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Soil quality assessment in gulmit and shiskat valley of upper hunza, district Hunza Nagar, Gilgit-Baltistan

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Abstract

The study was carried out in Upper Hunza to identify the soil quality assessment in Shiskat and Gulmit village. The examined soil properties were pH, Soil Organic Carbon (SOC), Nitrate-Nitrogen (NO_3-N) Electrical Conductivity (EC), Available Phosphorus (P), Exchangeable Potassium (K), Silt, Sand and Clay content (texture). Stratified random sampling was done in Shiskat and Gulmit Valley form top soil 0-15 cm. Total 40 soil samples were collected from both valleys, 20 samples from Gulmit and 20 samples from Shiskat. Soil samples were taken to Laboratory for standard analysis of soil quality parameters. Independent T test was applied to determine the significant difference of soil properties with respect to location wise. Soil parameters like pH, NO_3-N, lay, Sand and Silt differed significantly with respect to location, while SOC and P were non-significant according to location wise. Soil chemical properties like SOC and NO_3-N was found higher in Shiskat valley, compared to Gulmit it may be because of higher inputs of animal dung and green manure. Continuous assessment and monitoring of soil quality is necessary in this area to maintain the soil quality, which will be beneficial for higher production of yield amount.

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Introduction

Soil is an important factor representing the potential of an area for its production within a particular and specific climatic condition (Holechek *et al.,*1995; Roukos *et al.,* 2011), the increase of human population has also increased the anticipations of life standard and values indirectly in the scarcity of natural resources. The current study is an attempt to identify the physical, chemical and fertility status in upper Hunza, where the livelihood is totally dependent the farming. This study will provide the suitable recommendation for the better farming practice and agricultural management, to get more production using sustainable agriculture practices. Today, there is an accord that land-use change is one of the foremost causes of the change in the quality of the soil in the environment (Gholomi *et al.,* 2012). In many parts of the world, agriculture is the main reason of land use change. Much of the pressure on convert forests, the agricultural uses comes from and developmental demands and from increasing of population growth (Yuksek, 2009). Soil is a complex system, where physical, chemical, and biochemical factors are held together in a dynamic equilibrium. (Kizilkaya and Bayrakli, 2005).

Soil fertility is determined by both form physical properties and its nutrients. In the areas where rainfall is usually less, water supply is often the factor that determines the growth of crop (Evans *et al.,* 1987; Atiku and Noma, 2011).

Plant growth and the production depend on the chemical, physical and biological parameters (Khan *et al.,* 2004). Soil pH and soil organic carbon SOC concentration influence by rotation and tillage, especially in the surface 2.5 cm soil. Increase in organic carbon (OC) in soil surface reduce the toxicity, like Al toxicity, and allow crops to grow satisfactorily (Godsey, 2007). Different land use type has a deep effect on soil organic carbon (SOC) storage, because it affects the amount and quality of litter input, litter decomposition rate, and stabilization of SOC (Guangyu *et al.,* 2010).

In developing countries rapid urbanization has led to extensive land use changing (Khaledian *et al*., 2012). As well as extensive agriculture activities are responsible for the destruction and degradation of soils, these land use changes are generally accompanied by decreasing in concentrations of SOC and nutrients availability and also degradation of soil structure (Emadi *et al.,* 2009). Changing in farming and management practices such as cultivation, fertilization, irrigation and drainage activities and tillage, may change the quality soil (Li *et al.,* 2008). Therefore assessing soil quality is a key tool to assess the soil health and to provide land management decisions related to soil quality (Sturtz and Christie, 2003).

In order to conserve a good soil quality and to make certain its fertility is essential to preserve soil physical, chemical and biological individuality unchanged (Santorufo, 2013). Most of the important soil quality indicators were drastically influenced by different land use systems, mainly at the surface perspective. OC, soil pH, CEC, total N, available P, and exchangeable bases, were affected due to rigorous cultivation and use of acid forming inorganic fertilizers (Jamala *et al.,* 2013).

In upper Hunza, livestock grazing and land use changes are common problem, this might lead to degrade the soil quality. None of the research has been carried out in this area about the soil quality assessment, there is a big knowledge gap on soil quality assessment and farming practices in this area, so this research will be a pioneer research, and it will help them for better management of their soil and farming practices.

