INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 16, No. 6, p. 90-97, 2020

RESEARCH PAPER OPEN ACCESS

Comparative study of soil physical properties of higher and lower elevation of Loralai Balochistan Pakistan

Wajia Noor[1*], Bibi Sadia[1], Saba kazmi[1], Asyia[1], Yasmeen Rehmat[1], Junaid Ahmad[2], Yasmeen[1]

[1]*Department of Botany, Sardar Bahadur Khan Women University, Quetta, Pakistan*

[2]*Department of Agronomy, The University of Agriculture, Peshawar, Pakistan*

Key words: Soil properties, pH, Soil EC, Soil porosity, Soil texture.

http://dx.doi.org/10.12692/ijb/16.6.90-97 Article published on June 16, 2020

Abstract

Soil is a dynamic and complicated system of living, dead and decaying organisms with residual mineral materials, organic substances, air and water. Studying soil properties can help the concerned people to make best soil management decisions. The present research was carried out to investigate Loralai top soil by comparative study of area's soil on higher and lower elevation from both the cultivated plans and non-cultivated plans. Soil was collected from four different elevations mountain sites, barren plan, cultivated fresh water site and cultivated drainage water site from the depths of 0-5, 5-10 and 10-15cm. The physical properties were analysed in laboratory in three replicated samples of each elevation and each depth. 36 soil samples were analysed by using physical parameters. These soil physical parameters were soil color, soil taxture, soil structure, soil profile, soil pH, soil conductivity, soil soluble salt content, soil bulk density, soil porosity and soil water holding capacity. It was observed that soil bulk density and water holding capacity values were maximum in the all depths of mountain site clay soil while minimum in sandy barren plan. Soil porosity was maximum in sandy plan and minimum in mountain site soil. Best porosity, PH, porosity and water holding capacity was observed for drainage exposed soil. Results concluded that there is no significant effect of elevation on soil physical characters. Physical properties are directly related with soil texture. Soil with clay-sand loamy taxture was analyzed and best soil for all physical parameters.

* **Corresponding Author:** Wajia Noor ✉ Hamzazaiwajia@gmail.com

Introduction

Soil quality concept is the assessment of soil properties and processes which relate to soil ability of functioning best as a part of healthy environment (Schoenholtz *et al.*, 2000). Soil properties mainly fall into three categories the biological, physical and chemical characteristics. All these characters strongly influence the land utilization decisions and management practices. These soil properties also determine that how much a land can be productive (Foster *et al.*, 2001). Factors involved in soil formation are Living matter (plants, animals and microorganisms), Climate (cold, heat, rainfall, snow, wind etc.), Parental material, Time, Relief (Sarangzai *et al.*, 2015). Soil is a dynamic and complicated system of living, dead and decaying organisms with residual mineral materials, organic substances, air and water. The physical, chemical and biological reactions occurring in soil are difficult to understand. However studying soil properties can help the concerned people to make best soil management decisions (Ruiz *et al.*, 2015).

In order to survive, every living organism require nutrition. Plants take their nutrition from soil in the form of nutrients (the macro & micronutrients). There are 16 essential elements required by the plants for regulation of metabolic processes. (Sarangzai *et al.*, 2015). Nutrients in soil are categorized into three types(1) Main or major nutrients including phosphorous nitrogen etc. (2)minor nutrients including calcium sulfur etc. (3)micronutrients including zinc, cobalt etc. (Garcia *et al.*, 2012) Naturally soils are enriched with many types of minerals like inorganic substances. There are different contributions of soil minerals for plant growth, some contribute very little while other being most essential for plant survival (Foster *et al.*, 2001). Soil ability to support number of activities are dependent on soil physical as well as chemical means of its composition. Many important functions are performed by soil like decomposition of dead organic matter of plants and animals, water filtration for purification, fulfilling the demands of plant nutrition, running biogeochemical cycles and supporting plant growth directly and indirectly the animal growth etc. (Cheng *et al.*, 2001).

