

Comparison between pH, EC, CaCO₃ and Mechanical Analysis of Qala Wahid and Company Areas Soil, Kabul, Afghanistan

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Abstract: This research carried out study on two different locations of soil profiles at Company and Qala Wahid located to the upper part of Kabul sedimentary basin, to find out the pH, EC, Calcium carbonate and soil fractions. Therefore, This research is important and essential to estimate the different size of soil fractions, pH, Electro - Conductivity (EC) and amount of CaCO₃ between different depth of soils, because there was no previous research in this area or basin. This article provides the results of transported at different size and type of sediments carried out by Paghman river discharge from Paghman mountain snow covered areas at upper part of Kabul basin in Afghanistan. The main objective of this study is to select some chemical and physical characteristics of river sediments transported by Paghman river discharges in upper parts of Kabul basin for the previous geological periods. When we find calcium carbonate by Calcimeter the amount of calcium carbonate at the A - Horizon of Company profile is 0.437%, in B-Horizon is 0.60% and at the C- Horizon of the profile is 0.32%, and When the mechanical analysis done at the A- Horizon of the sand is 50%, silt is 42% and clay is 8%, at the B- Horizon of this profile the sand was 48%, silt 42% and Clay 10%, and the C- Horizon of this horizon sand 49%, silt 40% and clay 11%. The pH of this profile at the A- Horizon is 7.90, EC 961 $\mu\text{S} / \text{Cm}$, B- Horizon pH is 7.87, EC 920 $\mu\text{S} / \text{Cm}$ and at the C- Horizon pH is 7.85, EC is 875 $\mu\text{S} / \text{Cm}$. At the profile of Qala Wahid the calcium carbonate is 0.35%, B- Horizon calcium carbonate is 0.406% and the C- Horizon calcium carbonate is 0.474%. When the mechanical analysis done on Qala Wahid at the A- Horizon sand is 50%, silt 38% and clay 12%, at the B- Horizon sand 48%, silt 42% and clay 10%, at the C- Horizon sand 50%, silt 42% and clay 8%. In this profile pH is 7.75, EC 849 $\mu\text{S} / \text{Cm}$, B- Horizon pH is 7.75, EC 861 $\mu\text{S} / \text{Cm}$ and at the C- Horizon pH is 7.75 and EC is 870 $\mu\text{S} / \text{Cm}$.

Keywords: Soils, Comparison, Pedogenic Horizon, Hydrometer, pH, EC, CaCO₃, Qala Wahid and Company

1. Introduction

As all know Afghanistan is one of the countries here was many years war and there was lack of Laboratory instruments, research works and practically in the field works. , it was not possible to test the PH, EC and CaCO₃ of soil inside the country now we have equipped laboratories and the pave is ground for testing the above mentioned component. There was lack of Laboratory instruments, research works and practically in the field works. One of these works are consisting comparison of pH, EC (EC = shows electro conductivity related to the amount of dissolved of salt in the waters), CaCO₃, [2] mechanical analysis by hydrometer and explanation of Pedogenic Horizons between company and Qala Wahid villages soils located at the fifth zone west side of Kabul, Afghanistan. In this we done this research and both results we compare with one another's [2]. The Kabul river watershed covers more than 25500 km², the small tributaries of the Kabul basin is Paghman river which is cover drainage area 500 km², and less flow into the upper Kabul from the Paghman mountains range to the west to north. Major tributaries of Kabul basin is Loger River from the southernmost area of the basin, which watershed that cover approximately 10000 km². The gravels and sand were mainly deposited in river channels [7]. The Reworked loess series is thick as 80 m in the Kabul basin. The older deposits are the Lataband Series, the Kabul series, and the Butkhak Series. The Lataband series includes gravels and conglomerates ranging in the thickness from several meters to several hundred meters [8], describe the Lataband formation as Quaternary terraces sediments of the middle and younger Pleistocene age overlying conglomerates. In the central parts of the subbasins, the