Materials and methods

Study Area

The research was conducted in the upper Hunza in Gulmit and Shiskat valley. Geographically the study area is mountainous, with temperature the freezing in winter, while in summer it may exceed from 25-30^{o}C. Upper Hunza mostly falls in Single cropping zone due to harsh climatic condition. The study area is badly affected by the Atta Abad Land sliding, before the land sliding it was good for the potato cultivationwhile after the land sliding community mostly cultivate the wheat and corn. Mostly larger areas of Shiskat and Gulmit valley are submerged in the lake. Forest is dominated with popular tree, willow and mulberries as well as the apricot trees are also dominant.

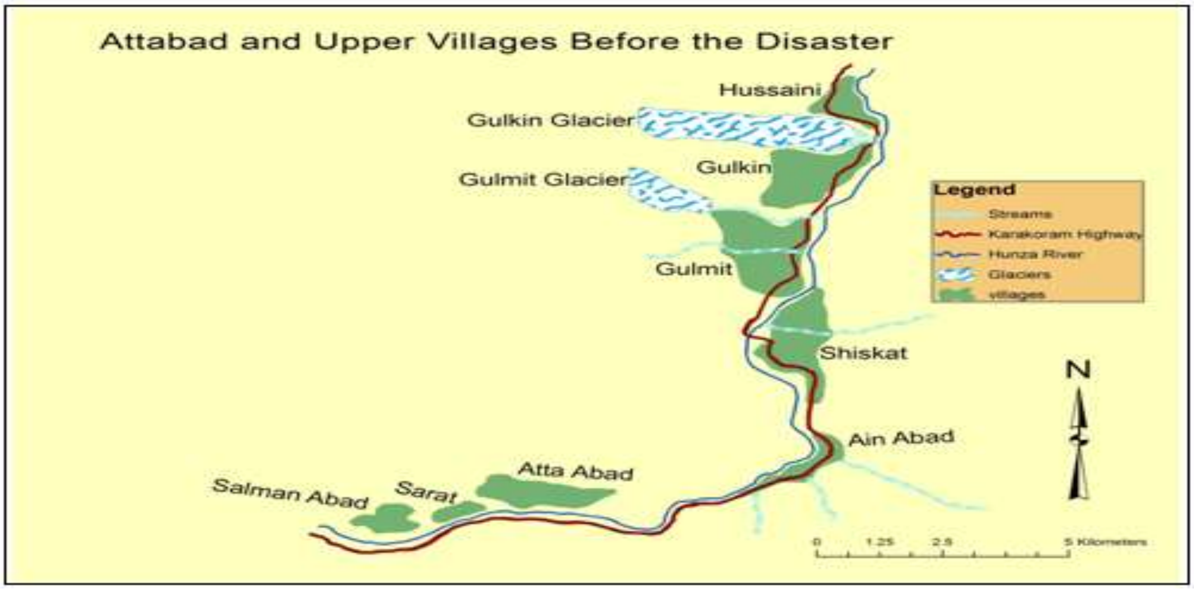

Fig. 1. The above map showing Attabad and Upper village before the Disaster.

