter in soil samples. 1 gm of soil was mixed with 10 ml of 1 N $K_2Cr_20_7$ and 20 ml of concentrated H_2SO_4 in this procedure. The suspension was filtered after cooling, and the supernatant was valerate against 0.5 N $FeSO_4$ mixture utilizing ortho-phenolphthalein as an indicator and the presence of maroon hue as the end state. A control sample was taken at the same time as the soil samples. The moles of $K_2Cr_2O_7$ used in the oxidizing organic C in soil were used to compute the quantity of OM.

3.2.3 AB-DTPA Extractable P:

The content of P in the soil was evaluated by isolating it in a solvent. A 10gm sample was combined with a 20ml ammonium bicarbonate-diethlyenetriamine pentaacetic acid solution in a flask. The liquid was then agitated for 15-20 minutes on a rotary shaker preceding extraction with Wattman no 42-filter paper.

1 mL supernatant and 3 mL distilled water were put to a conical flask for the phosphorus analysis. Then 5 mL of ascorbic acid indicator solution was introduced to bring the final volume. The 25 mL flask was then retained in the dark to develop blue color. The spectrophotometer Soltanpur (1985) was used to analyze P together with the blank and standards.

3.2.4 AB-DTPA Extractable K:

The K content in the soil was evaluated by isolating it in a solvent. Using a 2mm sieve, pass the air-dried soil specimen. To prevent tamping, divide out 10ml of the sieved soil with a scoop before pressing. Mix ammonium acetate/acetic acid (50 mL) solution thoroughly in a 100ml plastic bottle. Remove the stopper from the bottle, place it in a shaker, set it aside for a few minutes, and decant it using Whatman No. 2 filter paper. Make standard potassium solvent ranging from 0-

100 parts per million potassium. Adjust the Flame Photometer to 100 using a 100ppm potassium mixture. Aspirate 20, 40, 60 and 80 ppm potassium stock solution to create a standard graph. The sample was withdrawn from the solution and diluted as required in ammonium acetate/acetic acid solution to evaluate the soil sample's potassium content.

3.2.5 Bulk Density:

The soil samples were collected from three depths using a sharp-edged cylindrical auger with a 5 cm internal diameter. To prevent compression, the auger must be adequately pushed into the earth. The depth of the soil layer would need to be 10 cm. Take the sample weight in the field. Unless a constant weight is achieved, the sample would be dried in the oven at 105°C after weighing it. It causes the soil to lose its dry weight. The bulk density can be estimated by dividing the dry weight of soil material (Wd) by the volume of soil (V) or the interior volume of the auger.

3.2.6 Lime:

Ten gm of the soil was weigh-in six plastic vials. According to the volume ratio, distilled water, and 0.04 N Ca(OH)2 (0.02M) solution were added, followed by stirring for 30 minutes before measuring pH, then leaving them aside for a further 1/2 hour. The lime contents were measured by plotting pH vs. mL 0.04N Ca(OH)2.

3.2.7 Saturation:

Changes in soil structure, texture, and organic matter content may contribute to saturation percentage variations. Organic matter helps build soil aggregates, promoting moisture retention in the soil. According to Frye (1987), soils with greater organic matter produce granular aggregates and are comparatively more water responsive.

4. RESULTS AND DISCUSSION

4.1 Soil Texture:

The results showed that the majority of the soils were sandy clay loam (10%), sandy loam (10%), silty clay loam (15%), loam (35%), and clay loam (30%). Fig. 1 shows the textural Class of District Mansehra.

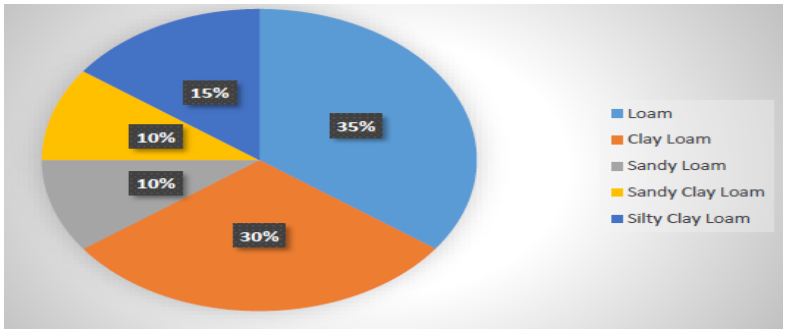

Figure 1. Textural Class of District Mansehra

4.2 pH of soil samples:

The pH values of collected samples from 10 different locations 0-20cm deep were assembled. The pH of samples of Tehsil Mansehra ranged from 7.1 to 7.8, having an average value of 7.4 (Fig 2), showing slight alkalinity. Therefore, pH was not taken into account when classifying soil as salt-affected. According to Shainberg and Oster (1985), pH is not a recognized criterion since it is neutralized by soil, or most crops can handle a variety of pH. Most crop plants thrive in a pH range of 6.5-7.5.

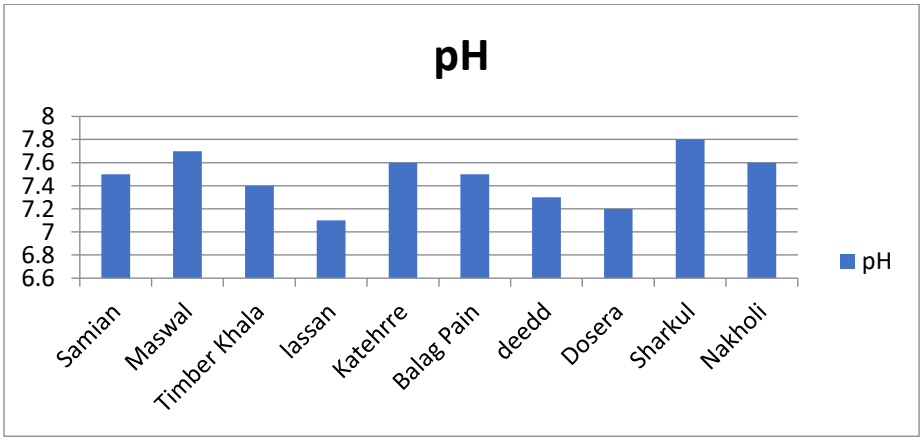

Figure 2: pH of eroded soils of District Mansehra

4.3 EC (dS m^{-1}) of Soil Samples:

The EC of soil samples of Tehsil Mansehra is shown in Fig 3. Samples with 0-20cm depth were collected from 10 different locations. These findings revealed that the soils were adequately related to the acidity, ranging from 2.2 to 2.9 dS $m^{-1}$with a mean value of 2.5 dS m^{-1}. These results showed that the soils were average concerning salinity.

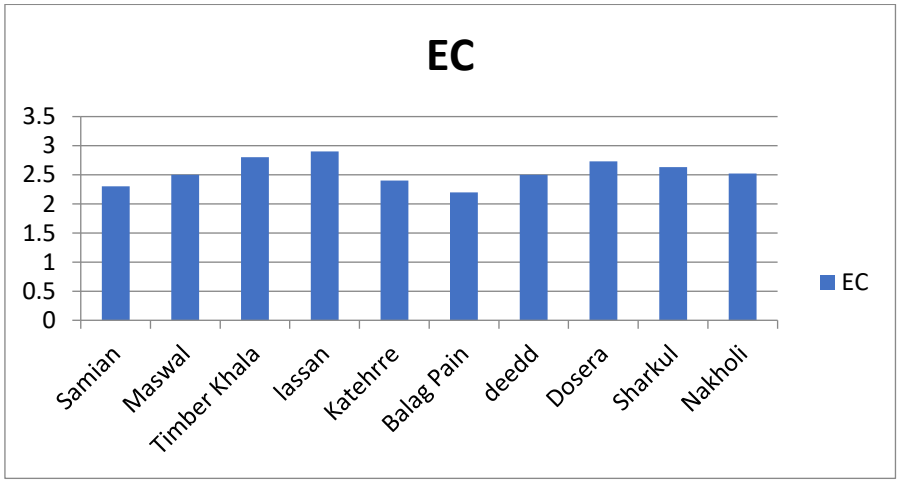

Figure 3: EC eroded soils of District Mansehra

4.4 Organic Matter (%):

The OM of soil samples with 0-20cm depth were collected from 10 different locations of Tehsil Mansehra. The organic matter contents varied between 0.59 to 0.92 % having a mean value of 0.75% (Fig 4). The findings showed that the entire samples were lacking in organic matter contents.