Kabul Series is described as at least 200 m thick [7]. The series consists of morales, clays, siltstones, and fine grained sandstones [9]. Two boreholes drilled in the Loger sub basins penetrated 130 m of Kabul Series sediments. The Butkhak series consists of the oldest known sedimentary deposits in the Kabul basin, which are red silts, and conglomerates. The total thickness is through to be more than 200 m. The Loger river Aquifer extend along both sides of the Loger river over a length of 10 km and width of around 3 km. it has average thickness of 70 m. The lower part of this sediments consist of course grain deposits mainly conglomerates and coarse grain sandstones hardened with calcareous sediments. According to report from 1971, the overlying areas contain sand and gravel [3]. Particularly In the southern parts, the deposits in the lower zones of the sediments are inter bedded with clay layers with thickness of 10 to 15m and more. In the Kabul river aquifer a zone of course grain deposits with a length of 9 km and a width of 2.5 km has been confirmed running paralleled to the Kabul river. This zone comprises most of the Kabul sediments. Analogous to the Loger sediments, the Kabul consists of three horizons. The main part of the sediments consists of conglomerate and sandstones cover by a thin layer of sand and gravels. The cover rocks consists of loam with large pore spaces. The whole plain is covered by these loams the only exception being the area directly adjacent to flowing water [1]. The overlying loam bed is only very thin in the center of the valley. The overlying layers have a thickness of 1 - 5 m. The thickness are up to 15 m were measured at the adjust of the plain in the 1960s. The thickness of the sand and gravel layer in higher parts of the plain is only 2 to 9 m. In lower zones it's up to 20 m thick. Because the lower beds consist of older deposits which became consolidated and subsided over time as they became cover by younger

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deposits, they have become more consolidated and more compact with depth. The lowest conglomerate and sandstone layer has a thickness of 30 to 65 m. The whole aquifer has a total thickness of 40 to 80 m. The Paghman aquifer consists of gravel bed located along the Paghman river in the Paghman Darlaman basin is around 10 km long, 4 km wide and up to 70 m thick. This phreatic aquifer consists mainly of gravel and sand. Conglomerates and sandstones only occur in minor amounts at certain locations [2].

1.1 Description of the Study sites

These two different locations of Company and Qala Wahid regions at the south west side of Kabul related to the upper part of Kabul. The north side of these regions are located

Kabul and Kandahar road, west side Chaltan mountain, east side Kataisangi and south side Dashta barchi and Darlaman (figure 1). All the agriculture land, irrigation by Paghman river which is started from (3500 m a. s. l) Paghman river starts from (3500 m a.s.l.) Paghman mountain range, in the first stage this river running in very steep slope and with very high velocity from north south to Kampany Bridge and after this river change the direction to Northwest to Northeast and in Guzarga region and join Kabul river at Chahar Dahai[18]. The location of Company profile is 1877 m a. s. l, $34^{\circ} 31' 16''$ latitude and $69^{\circ} 03' 45''$ longitude. Qala Wahid profile is 1830 m a. s. l, $34^{\circ} 30' 50''$ latitude and $69^{\circ} 06' 80''$ longitude.