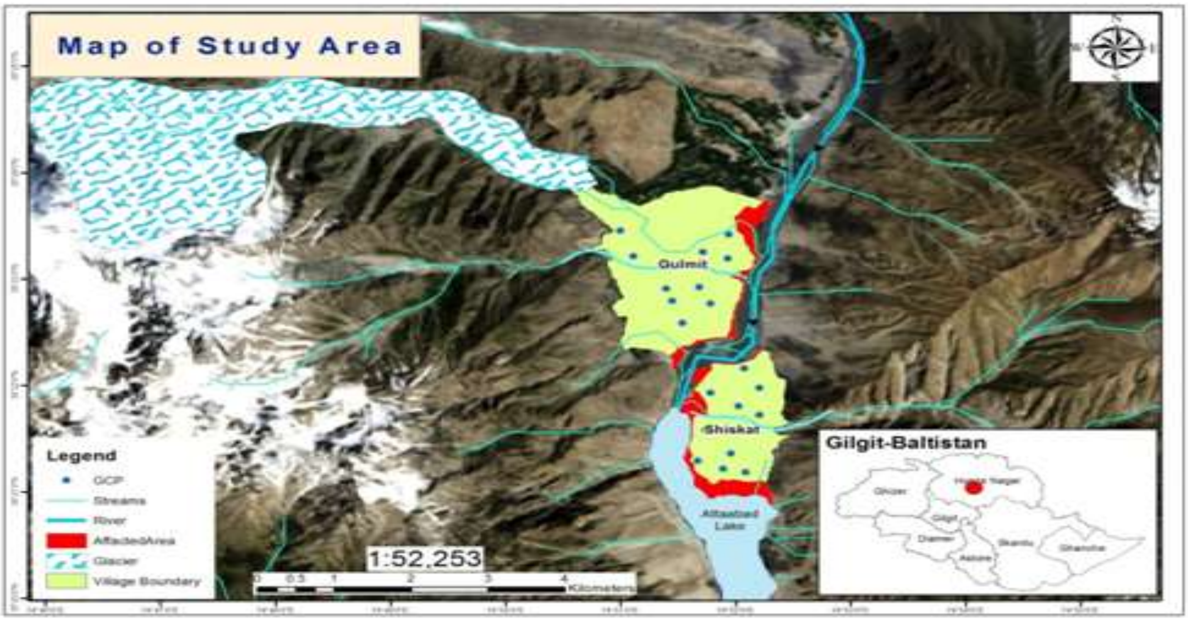

Fig. 2. Map showing the sampling points at study area.

Sampling design

Soil sampling was done by using stratified random sampling method. The samples were collected from the depth of 0 to 10cm. Samples were collected using a spade and hand trowel.A total of 40 soil samples were taken, 20 in each study sites. Approximately 500 g of each soil sample were stored in separate plastic bags with proper labeling.

The soil samples were air dried and sieved with 2mm sieve prior to any analysis. The soil samples were taken to the lab (Mountain Areas Agricultural Center, Juglote; MARC) for the analysis. The parameters analyzed include soil texture classes (SIC, hydrometric method), Soil pH was measured with 1:1 soil and water (McKeague, 1978; McLean, 1982). EC was measured with (electrical conductivity meter) (Richards, 1954). Soil organic carbon was measured by (Walkley, 1947). Soil NO3-N, P, K was determined by the Ammonium Bicarbonate – DTPA Extractable method (Sultanpour and Schwab, 1997).

Statistical analysis

The date was further analyzed to determine the, physiochemical and fertility status of soil by location wise difference. The main statistical test applied "Independent Sampling "T" Test" for locations to determine the significant difference, between the clusters wise.

Results and discussion

Independent sample T test indicated that pH, NO_3.N, K, EC, Clay, Sand and Silt differed significantly with respect to location, while SOC and P were non-significant as shown here in table 1.

Table 1. Independent Sampling "T" Test for Locations.

Location	pH	SOC	NO_3-N	P	K	EC	Clay	Sand	Silt
Shishkat and Gulmit	2.6*	0.96^{ns}	5.38***	0.19^{ns}	-2.546**	2.64**	0.172^{ns}	2.680**	2.93**

Note: *, **, ***, and "ns" indicates p<0.05(5%), p< 0.01(1%), p<0.001 and "ns"
non-significant respectively
SOC; Soil Organic Carbon, NO_3.N; Nitrate-Nitrogen, P; Phosphorus, K; Potassium, EC; Electric conductivity.

Soil pH is an important parameter which may change because of variations in geology, soil biological activities, and slope pattern and also because of landscape position. It is considered as one of the important soil chemical indicator because it gives and indicate the soil health and soil nutrient availability and difference is soil pH alter the soil physiochemical and biological properties. The mean pH of soil was slightly alkaline (7.5) in Shishkat as compared to Gulmit soil (7.2) Figure 3.

