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# A comparative evaluation of soil pH of different land use classes from district Gilgit, Pakistan

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**Key words:** Agriculture, Land use classes, Alkalinity, Acidity, Productivity.

**Abstract**

Soil pH is an important factor for desirable crop productions. However, due to soil amendments it is changing and negatively impacting on agricultural produce and production. A total of 162 samples tested from three different land use classes (agriculture, barren and commercial) collected from four valleys of district Gilgit in Gilgit-Baltistan province of Pakistan. Different valleys and land use classes surveyed revealed a differential scope of pH level. However, in general entire soils are alkaline and pH ranges from 8.35 – 9.03 (average 8.65). Similarly, agriculture and barren lands in Gilgit town, Danyor and Sultanabad show relatively close affinity (average 8.52 and 8.62 respectively) as compared to Oshikhandas (average 9.02 and 9.03). Continuous unplanned use of chemical fertilizers and commercial wastes are continuously influence soil pH in the area which need a regular follow-up by the Government agriculture department. At the moments, farmers are totally ignorant about soil health status and such a technique or facility to monitor these parameters to optimize their agricultural productivity. Present study provides a baseline for future studies and caution for relevant departments to look into issues related to soil health. Study is unique and conducted for the first time from the area.

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## Introduction

A soil is a combination of organic matter, air, living organisms, water and minerals. It is considered as an outermost layer of earth. In pedosphere the soil and soil forming factors are active and it is formed by the interaction of biosphere (organic and inorganic), lithosphere (minerals), hydrosphere (water) and atmosphere (gases). Different part of earth contains different kinds of soil according to their composition, color, and particle size (Anonymous, 2015b). In 1940s, Hans Jenny proved that different types of soil are determined by five interrelated factors i.e. time, climate, parent material, living organisms and topography.

The soil physical properties include soil color, texture, porosity, density, temperature, resistivity and consistency. The resistivity of soil is range between 2-1000 Ωm and there is a direct relation between resistivity and salinity. The consistency of soil is measured in three states i.e. dry, moist and wet soil (Anonymous, 2013). Soil chemical properties include soil pH, soil reactions and cation exchange capacity. In soil mostly minerals and heavy metals are found in the form of cations like calcium ($Ca^{+2}$), magnesium ($Mg^{+2}$), potassium ($K^{+}$) etc. It is the most important property of soil for nutrients supply and absorption. The soil pH is affected by climate, parent material and vegetation. Some rocky soil are acidic whereas soil containing calcium carbonate is alkaline.

The soil pH is very essential characteristics and responsible for crop production (Anonymous, 2016a). It plays a significant role as it effects both chemical and biological reactions including availability of most essential nutrients, action of microbe, ability of soil to hold positively charged nutrients (cation), solubility of non-important elements and performance of some herbicides (Schulte *et al.*, 2005). Soil with approximately 6.0-7.0 pH usually has a very high concentration of available nutrients (Williston and La Fayette, 1978). If soil pH reaches less than 4.5 and greater than 8.5, in extreme level, it can makes some nutrients toxic and other unavailable to plant. The soil pH at low level <4.5, manganese, aluminum, are largely available for plant uptake and pH level becomes>7.5 the potassium and calcium are plentiful as a result some plants take too much nutrients while other lacking in it.

Soil pH is responsible for the activity of microorganism to breaking down organic matter and chemical transformation in the soil. Some plants have their preferred pH range, for example, Bean 6.0-7.5, Carrot 5.5-7.5, cucumber 5.5- 7.5, Onion 6.0-7.0 and pea 6.0-7.5 respectively. Acidic conditions have been reported to limit microbial activity and slow mineralization of nitrogen as well as nitrification (Mullen, 2004). The objective was to find a relationship between soil pH and agricultural productivity across different valleys in district Gilgit, Pakistan.

## Material and method

*Study area*

Study area is part of administrative district of Gilgit (Fig. 1), which is one out of nine districts in the defective province of Gilgit Baltistan, is situated in Northern part of Pakistan. It extends over 35°N to 36.5°N Latitude and from 74°E to 77°E Longitude (Hussain *et al.,* 2012). Altitude of Gilgit vary between 3000 feet (900 m) and 12875 feet (4000 m) above sea level (Zain, 2010). Some popular crops and fruits cultivated in district Gilgit are wheat, Maize, Barley, vegetables, apricot, almond, apple and cherry.