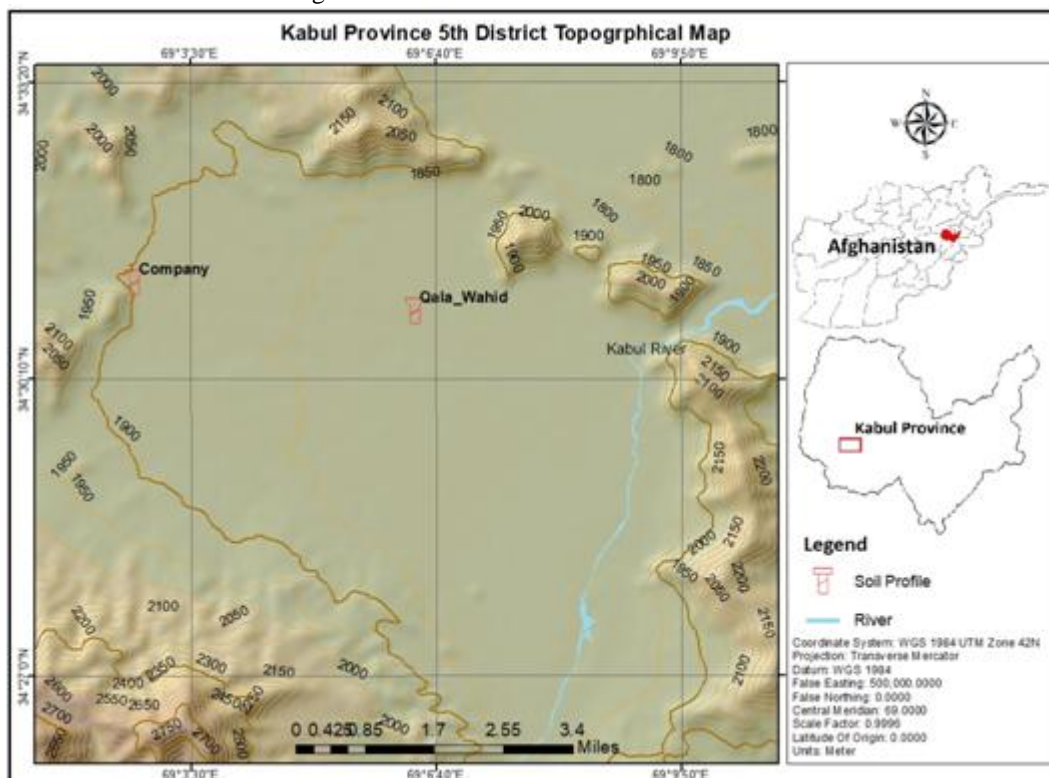


Figure 1: Location map of Company and Qala Wahid profiles, Kabul, Afghanistan

2. Method and Materials

This research including two parts:

a) Field works

- Determination of soil profile location by GPS at the relative locations,
- Excavation of soil profile to the relative depth,
- Explanation of soil Pedogenic horizons,
- Comparison of soil samples at the dry and wet conditions to select color by Munsell color chart for the relative horizons and
- Collection 1kg soil samples from each layers for laboratory analysis.

b) Laboratory works

- Determination the amount of CaCO_3 by Calcimeter at the existence of 14 % HCL from each samples[6],
- Determination pH and EC by Electro - conductivity meter and pH - meter at the existence of clear water and

- Determination soil fractions by Hydrometer at the relative samples in laboratory of department geology, geoscience faculty, Kabul University.

c) The time of field and laboratory works that we done

As all know the climate of Afghanistan is arid and semi-arid like other countries in Afghanistan there are four seasons in Afghanistan spring starts from (April to June), summer form (July to September), fall from (October to December) and winter from (January to March). According to the season we have different weathers for example spring in Afghanistan is rainy and Temperated climate but in the summer dry and warm, in fall Temperated and cold but in winter the weather is cold and snow will falls in Afghanistan we have snow cower to the spring season. This research is divided in two parts first field work and second is laboratory works, usually field works we done in warm and Temperated seasons and laboratory works generally we done at the rainy and cold seasons. This research we starts from 15/December/ 2018. Generally this research we divided at the three parts like

field works, Laboratory works and writing of article. In this research we done field works from 15 / December / 2018 to 30 / December / 2018 and we got selected location of soil profile, Excavation of profiles to the relative depth, explain of soil Pedogenic horizons and collected sampling. We start the laboratory form 20/ February/ 2018 to 1/ May/ 2018 and after that we started writing section up to now.

3. Result and Discussion

All sediments that located in Kabul sedimentary basin related to the Tertiary (Neogene) and Quaternary (Pleistocene) periods (20- 45) million years age its deposited between mountains basins at the different parts of Kabul sedimentary in the previous geological periods and its name is tertiary and Quaternary formations [17]. Generally mentioned areas consisting consolidated and unconsolidated gravels, but generally the lower part of Kabul basin is belonging to young tertiary and its marls, Sandston at the color of gray, whit, green and brown colors we can see [17] and at the upper parts of these sediments we can see different height type of rivers terraces located.