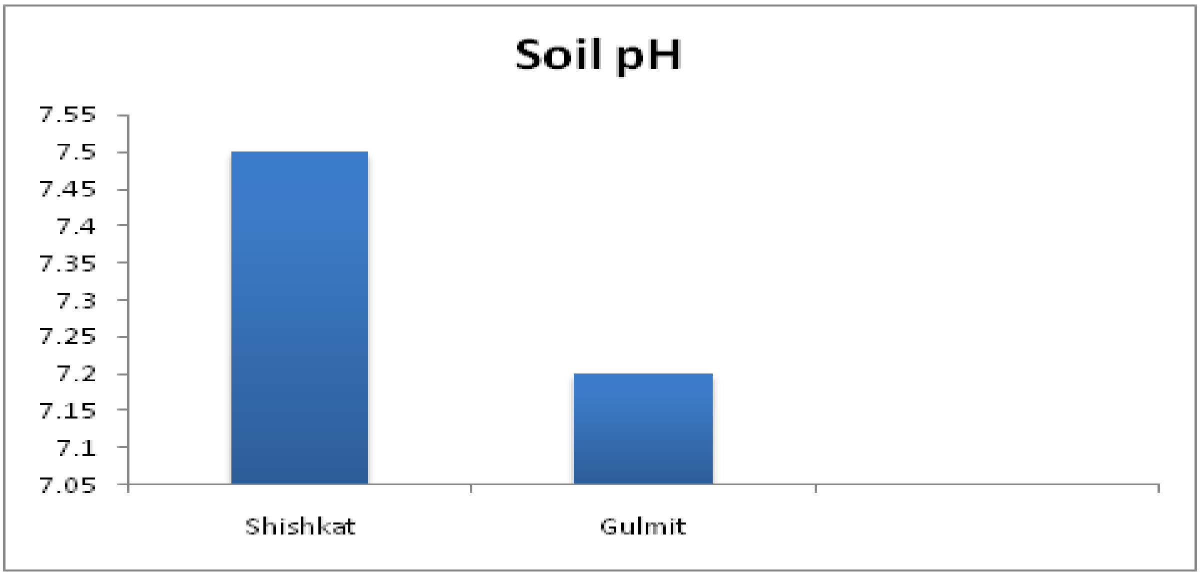

Fig. 3. Percentage distribution of soil pH according to location wise.

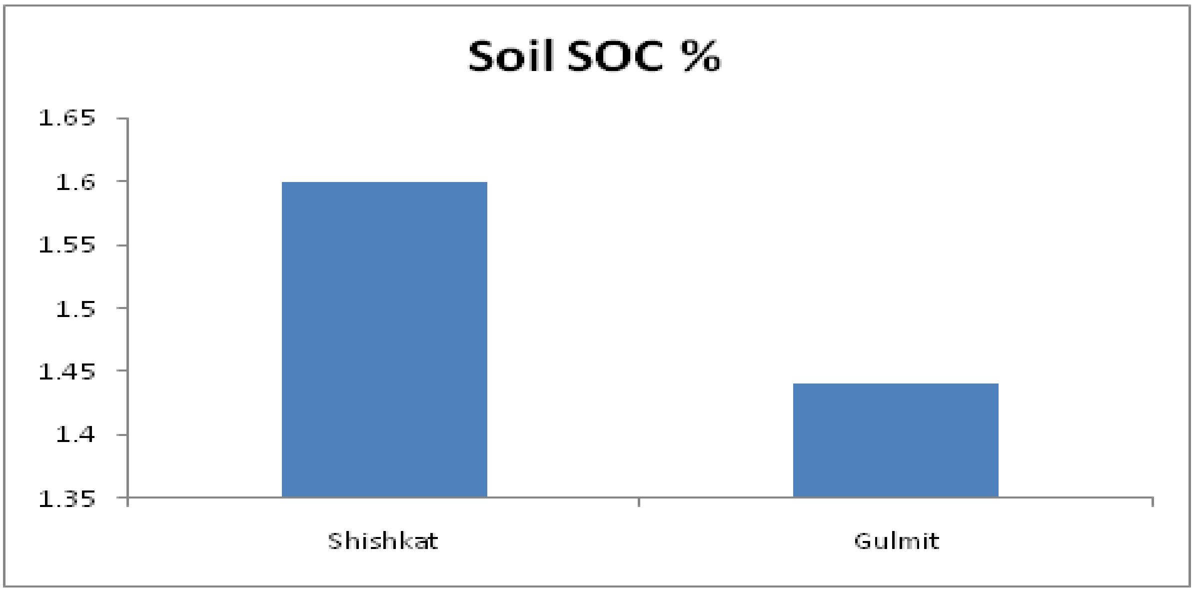

Fig. 4. Percentage distribution of Soil Organic Carbon (SOC) according to location wise.