Soil biochemical characteristics serves as indicators of soil quality as are more valuable for soil management practices if comparing with soil physical and chemical properties. Soil prevention against excessive contamination is needed. Effective methods should also be needed to clean up contaminated areas (Dawoodi *et al.*, 2015). Characteristics of soil quality such as its stability, tendency to resist the disturbance and biodiversity are greatly affected by the way of land usage and management practices applied. Soil quality can also be improve by moderate compaction of loose soils (Combi *et al.*, 2008). Soil testing on regular bases can be the best tool in soil nutrient management. We can use soil testing methods for soil management. In order to obtain accurate results, sample the soil correctly.

Loralai is one of 32 districts of Balochistan province. City Loralai is the main principle city of Loralai district. Its location is in the north east of Balochistan Pakistan. For a long time city Loralai was familiar by the name “Bori”. Loralai is 4700 feets above the sea level. The present research is to analyze Loralai main city and nearby villages soil cultivated and non-cultivated on higher and lower elevations.

Material and methods

Soil was collected from different areas of Loralai. Loralai is district with area 1653km sq. Climate of Loralai is highly semiarid with the significant variation between summer & winter temperature. Different types of soil taken from different areas of Loralai like fresh water soil, drainage water soil, barren area soil, mountain soil etc. Soil samples were collected from kili chamaza, kili punga, kili mekhtar, kili shabozai. Soil was taken from different depth from 5cm, 10cm & 15cm measured by the help of scale. First we dug the ground to three different depth 5cm, 10cm &15cm. Soil collected from these levels all have different color ranging from light brown to dark brown. We kept the soil in polythene beg for observation.

Fig. 1. Map of Baluchistan province of Pakistan and their surrounding areas.

Determination of soil color

Soils of different area show huge color variations. This variation may be due to soil parental material or due to forming processes. Soil color is one of the fundamental soil physical properties which provides basic information about soil nutrients. In this short term research project, soil color was determined by using mensal color chart.

Determination of soil texture

Texture of soil was analyzed by using these three simple methods i.e. Feel method, Sieve method, Wet method or ribbon method. In Feel method, by touching soil samples of different area, texture of soil was determined by using feel method. Soil particles types/soil separates like sand, silt, clay and gravels were analyzed. While in Sieve method, soil texture was analyzed by using sieves of different sizes. Firstly we dried out the soil samples, Soil was passed from the sieve of maximum pore size. Soil sample which was passed from first sieve was further passed from the sieve of comparatively small pores. In the same way, particles were passed from all available sieves. Finally the soil particle size and soil type was determined. Whereas in wet method: Soil texture was further analyzed by using wet method. Soil samples were taken separately in china dishes. In each sample, very little amount of water was added to make thick pastes. Wet soil was pressed between palms of two hands. Ribbons were made from each sample and finally checked weather the ribbons were formed of not in order to check soil texture.

Soil structure

Soil structure is the description of individual soil particles sand, silt, and clay are arranged into soil aggregates also called pads. Soil structure is easiest to observe in dry soil. The primary soil structure shapes are granular, platy, blocky, prismatic, and columnar. Granular soil structure contains pads that are generally small and round and are commonly found in horizons near the surface where high amounts of root activity are present and porosity is greater.

Soil conductivity

Soil conductivity was measured by using conductivity meter. Soil solutions in water was made. Solutions were filtered by using filter papers. Conductivities were checked in filtrates of soil samples.

Soil soluble salt content

Soluble salt content was calculated by formula: Soluble salt content = conductivity × 0.36.

Soil profile

Soil profile was analyzed by this procedure: 500g of each soil sample was measured by the help of digital balance. We took 12 beakers of 1000ml. In each beaker, put soil samples 500g separately. Beakers were filled with water up to 1000ml. Stirred the mixture thoroughly with the help of stirrer. Placed the solutions on stationary position for 24 hours. Different profiles were settled in water. Finally the layers of soil profile were noticed.