3.1 Geology of the Kabul basin

Kabul basin is belong to Quaternary (Pleistocene), [17]. Sediments carried from Paghman, Aliabad, Asmayie, Qargha and Loger mountains. These mountains located at the surrounded area of upper and middle parts of Kabul basin and these sediments carried by water at the different periods of time and made different thickness, the upper and middle parts of Kabul basin terraces and there accumulated some heavy and light minerals and these minerals belong to mother rocks that located at the surrounding mountains areas of Kabul basin. For example Epidote, Kyanite and Garnite we can find in some terraces of Kabul river basin because these are belonging to all Metamorphic rocks (Crystalline) [5], it's located at the surrounding mountains of Kabul basin, also there is some others minerals like Rutile and Zircon because its belong to Igneous rocks of Paghman Mountains range [15]. In adaption there is some others minerals like Muscovite and Biotite, also belonging to all metamorphic rocks its located at the surrounding mountains of Kabul basin, as well as Biotite and Rutile minerals in middle and lower terraces of Paghman river belong to Igneous Rocks of Paghman mountain range and all sediments carried by water and all to gathers accumulated in terraces [15]. All rivers of Kabul basin joined to gathers at the different locations and all running about from west to East, and sediments of this basin belonging to Tertiary (Iocene and Oligocene), the age of sediments in between upper and middle parts of Kabul basin about (20 - 45) millions years, it's called Tertiary formations [10]. Upper part of these sediments covered by younger sediments of lower Quaternary (Pleistocene) sediments and its consists of these terraces, it have different complex, altitudes and locations, for example upper part of Kabul river basin is belonging to Quaternary and there we can see more consolidated and unconsolidated gravels sediments, but middle part of Kabul river basin belong to Tertiary and there is some unconsolidated sands, Marls (gray, white, green and brown) colors, and upper part of these sediments covered by rivers terraces [17]. All mountains surrounding of Kabul province, made by metamorphic

rocks, without Paghman mountains in adaption metamorphic rocks, it's made by some Igneous rocks also, other all mountain made from metamorphic rocks, from Radiometry method they find the life time of these mountains about (928 ± 8) million years ago [16]. The older one is located at the Khair Khana mountains and younger is in Shawaky and Qorugh mountains range [17].

3.2 Geology of Qalay Wahid and Company Regions

Generally the sedimentary materials of Company and Qala Wahid transported by Kabul and Paghman rivers from Paghman mountains range in Afghanistan and in these regions accumulated [4]. This kind of sediments located angular unconformity on the bedrocks and previous sediments its consisting boulders, cobbles, pebbles, granuls, sands, silts, mud, clay and clay. Mency in 1968 this kind rock of this kind sediments named under the Latabend series separated the thickness of these sediments is more than 500 m [17]. The sediments of these regions generally related to the recent sediments of river sediments and its belonging to the Quaternary period and these sediments from view point of genetic divided into alluvials, deluvials and pralluvials, its consisting of stone particles, boulders, sandstone, marls and etcetera and divided into lower, middle and upper Quaternary [17].

Company profile: first of all we prepare some instrument like cloths and some instruments for to dig the soil profile and from field works that we done in this research its consisting of select GPS point in relative location of profile, Excavation of profile to the relative depth, Explanation of profile and choice of relative horizons, compare of soil horizons with Munsell color chart and collection 1kg samples from each horizons.

Qala Wahid profile: First of all we prepare some instrument like cloths and some instruments for to dig the soil profile and from field works that we done in this research its consisting of select GPS point in relative location of profile, Excavation of profile to the relative depth, Explanation of profile and choice of relative horizons, compare of soil horizons with Munsell color chart and collection 1kg samples from each horizons.

3.3 Explanation of Profiles

Determination soil color

In this research we select the soil color by Munsell color chart, Munsell was one of the scientist of American at the first time in 1999 and its compare soils with different colors of soil according to the location and belonging to the different climatic condition (Paetzold, S. et al., 2005).

Company profile: The color of Company soil in A - Horizon is Dark brown (10 YR, 7/3), B - Horizon is light brown (10 YR, 6/4) and C - Horizon is Yellow brown (10 YR, 5/4), (Munsell, 1999).

Qala Wahid profile: The soil of Qala Wahid according to the Munsell color chart in A - Horizon is Red brown (5YR, 6/3), B - Horizon is Light brown (7.5 YR, 6/3) and C - Horizon is Brown (7.5 YR, 5/2), (Munsell, 1999).