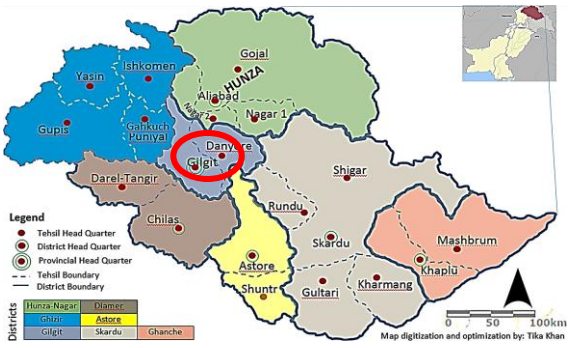


**Fig. 1.** Showing map of study area (red encircled) within the districts of Gilgit-Baltistan of Pakistan.

*Collection of soil samples*

Following a randomized method, a total of 162 soil samples from different land use classes (agricultural, barren and commercial) of four valleys were collected. The soil samples were taken up to 8-10 inches (or 20.32-25.4 centimeters) deep. Testing was made at The Water Quality Laboratory, Department of Biological Sciences, Karakoram International University (KIU), Gilgit, Pakistan.

Soil samples were collected from 13 (n=117) major sites of Gilgit city (Noor colony, Central Zulfiqarabad, Zulfiqarabad Prince Colony, Upper Jutial, Yaseen Colony, Karim Town, Sonikot Paeen, Sonikot Alsabah chok, Khomar, City Area, Majeni Muhalla, Pologround Majeni Muhalla and KIU campus), 3 (n=27) major sites of Danyor (Danyor Main chok, Danyor Baig Market, Muhammadabad), 1 (n=9) sample each type from Oshikhandas and 1 (n=9) sample each type from Sultanabad.

*Parameters*

Soil pH was taken into consideration as a sole parameter.

*Methodology*

Following the sample collection, soil samples were air dried and sieved to remove pebbles where double distilled water was used (1:1. 25 grams) to make saturated solutions. The soil solutions was stirred for 2-3 minutes and left for 15 minutes to settle the soil particles. The electrode of calibrated electronic pH meter was dipped into the solutions and the readings were noted. For each next sample, the electrode of pH meter was rinsed before dipped in next solution of soil samples. Room temperature during the experiment was 18-200 C (or 291.15-293.15 Kelvin).

**Results and discussion**

*Analysis of soil pH of villages of Gilgit city*

A cumulative average of pH of all three land use types in Gilgit city was recorded 8.66. It is found that the pH of agricultural soil of Noor colony, Centre Zulfiqarabad, Prince colony Zulfiqarabad, Upper Jutial, Yasin colony, Karim town, Sonikot Pieen, Alsabah Chok Sonikot, Khomar, City area, Majeni Muhalla, Old Polo Ground Majeni Muhalla and KIU campus is 8.9, 8.28, 8.41, 8.4, 8.98, 8.18, 9.85, 9.0, 8.86, 8.74, 8.55, 8.35 and 8.97 (Fig. 2) respectively with as average of 8.73 whereas the pH of barren soil of Noor colony, Centre Zulfiqarabad, Prince colony Zulfiqarabad, Upper Jutial, Yasin colony, Karim town, Sonikot Pieen, Alsabah Chok Sonikot, Khomar, City Area, Majeni Muhalla, Old Polo Ground Majeni Muhalla and KIU campus is 9.1, 7.65, 8.42, 8.62, 8.81, 7.78, 8.76, 8.98, 9.09, 8.78, 8.37, 8.2 and 8.75 (Fig. 2) respectively with as average of 8.56.

In same way the pH of barren soil of Noor colony, Centre Zulfiqarabad, Prince colony Zulfiqarabad, Upper Jutial, Yasin colony, Karim town, Sonikot Pieen, Alsabah Chok Sonikot, Khomar, City Area, Majeni Muhalla, Old Polo Ground Majeni Muhalla and KIU campus is 8.19, 9.59, 8.5, 7.94, 8.37, 8.58, 8.86, 9.72, 8.57, 8.26, 8.39, 8.45 and 9.42 (Fig. 2) respectively with as average of 8.68.