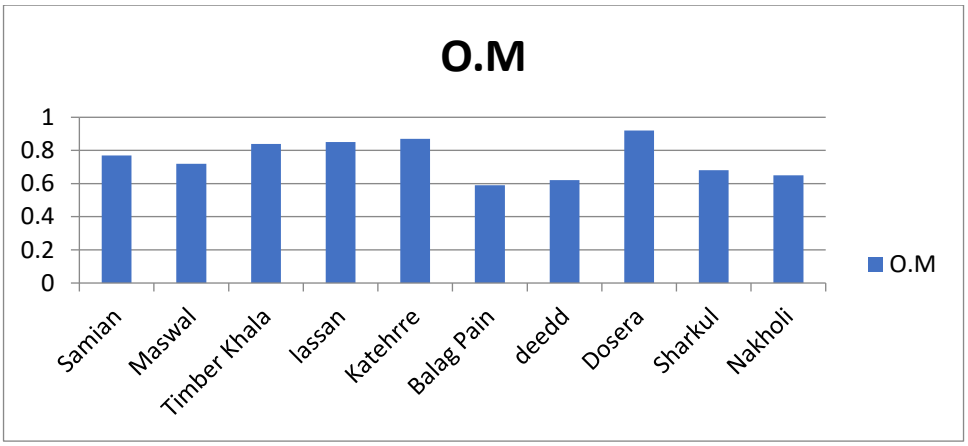

Figure 4: %O.M of eroded soils of District Mansehra

4.5 AB-DTPA Extractable P contents:

The results of extractable phosphorus content in the soil of Tehsil Mansehra are given in Fig 5. P values range between 3.4-4.45 mg kg^{-1}, with a weighted mean of 3.9 mg kg^{-1}, as shown in Fig. (5). Overall, the findings suggest that while few samples were competent, the remaining samples were inadequate and required more P fertilizer for successful crop production, which was similar to the reports of Soltanpour (1985) reports.

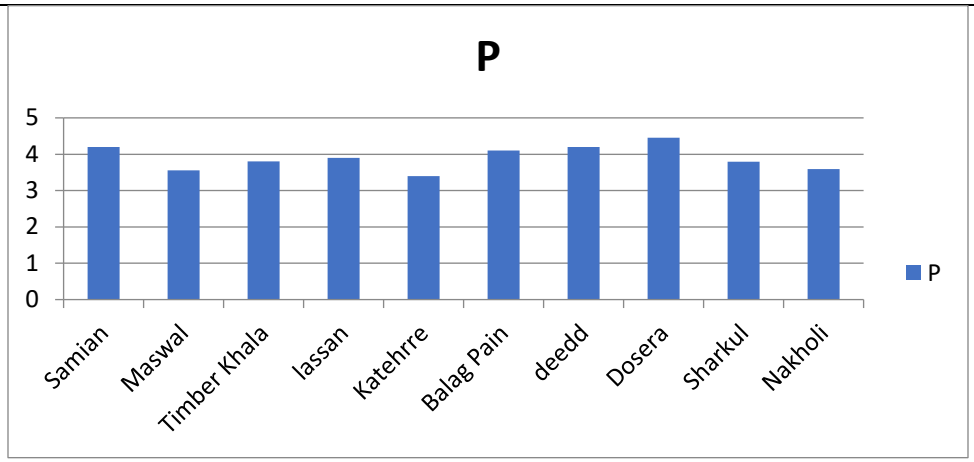

Figure 5: AB-DTPA Extractable Phosphorous of eroded soils of District Mansehra

4.6 AB-DTPA Extractable K contents:

The results of extractable potassium content in the soil of Tehsil Mansehra are given in Fig 6. K concentration varies between 73.45-78.71 mg kg^{-1}, having average values of 76.08 mg kg^{-1}. Therefore, the findings suggest that while some soil samples were sufficient, most were poor and required additional K fertilizer for productive crop cultivation.