Field works: some field works that we done in this research its consisting the following:

2- Profile construction and texture

Company profile: Generally the agriculture land of Company is barren without any cultivation, the parent materials of this area is belonging to the Neogene sediments. In the A – Horizon 0 – 15 Cm depth generally we can see different type of Crumbling structures, as well as some cave of earth worms, plants roots, different type of porous space and root zone is 15 Cm depth from earth surface, as well as at the B - Horizon this horizon is 15 – 29 Cm depth and C - Horizons is 29 Cm - 1m+ and we can see some columnar structures, some particles of stones, coals and indexes of with and red color its representation from Oxidation and Reductions.

Qala Wahid profile: Ap - Horizon depth is 0-15 Cm , in this horizon we can find crumbling structures, Plant roots, different types of porous and some dark vines of organic matters. B - Horizon is 16 - 29Cm in this part of horizon we can see some remnants of Organic matters, rock particles and it's about 1Cm as well as we can find some roots of plants. C- Horizon is 29 Cm - 1m+ , in this horizon we can see some plant roots, some red and Wight remnants its belonging to the Oxidation and Reduction. The materials of this area is belonging to the Neogene sediments. Some particles of stones and coals.

3.4 Laboratory works

In this research we have done some chemical characteristics and mechanical works at the laboratory of Geology depart, Geosciences faculty, Kabul university these are consisting the following:

2. Mechanical characteristics of Company profile:

Soil type and soil fractions determination in Company profile: The soil Mechanical Analysis is done by Hydrometer or Areyometer (Wright, L. D., 2000) and found different type is Loam and this A – Horizon is 0 - 16 Cm depth in this horizon different type of fraction like Sand 50 % , Silt 42 % Clay 8 % . B – Horizon is 16 - 27 Cm depth in this amount of soil fraction are Sand 48 % , Silt 42% and Clay 10 % , and C – Horizon is 27 Cm – 1 m + depth and soil fraction is Sand 49 % , Silt 40% and Clay 11 % .

Mechanical characteristics of Qala Wahid soils: When we done the mechanical analysis by Hydrometer we found in A- Horizon to the 0 -15 Cm depth the 50 % Sand, 38 % Silt and

Clay 12 % and soil type is Loam . The B - Horizon to the 15 – 29 Cm depth we found 48 % Sand, 42 % Silt 10 % Clay soil type is Loam and in C- Horizon 29Cm – 1m+ depth we Sand 50 % , 42 % Silt and 8 % Clay and soil type is Loam.

Determination of pH Company soils : when we measured by pH – meter the fine fraction of sieving in this case we found in A – Horizon (0- 16) Cm the pH of soils was 6. 50. In B – Horizon (16 - 27) Cm the pH was 7.87 and in C – Horizon 27 Cm – 1 m+(1m += more than one meter to infinite depth) the pH was 7.85.

Determination of pH Qala Wahid soils: When we analysis the soil sample by pH – meter we find in A- Horizon to the 0 -15 Cm pH was 7.75 , in B - Horizon at the 15 - 29 Cm depth the pH was 7.71 , and C - Horizon is 29 – 1m+ the pH was 7.76.

Determination of EC Company soils: When we measured by Electro - conductivity meter the fine fraction of sieving in this case we found in A – Horizon (0- 16) Cm the EC was 961 $\mu\text{S} / \text{Cm}$. In B – Horizon (16 - 27) Cm the EC was 875 $\mu\text{S} / \text{Cm}$. in C – Horizon (27 Cm – 1 m+), EC was 875 $\mu\text{S} / \text{Cm}$.

Determination of EC Qala Wahid soils

when we analysis the soil sample by Electro - conductivity meter we find in A- Horizon to the 0 -15 Cm the EC was 849 $\mu\text{S} / \text{Cm}$, in B - Horizon at the 15 - 29 Cm depth the EC was 861 $\mu\text{S} / \text{Cm}$, and C - Horizon is 29 – 1m+ the EC was 870 $\mu\text{S} / \text{Cm}$, (Elliontt, T., 2001).

1. Chemical analysis of Company soils

Qala Wahid of CaCO_3 Company soils: We measure the amount of CaCO_3 by Calcimeter, Ap – Horizon is 0 - 16 Cm the of CaCO_3 in this horizon is 0.437 % , B - Horizon is 16 – 27 Cm depth from earth surface the of CaCO_3 in this horizon is 0.60 % , C - Horizon is 27 Cm – 1m + depth from earth surface the amount of CaCO_3 in this horizon is 0.32 % .