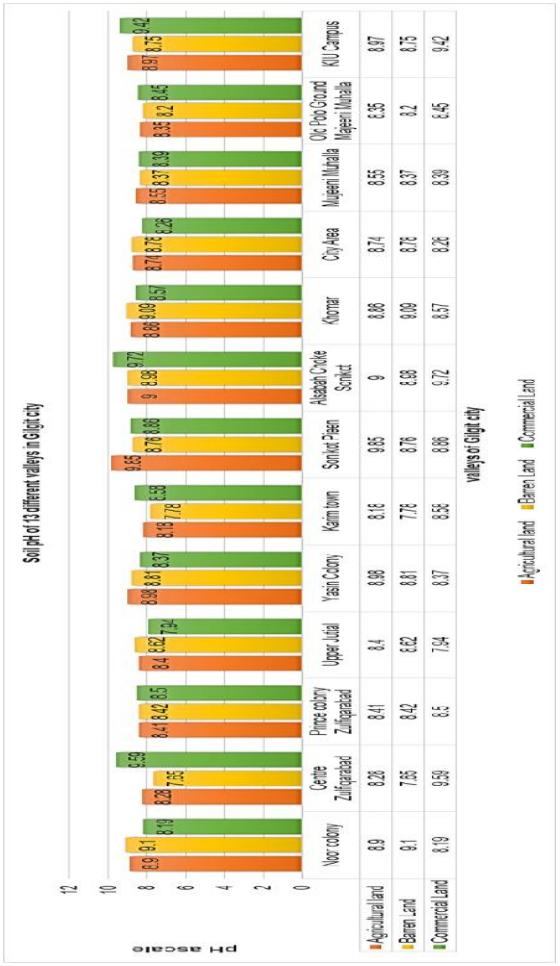


**Fig. 2.** The bar chart showing soil pH of 13 different sampling sites of Gilgit city.

*Analysis of soil pH of different sample sites of Danyor*

It is found that the pH of agricultural soil of Muhammadabad, Baig market, Danyor Chok is 8.05, 8.5 and 8.51 (Fig. 3) respectively with as average of 8.35 whereas the pH of barren soil of Muhammadabad, Baig market, Danyor Chok is 9.14, 8.79 and 8.42 (Fig. 3) respectively with as average of 8.78. Moreover, the pH of barren soil of Muhammadabad, Baig market, Danyor Chok is 8.78, 8.73 and 8.73 respectively (Fig. 3) with as average of 8.75.

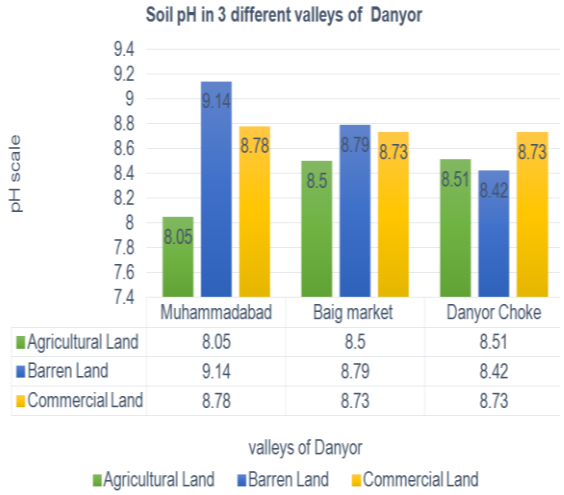


**Fig. 3.** Chart showing soil pH of three major sampling sites of Danyor.

*Soil pH of Sultanabad*

The soil pH from agricultural, barren and commercial land from a valley in Sultanabad is 8.47, 8.51 and 8.60 respectively (Fig. 4).