Soil bulk density

Procedure used for to determine soil bulk density: Empty petri dishes weight was taken with digital balance. Weight of petri dishes with soil was determined. Soil samples in petri dishes were kept in oven for 24 hours at 105°C to attain constant soil weight. Soil weight with petri dishes was determined after drying completely. Dry soil weight alone was calculated. Soil was transferred to measuring cylinder to determine soil volume in cm^3. Same procedure was applied to all samples. Soil bulk density was determined by following formula:

Bulk Density (g/cm^3) = Weight of soil (grams) / Volume of soil (cm^3)

Percentage porosity of soil

Procedure used to determine soil %age porosity was similar to the procedure used to determine soil bulk density, only the difference was in formula used. % pore space or porosity was found by putting the values of soil bulk density in the formula of porosity.

Formula:

%age porosity = (2.6 – Bulk density / 2.6) × 100

Water holding capacity of soil

Procedure was used to determine water holding capacity of soil samples; All the soil samples were dried in oven for 1 hours. A plastic glass with perforated bottom was taken and weighed with the help of digital balance. Filter papers were taken and weighed. Filter papers were placed in the bottom of the disposable glass. Soil was taken on the filter paper in glass. Then the glass was placed in petri dish containing water in it for overnight. Weight of glass was noticed. **S**oil was then placed in oven for 24 hours at 105°C to attain constant weight. Weight after drying was noticed. Filter paper similar to that used in experiment was dipped in water to determine water content absorbed by that filter paper. Following formulas were applied to determine water holding capacity. Formula:

Amount of water absorbed by soil = total water absorbed – water absorbed by filter paper

Water Holding Capacity = (water absorbed by the soil / oven dried soil) × 100.

Results and discussion

Soil physical characteristics were analyze in cultivated and no cultivated sites. Mountain site, barren area and cultivated plans these areas can also be called as higher and lower elevations. 36 soil samples of different elevations and different depths were analysed in laboratory by using physical parameters. These soil physical parameters were soil color, soil taxture, soil structure, soil profile, soil pH, soil conductivity, soil soluble salt content, soil bulk density, soil porosity and soil water holding capacity. Soil color was observed as it is indicating soil fertility. The darkest color soil was drainage site soil and it was the most fertile soil of loralai. Soil profile was mainly clay on mountain site, mainly sandy and gravels on barren plan while silt-sandy loam in cultivated plans. Greater humus layer was observed to be formed in drainage site cultivated plan.

It was observed that soil bulk density and water holding capacity values were maximum in the all depths of mountain site clay soil while minimum in sandy barren plan. Similar results for soil water holding capacities and bulk density for such textured soils were given by many researchers. Sevegi *et al.*, (2009). Soil porosity was maximum in sandy plan and minimum in mountain site soil as it was observed

most compact among all types of soil collected. Moderate values of physical tests were observed in cultivated plans these were also representing soil fertility. Best porosity, PH, porosity and water holding capacity was observed for drainage exposed soil. Similar results were given by Combi *et al.* (2015). There is no significant effect of elevation on soil physical characters. Physical properties are directly related with soil taxture. Soil with clay-sand loamy taxture was analyzed and best soil.

Table 1. Soil color, soil texture, soil particle size and soil water holding capacity of different sites of district loralai Balochistan.

Soil color				
Soil depths(cm)	Mountain site	Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	Pale yellow	Very pale brown	light brown	Brown
5-10cm	Pale yellow	Pale brown	Brown	Light brown
10-15cm	Pale yellow	Light yellowish brown	Light grey	Brown
Soil texture				
Soil depths(cm)	Mountain site	Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	Gravels	Sandy loam	silt loam	silt loam
5-10cm	Clay (in stony bulk)	Sandy loam	silt loam	silt loam
10-15cm	Clay (in stony bulk)	Sand	Clay sandy loam	silt loam

Soil particle size					
Soil depths(cm)	Mountain site		Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	Very minute 0.002mm<2mm	Large	0.02-2.00mm	Medium 0.002-2.00mm	Medium 0.002-2.00mm
5-10cm	Very minute 0.002mm	Large	0.02-2.00mm	Medium 0.002-2.00mm	Medium 0.002-2.00mm
10-15cm	Very minute 0.002mm	Large	0.02-2.00mm	Medium 0.002-2.00mm	Medium 0.002-2.00mm
10-15cm	Very minute 0.002mm	Large	0.02-2.00mm	Medium 0.002-2.00mm	Medium 0.002-2.00mm