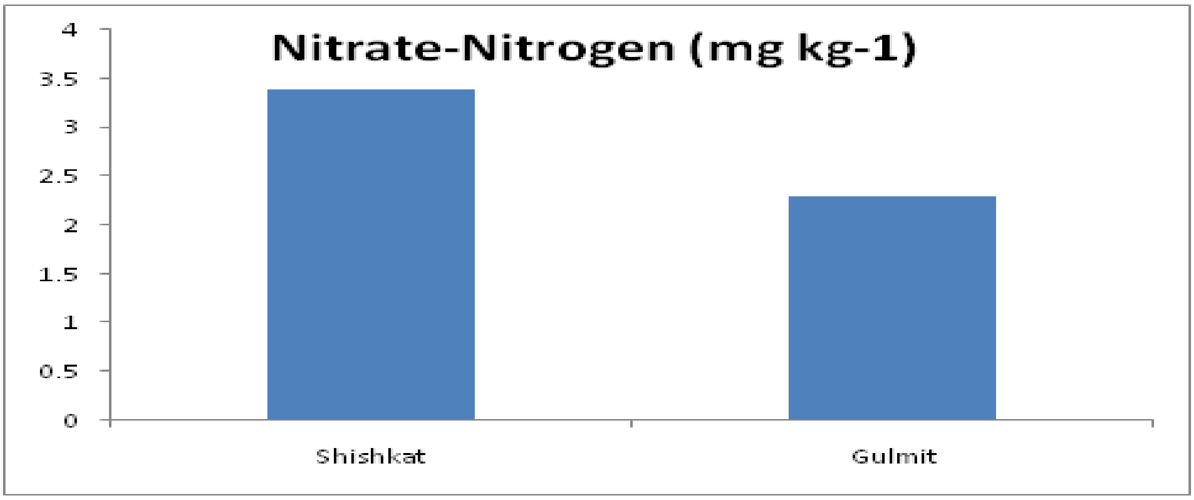

Fig. 5. Percentage distribution of Nitrate-Nitrogen (mg kg-1) according to location wise.

Soil Organic Caron is an important soil quality indicator. SOC plays a vital role in the global carbon budget, and can also perform as a source or a sink of atmospheric carbon, thereby probably influencing the course of climate change (Martin *et al.,* 2011). Soil Organic carbon is quite different in both locations. Mean SOC content was slightly higher in Shiskat (1.6%) as compared to SOC content in Gulmit (1.44%) (Figure 4).

Most of the soil physiochemical properties are differ due to the land use patterns in different location. Soil systems are not stagnant they may vary due to subject to natural changes. These changes are both directional and cyclic nature. Such changes may occur from day to day millennia (Grieve, 2001). The mean TN was highest in the Shiskat (3.4 mg kg-1) as compared to TN in Gulmit (2.3mg kg-1) (Figure 5). In Shiskat it might be because of highest SOC percentage.

The available phosphorus was not statistically significant and slightly different in both locations 2.49 mg kg-1 in Shiskat and 2.45 mg kg-1in Gulmit as shown in (Figure 6). Mean Exchangeable potassium was highest in Gulmit (87.7 mg kg-1) while in Shiskat it was (65.8 mg kg-1). Mean difference were ($p<0.01$) Figure 7.