Determination of CaCO_3 Qala Wahid soils: In this soil profile we found the amount of CaCO_3 in the laboratory of geology department, Kabul university by Calcimeter its mentioned at the every horizon of profile of Dewanbagi and its consisting in A- Horizon its 0 – 15 Cm depth from earth surface the amount of CaCO_3 was 0.35 % . The B- Horizon is 15 - 29 Cm and the amount of CaCO_3 is 0.406 % . C - Horizon is 29 – 1 m+ and the amount of CaCO_3 is 0.474 % .

Table 1: in this table is explain some chemical, physical and Geographical locations of Qala Wahid and Company soils

Soil mechanical analysis (%)	CaCO_3 (%)	EC $\mu\text{S}/\text{cm}$	pH	Geographical location			Pedogenic horizon	Location
				Elevation (m)	Longitudes	Latitudes		
Sand(50), silt(42), Clay(8)	0.437	961	6.50	1877	69.0345	34.3116	A - Horizon	Company
Sand(48), silt(42), Clay(10)	0.60	920	7.87	1877	69.0345	34.3116	B- Horizon	Company
Sand(49), silt(40), Clay(11)	0.32	875	7.85	1877	69.0345	34.3116	C – Horizon	Company
Sand(50), silt(38), Clay(12)	0.35	849	7.75	1830	69.0680	34.3050	A – Horizon	Qala Wahid
Sand(48), silt(42), Clay(10)	0.406	861	7.75	1830	69.0680	34.3050	B – Horizon	Qala Wahid
Sand(50), silt(42), Clay(8)	0.474	870	7.75	1830	69.0680	34.3050	C - Horizon	Qala Wahid

4. Conclusion

We analysis that the soil samples of Company in laboratory by Calcimeter in the result we found the amount of CaCO_3 in A - Horizon was 0.437 % , in B - Horizon was 0.60 % and in C - Horizon was 0.32 % , from here we can found the CaCO_3 is leached from A - Horizon to B - Horizon and accumulated in B - Horizon and small amount (0.32 %) spread toC - Horizon. In Company soils at the A- Horizon the amount of pH 6.50 and EC 961 $\mu\text{S}/\text{Cm}$ and its representation from basic condition, as well as in B - Horizon pH is 7.87 and EC is 920 $\mu\text{S}/\text{Cm}$, in C – Horizon pH is 7.85 and EC is 875 $\mu\text{S}/\text{Cm}$. in A - Horizon of Qala Wahid profile pH is 7.75 and EC is 849 $\mu\text{S}/\text{Cm}$ and soil of this profile representation from basic condition and the B - Horizon pH is 7.75 and EC is 861 $\mu\text{S}/\text{Cm}$ and at the C - Horizon pH is 7.75 and EC is 870 $\mu\text{S}/\text{Cm}$. in the Qala Wahid profile in A - Horizon the amount CaCO_3 was 0.35 % , B - Horizon CaCO_3 is 0.406 % and in C - Horizon the amount of CaCO_3 0.474 % . As well as when we done the mechanical analysis on the Company profile in this case in A - Horizon soil fraction consisting sand 50 % , 42 % Silt and 8%Clay, in B - Horizon was 48 % Sand , 42 % Silt and Clay 10 % and in C - Horizon was Sand 49 % , 40 % Silt 11%Clay. As well as in Qala Wahid profile in A - Horizon the soil fractions consist of 50 % sand, 38 % Silt and 12 % Clay, in B - Horizon 48 % Sand, Silt 42 % , Clay 10 % and in C - Horizon Sand 50 % , Silt 42 % , Clay 8 % .

The results obtained suggested that to done another research's like soil physical and chemical properties by different laboratory tests, detail another sedimentological, Geochemical, engineering geology, hydrogeology (Ground water modeling section), hydrology, petrography, tectonic and geological mapping. As well as the Sedimentological research can be used efficiently in the other catchments of basin and other mountain basins in Afghanistan, we need and have good places for research but unfortunately there is no chance.

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