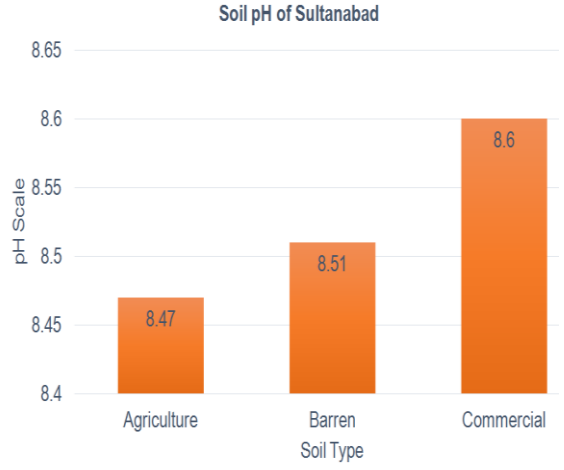


**Fig. 4.** The bar chart/graphical representation of soil pH of Sultanabad.

*Soil pH of Oshikhandas*

The soil pH from agricultural, barren and commercial land from a valley in Oshikhandas is 9.02, 9.03 and 8.35 respectively (Fig. 5).

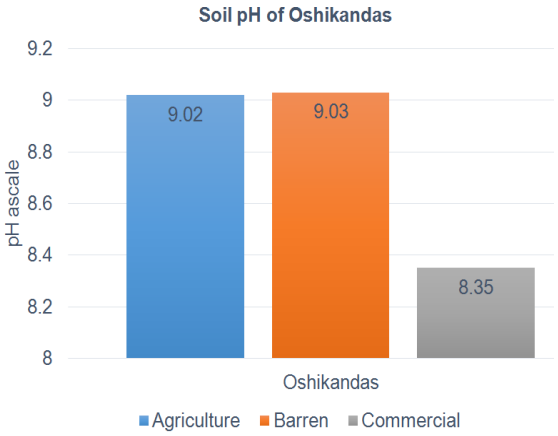


**Fig. 5.** The bar chart/graphical representation of soil pH of Oshikhandas.

*Comparison of average pH of soil types in Gilgit city, Danyor, Oshikhandas and Sultanabad*

In comparative analysis, it is found that the average pH of agriculture, barren and commercial soil types is 8.73, 8.56 and 8.68 in valleys of Gilgit town whereas in valleys of Danyor, the averages of agriculture, barren and commercial soil types are 8.35, 8.78 and 8.75 respectively. The soil pH from agricultural, barren and commercial land from in Sultanabad valley is 8.47, 8.51 and 8.60 whereas soil pH from agricultural, barren and commercial land from in Oshikhandas valley is 9.02, 9.03 and 8.35 (Fig. 6).

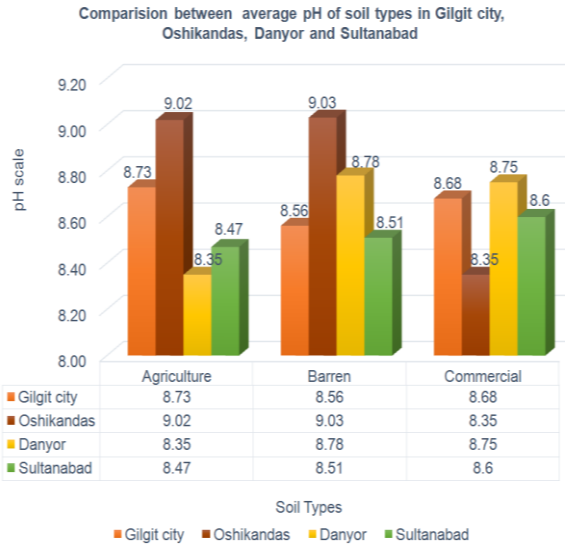


**Fig. 6.** The bar chart/graphical representation of comparison between pH of soil types in Gilgit city, Oshikhandas, Danyor and Sultanabad.

Study concludes that the soil in Gilgit city, Oshikhandas, Danyor and Sultanabad is slightly or moderately alkaline in nature which favors the growth of vegetation falling in this range of pH. Crops are grown healthy but unplanned use of chemical fertilizers and pesticides along with auto wastes are continuously influencing the pH which at certain point in time can transform soils unfit for agricultural produce and production. Government department of agriculture should take care of agriculture and farmer capacity building while establishment of soil testing facility in the area is also a necessary management tool. Ignorance at a longer time period could be harmful for agricultural production in the area.

**Acknowledgement**

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