Soil water holding capacity				
Soil depths(cm)	Mountain site	Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	8.34(0.44)	1.43(0.45)	6.47(0.33)	5.23(0.33)
5-10cm	7.95(0.33)	2.71(0.43)	5.67(0.34)	5.11(0.34)
10-15cm	7.77(0.45)	2.31(0.44)	6.32(0.44)	6.14(0.33)
Mean	8.02	2.15	6.153333	5.493333
median	7.95	2.31	6.32	5.23
Sd	0.291376	0.654828	0.425245	0.563235
Verience	0.0849	0.4288	0.180833	0.317233

Soil texture

Data collected from different areas of Lorelai in form of soil samples were exhibiting verities of textures such as clay, sand, silt/loam, gravels (Table 1). In specific areas, this soil texture was mainly responsible for enhancing or inhibiting plant growth in that area. Similar results were also observed by Tones and others in 2000 for some other areas. Soil collected from different depths of barren area had more sand content in the soil. Soil compactness was least as the soil particles are loosely arranged in sandy soil. Soil of upper site 0 to 5cm depth was sand silt loam but in deep sites (5 to 10cm and 10 to 15cm) soil had about 80 to 90% sandy. Content of gravels was also noticed in this type of soil. Rough or no ribbons were formed in soil of barren area. Drainage site soil was cultivated plane. Soil texture demonstrated by feel method, sieve method and wet/ribbon methods was clay silt

loam. Soil was mixture of different sized particles. This capability of soil made it neither fully compact nor very loosely arranged so this soil type was favorable for plant growth and root movements in response to stimuli. Ribbons were roughly formed in this soil type. Fresh water soil site was also cultivated plan of land. Soil texture was similar to the texture of soil of drainage site. Soil of mountain site was clay textured as whole. Soil was compact enough to form large stony structures. This soil was uncultivated plain of lands as having very great water holding and compact structure and texture. Ribbons from this type of soil was made very finely.

Table 2. Soil bulk density, soil % pore space and soil conductivity.

Soil bulk density g/cm³				
Soil depths(cm)	Mountain site	Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	1.56(0.40)	1.86(0.46)	1.61(0.86)	1.68(0.63)
5-10cm	1.55(0.56)	1.61(0.65)	1.35(0.34)	1.75(0.56)
10-15cm	1.58(0.35)	1.71(0.40)	1.61(0.46)	1.95(0.42)
Mean	1.563333	1.726667	1.523333	1.793333
Median	1.56	1.71	1.61	1.75
Sd	0.015275	0.125831	0.150111	0.140119
varience	0.000233	0.015833	0.022533	0.019633
Soil % pore space				
Soil depths(cm)	Barren area	Mountain site	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	40(0.34)	28.46(0.33)	38.07(0.43)	35.38(0.33)
5-10cm	40.38(0.54)	28.07(0.44)	39.05(0.55)	36.69(0.32)
10-15cm	39.23(0.39)	27(0.33)	38.07(0.44)	35(0.33)
Statistics				
mean	39.87	27.84333	38.39667	35.69
mediun	40	28.07	38.07	35.38
Sd	0.585918	0.755932	0.565803	0.886623
variance	0.3433	0.571433	0.320133	0.7861
Soil conductivity at temperature °C				
Soil depths(cm)	Mountain site	Barren area	Cultivated site (fresh water)	Cultivated site (drainage water)
0-5cm	1148(0.33)	1359(0.37)	1016(0.34)	1105(0.34)
5-10cm	1285(0.36)	1348(0.34)	1127(0.35)	1238(0.36)
10-15cm	1347(0.56)	1412(0.44)	1148(0.33)	1326(0.38)
mean	1260	1373	1097	1223
median	1285	1359	1127	1238

Soil profile

Profile study also concluded the same result as more clay content in mountain soil, more sand content in barren plan while moderate amount of clay and sand in cultivated soils.

Soil structure

Soil structures refers to soil shapes granular, blocky, platy, prismatic and columnar etc. Soil structure was observed similar in the depths of soil ranging from 0 to 15cm of same site (Table 1). Soil structure of mountain site was roughly blocky and prismatic, soil of barren site was sandy granule while soil structure of drainage site and fresh water site was roughly blocky to granular.