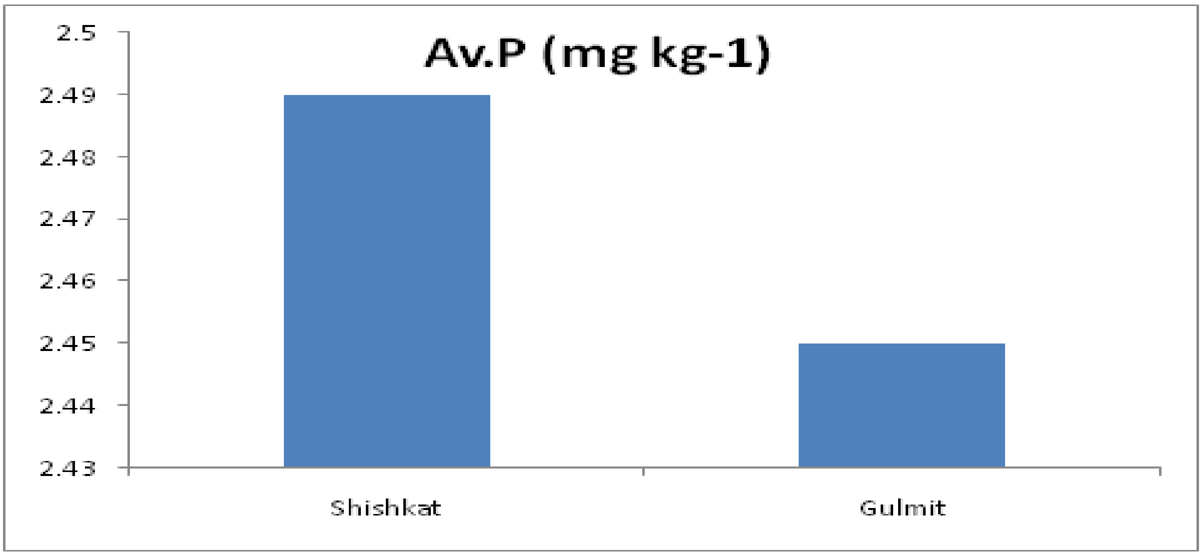

Fig. 6. Available Phosphorus (P) (mg kg-1) according to location wise.

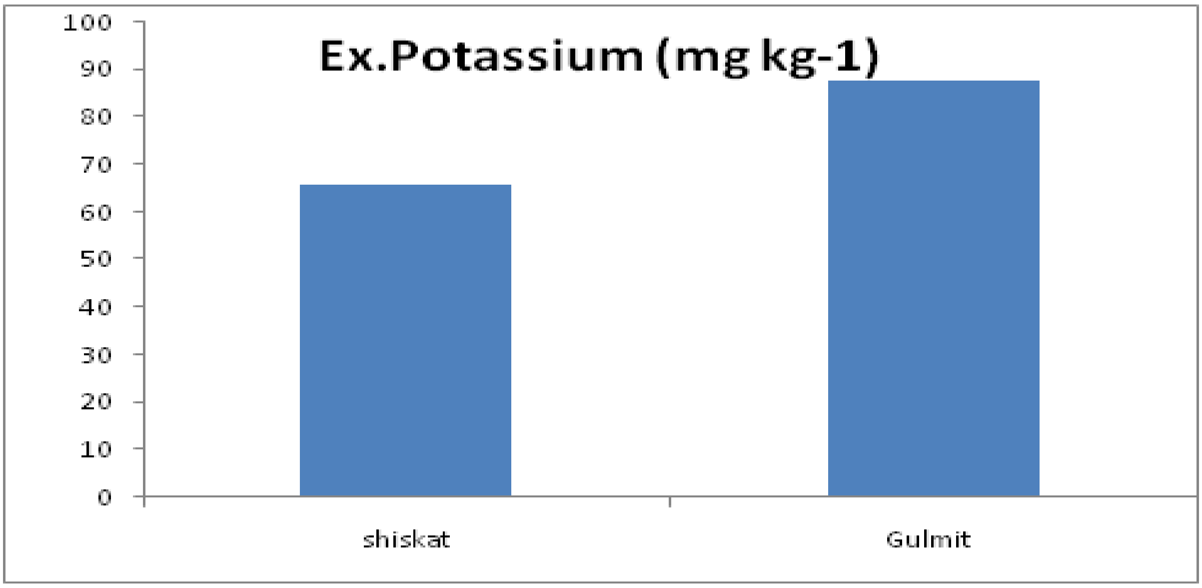

Fig. 7. Exchangeable Potassium (K) (mg kg-1) according to location wise.