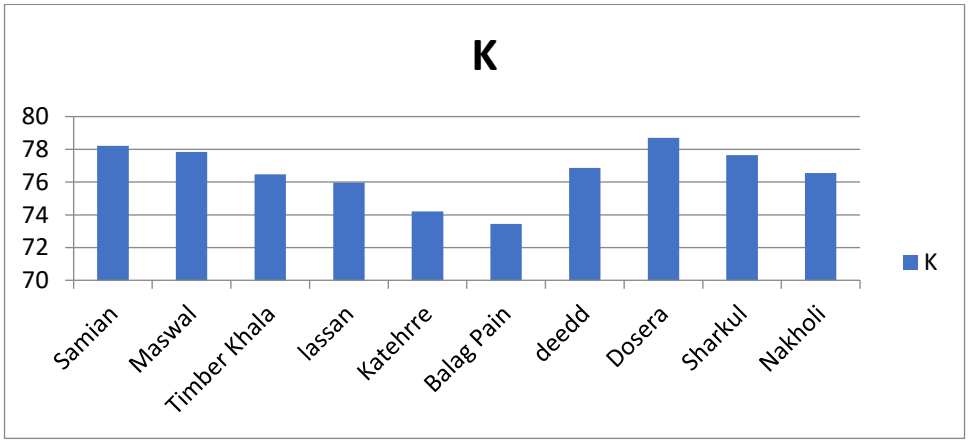

Figure 6: AB-DTPA Extractable Potassium in eroded soils of District Mansehra

4.7 Lime content (%):

The results of Lime content in the soil of Tehsil Mansehra are given in Fig 7. The lime concentration varies between 2.56-3.99 %, with a mean value of 3.27 %. Essentially, the soil was found to be non-calcareous to moderately calcareous, requiring supplementary lime for effective crops.

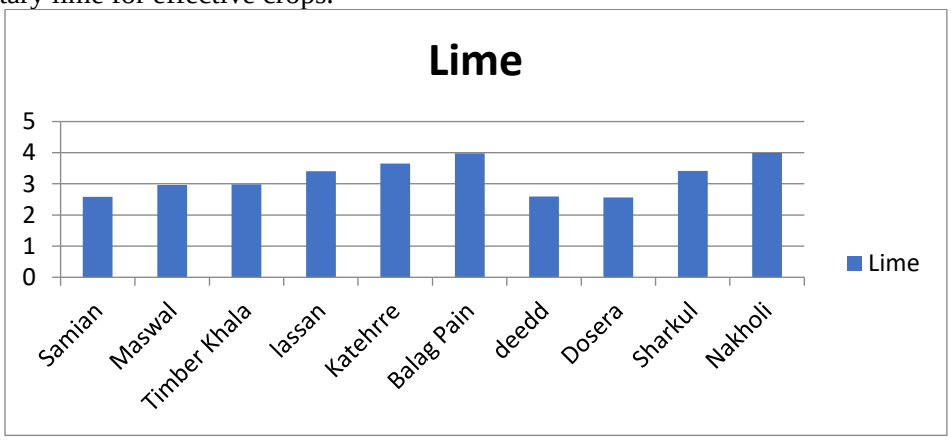

Figure 7: The lime content of eroded soils of District Mansehra

4.8 Bulk Density:

The results of bulk density content in the soil of Tehsil Mansehra are given in Fig 8. As seen in the graph, bulk density values range between 1.23-1.38 Mg m-3, having a mean value of 1.30 Mg m^{-3}. Ultimately, the findings imply that while some soil samples were suitable, most were low and needed significant bulk density for viable crop development.