Soil pH

pH values for different types of soil were observed different (Table 1). Soil of mountain site was more basic in comparison with soil of barren area and cultivated areas. Soil of barren sandy area was also basic but comparatively less while the soils of

cultivated plans were mainly slightly acidic as acidic soil favors root growth and nutrient absorption. However soil PH and hydraulic conductivity is not related to soil elevation.

Soil conductivity

Table 2 represents soil conductivity that was measured by using conductivity meter. Conductivity values at mountain site soil was observed greater. Values were observed increasing with increase in depth of mountain soil. For barren area values for conductivity were ranging from 959 to 1459uS. Conductivity values for cultivated soil were observed greater than conductivity values of barren area soil but lesser than conductivity of mountain site soil. Soil conductivity of domestic water site was observed greater as compare to fresh water soil site.

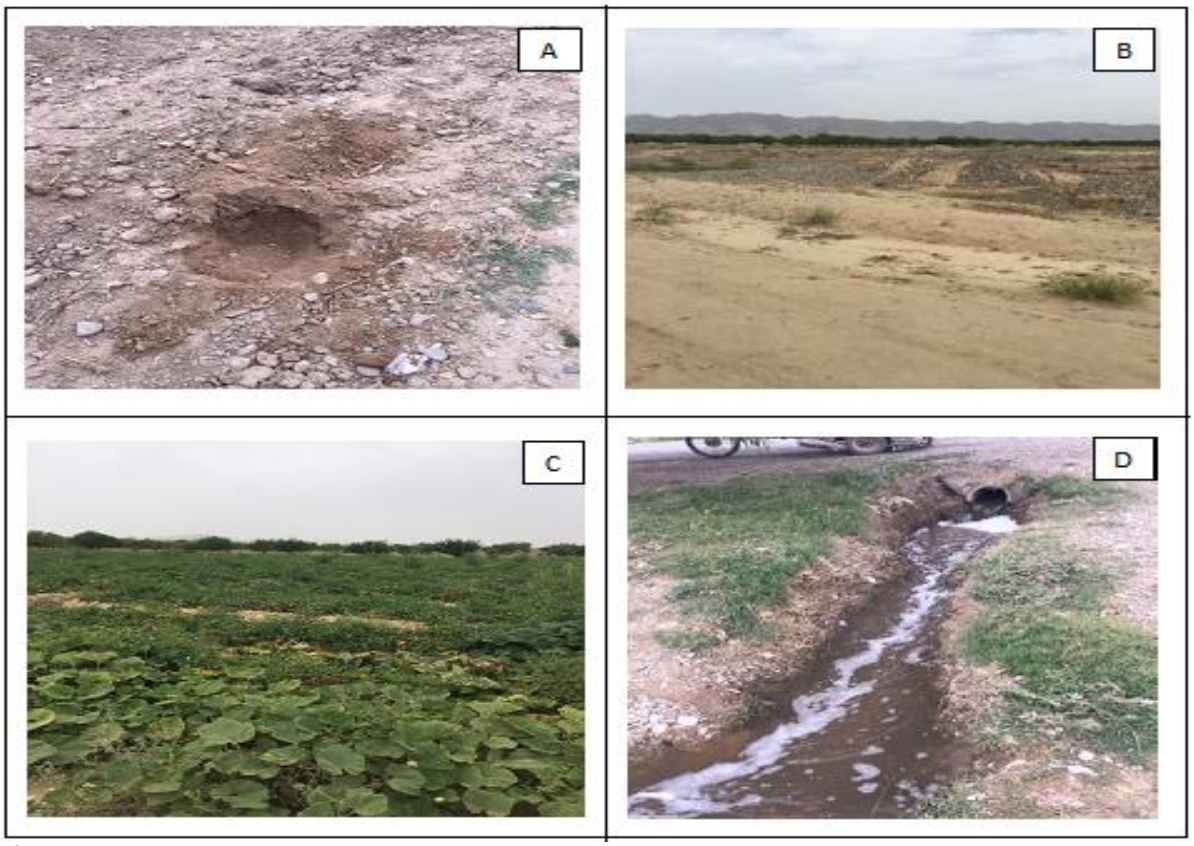

Fig. 2. Soil collection sites. A= Mountain site, B=Barren site, C=Fresh water site, D=drainage water cultivated site.