Physiochemical and fertility status of Gilgit soil were evaluated during 1999- 2000 by (Khan, *et al.,* 2004). for to formulate proper recommendation for agriculture production. The electrical conductivity they found was varied from 0.06 to 0.5 dS/m. In the present research there is a greater difference in electrical conductivity. EC of Shiskat is (2.44 us/cm) while EC of Gulmit is 78.2 us/cm (Figure 8).

According to Baber *et al.*, 2004 the textural classes of Gilgit soil varied from silt loam to silt clay. The most textural classes they have found were silt loam (35%) followed by sandy loam (30%), loamy sand (7.5%), loam (20%), silt clay (25%) and silt clay loam (5%).In the present research the mean textural class of Shiskat soil lies in Silt while the mean textural class of Gulmit soil lies in Silt loam (Figures 9, 10). The results of (Baber, *et al.*, 2004) showed that the mean textual class of shiskat soils was loam, and Gulmit soils was sandy loam, while in the present research the textural class of shiskat soils was Silt and the Gulmit soils was Silt loam. The results reveals that the soil physical properties are been changed due the land sliding in Atta bad.

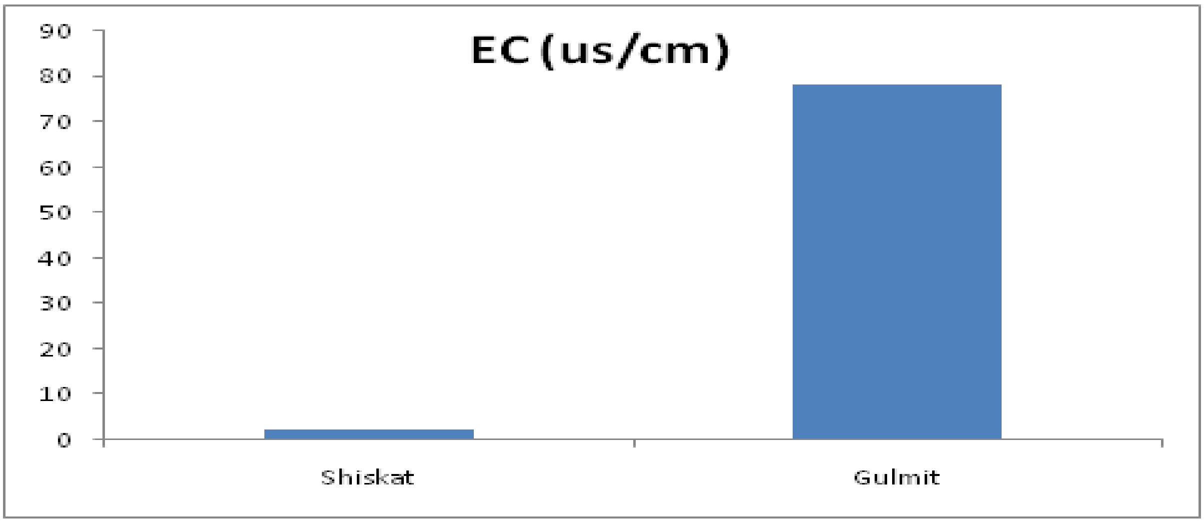

Fig. 8. Percentage distribution of Electrical Conductivity (EC) according to location wise.