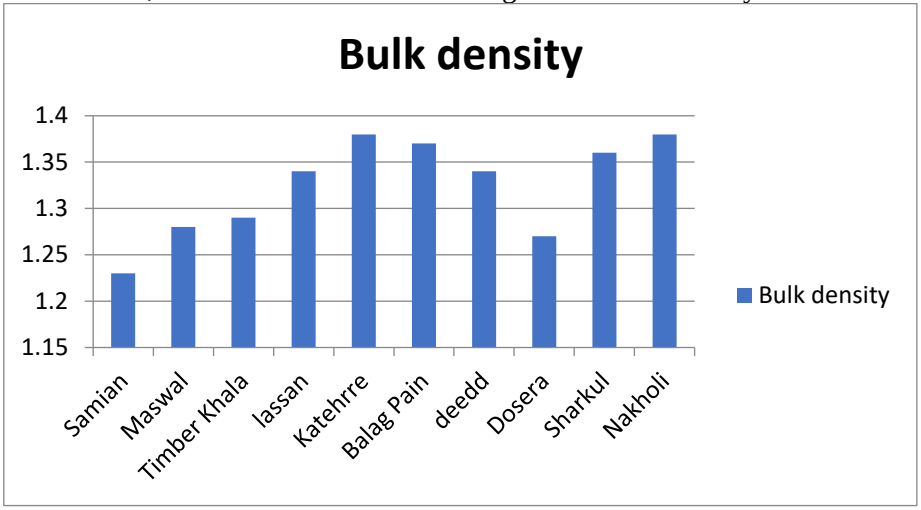

Figure 8: The bulk density of eroded soils of District Mansehra

4.9 Saturation (%):

The results of saturation content in the soil of Tehsil Mansehra are given in Fig 9. The saturation content varied around 32.4-40.1 %, with an average value of 36.25 %. Consequently, the results suggest that certain samples collected were sufficient, but most samples were inadequate and required supplementary saturation for viable crop development.

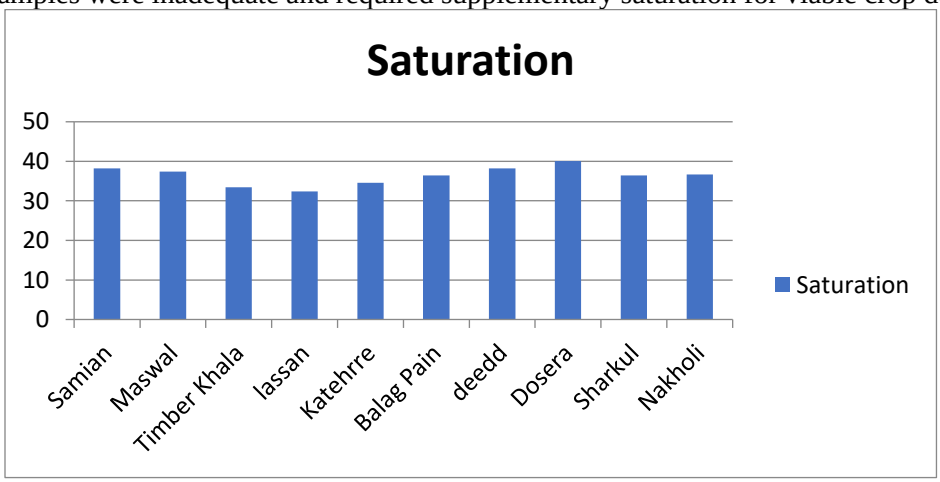

Figure 9: The saturation of eroded soils of District Mansehra

5. Conclusions

It was concluded that the area's soils understudy had almost slightly alkaline pH (1:5 soil water suspensions) with an average value of 7.40, lower than the country's plain areas but higher than hilly areas in the state. However, the soil pH values of all the soils were suitable for the cultivation of almost all crops cultivated in the country. The EC value showed that the area under study had no sign of salinity while soil OM was lower than 1.0 % organic matter. The AB-DTPA extractable P was in the marginal range, followed by the mean AB-DTPA extractable K value of 76.08 mg kg^{-1}. The lime content ranged from 2.56 to 3.99 %, with bulk density between 1.23-1.38 Mg m^{-3} and the saturation % values between 32.4-40.1 %, with a mean value of 36.25 %.

Acknowledgment:

The authors highly acknowledged the laboratory Department of Horticulture, The University of Haripur, Haripur-Pakistan

Conflict of interest

The authors reported no potential conflict of interest

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Received: 10th February 2022 **Accepted: 5th April 2022**