Soil bulk density

For bulk density it was observed that for cultivated plans (drainage water site and the fresh water site), soil had fine textured particles. Soil had loamy composition. (Table. 2) shows Bulk density values for barren sandy soil was observed maximum while for mountain site it was calculated least because of having more compact structure of soil.

Soil porosity % age pore space

Soil of mountain site had compact appearance due to more clay content. %age pore space was observed low in all depths of mountain site soil. Mountain site soil was most compact because of greater clay content (Table. 2). The small soil particles were arranged compactly and decreasing the %age pore space among particles. Maximum %age pore space was observed in barren areas soil in the depths of 10-15cm as this soil was more sandy in texture.

Soil of cultivated plans compact but not enough to resist root growth as the mountain soil. Pore space was intermediate between sandy barren site soil and clay mountain site soil.)

Soil water holding capacity

Soil of mountain site was observed experimentally of having maximum water holding capacity in all its depths ranging from 0 to 15cm (Table.1). as mountain site soil has more clay content and it is the property of clay to uptake large amount of water in it. Cultivated plans of Loralai were observed good for water holding capacities, the values which are best for plant growth. The water holding capacity of sandy barren area site soil was observed least in all depths observed.

Conclusion

In the present research soil was collected from higher and lower elevations of Loralai. Soil was collected from cultivated and no cultivated plans in order to analyze physically. In the experimental efforts, it was observed that soil physical properties are highly inter related. Soil texture structure and particle size have very much effect on soil other physical properties such as soil bulk density, water holding capacity and porosity etc. Studies concluded that the soils of the two main cultivated plans have higher concentration of silt and clay loam and were suited best for plant growth and cultivation because of the reason that such type of soils held good amount of water, having high moisture contents and suitable porosity and bulk density values for plant growth. Hence the proposed result concluded that higher elevation or lower elevation doesn't affect soil physical properties. It is actually the soil texture which determines many of the soil physical properties.

References

Cambi M, Certini G, Fabiano F, Foderi C, Laschi A, Picchio R. 2015. Impact of wheeled and tracked tractors on soil physical properties in a mixed conifer stand. Forest-Biogeosciences and Forestry, 863.

Cheng JT, Chang WC. 2001. Effects of auxins and cytokinins on direct somatic embryogenesison leaf explants of Oncidium'Gower Ramsey'. Plant Growth Regulation **34(2)**, 229-232.

Dawoodi V, Madani M, Tahmourespour A, Golshani Z. 2015. The Study of Heterotrophic and Crude Oil-utilizing Soil Fungi in Crude Oil Contaminated Regions. Journal of Bioremediation and Biodegredation **6(2)**, 1.

Foster I, Kesselman C. Tuecke S. 2001. The anatomy of the grid: Enabling scalable virtual organizations. International journal of high performance computing applications **15(3),** 200-222.

García RA, Fuentes RA, Pauchard A. 2012. Effects of two nitrogen-fixing invasive plants species on soil chemical properties in south-central Chile. Gayana Bot **69(1).**

Ruiz EC, Ruiz AC, Vaca R, Aguila P, Lugo J. 2015. Assessment of Soil Parameters Related With Soil Quality in Agricultural Systems. Life Science Journal **12(1).**

Sarangzai AM, Siddiqui MF, Ahmed M, Hussain MI, Laghari SK, Ahmed A. 2015. Relationship between soil properties and natural regeneration pattern of Juniperus excelsa forest in Ziarat, Balochistan. Pakistan Journal of Botany, **47(3),** 905-910.

Schoenholtz SH, Van MH, Burger JA. 2000. A review of chemical and physical properties as indicators of forest soil quality: challenges and opportunities. Forest ecology and management, **138(1),** 335-356.

Sevgi O, Tecimen HB. 2009. Physical, chemical and pedogenetical properties of soil in relation with altitude at Kazdagi upland black pine forest. Journal of environmental Biology **30(3),** 349-354.