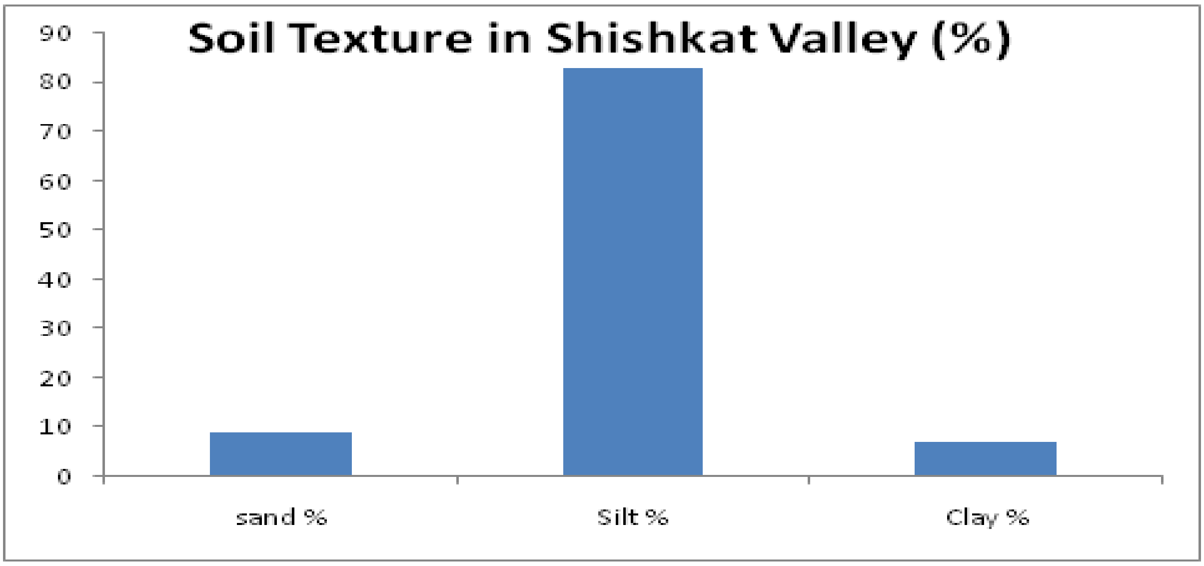

Fig. 9. Shows the percentage distribution of soil texture in Shishkat valley.

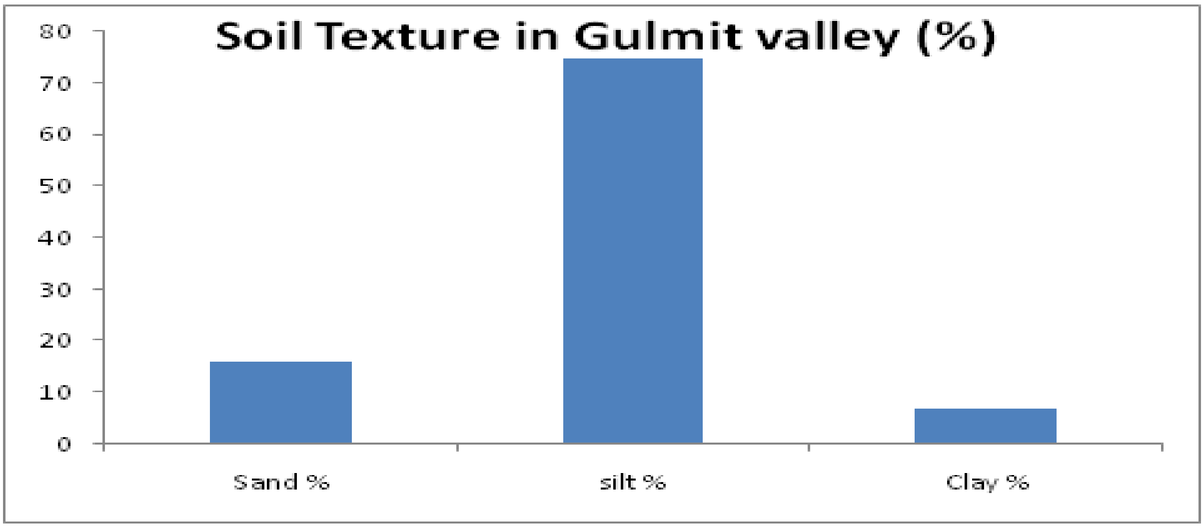

Fig. 10. Shows the percentage distribution of soil texture in Gulmit valley.

Conclusion

The study revealed some of the physiochemical properties and its fertility status of Upper Hunza soil. Soil properties were differed with respect to location, pH, NO_3-N, K, EC, Clay, Sand and Silt differed significantly with respect to location, while SOC and P were non-significant. The higher in SOC and NO_3-N in Shishkat valley indicated the higher input of animal fertilizers and green manure rather compared to Gulmit valley.

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