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Evaluation of physical and chemical properties of soils of Doroudzan dam region of Marvdasht province with respect to drainage conditions and elapsed time

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ABSTRACT

Properties of soils in arid and semi-arid regions are mainly influenced by parent materials. Texture is one of the most important physical soil properties, which greatly affects many of other properties including infiltration rate, water capacity, and fertility. In limy soils, lime might affect different constituents of the accumulated soil as well as the textural class. Identification of physicochemical properties of soils is highly significant in structural operations. For the current analysis, five soil series of Doroudzan Dam Region were selected based on the information acquired from elaborate pedology study maps, topographic and geological maps, aerial photos, and satellite images. In these 5 series, the soil profile was excavated and 4 soil samples were collected and the relevant pedological tests were carried out. Therefore, the objective of the present study is to analyze the physical and chemical properties of the regional soils under study taking into account the drainage conditions and the elapsed time.

Key words: Drainage, Lime, Saline and Alkaline, Physicochemical Properties

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INTRODUCTION

Soil is a normally unconsolidated and loose mixture of mineral and organic particles, which occurs naturally and covers the outer surface of the earth. Soil is formed as a result of mutual and interactive impacts of pedogenic processes. Pedogenic processes are also in turn affected by pedogenesis factors, and, the constituents of soils are formed under influence of climate and vegetation by the course of time and in different topographic conditions. Various soils are generated by mutual impacts of the abovementioned pedogenic factors and also human intervention and depend upon intensity and extent of the aforementioned effects. The geographical distribution of soils also differ in terms of variations in pedogenic factors, and consequently, different soils with variant properties and attributes and different talents and capacities, and occasionally, with different restrictions are formed [3].

Time by itself is not directly involved in formation and evolution of soil but impacts of pedogenic factors contribute to generation and evolution of soil as the time elapses. Time is a factor affecting maturity and formation of soil horizons. Therefore, time is not an independent factor in pedogenesis, but instead, the events leading to transformation of rocks and finally formation of soil occur during a period of time [5]. Time factor is significant in formation of rocks taking into account the impact on pedogenic processes. Relative age of soils is normally evaluated for comparing the soil formation time in pedological studies [3].

Topographic factor affects atmospheric parameters such as temperature and moisture. Role of topographic factors in soil generation can be viewed from two aspects:

1-as climate equilibrator and, 2- as a factor affecting genesis and formation of soil

The more arid climate and as a result less dense vegetation would result in further impact of topography on soil evolution. Topography does not have a remarkable effect on soil evolution in humid regions where there is sufficient vegetation and plants preserve the soil [5]. With decrease in ground slope, underground water level is observed near the soil surface, leading to occurrence of oxidation-reduction processes and also influencing the morphology of soils. The drainage conditions of soils also changes with variation in topographic attributes, as a result of which pedogenic processes are altered. Air and soil temperatures drop and accumulation of organic matters in soil surface increases as a result of increase in elevation. Precipitation might decline to some extent with increased elevation such that lime is usually observed in the vicinity of soil profile surface at higher elevations [3].

Physical properties of soil include: soil texture (gravel, silt, and clay), soil structure (oblique cube, granular, plate-shaped, prism-like, columnar, and oblique cube with flat edges), soil specific weight, lime and gypsum contents of soil, soil aeration, soil atmosphere, soil temperature, soil color, and soil and water interaction [3].

Chemical properties of soil include: different forms of soil elements, cation exchange phenomenon in soil, soil pH, soil nutrients, different forms of iron in soil, electrical conductivity and soil salinity (salinity-sensitive plants, salinity-resistant plants, toxic effects of certain ions, recognition of salinity factors and their treatment, climatic distribution of various salts, saline and alkaline soils, classification of saline and alkaline soils, risk of soil salination by water, treatment of alkaline soils, and gypsum application methods) [3].

Soil evolution is affected by the five constituting factors of soil i.e. climate, parent matter, topography, organisms, and time. Topography leaves its effect on soil evolution through affecting factors such as rate, direction and shape of slope, precipitation and infiltration rate, runoff rate, erosion extent, and transfer rate of matters as well as difference in drainage conditions [13]. On this basis, the sequence of continuous soil series classified in a single topographic level is designated as “catena” or “drainage sequence”. To study the soils resting on a slope is one of the simplest and meanwhile the best methods for determining the spatial correlation between soil properties and topography [14]. Evolution and transformation of soils in Iran’s southern regions, including the region under study, are to a large extent affected by presence of calcium carbonates. Presence of calcium carbonates in these soils is an obstacle for clay mobilization and formation of argillic horizon due to obstruction of clay dispersion. The calcium carbonate content in such soils is influenced by the type of parent matter, topographic condition, precipitation rate and distribution, vegetation, and physical properties of soil, specifically the texture [15]. Differentiation of pedogenic and lithogenic carbonates has been always studied by researchers of soil genetics. Morphological studies are among the significant and, even in some cases, vital measures in studies of soil genetics, including analysis of evolutionary trend of calcium carbonates in soils. In semi-arid regions with further precipitation, calcium carbonates are rinsed to the extent that physical movement of clay particles followed by formation of argillic horizon is a common phenomenon (especially at more stable levels). More humid climates in the past also could contribute to formation of the respective horizon [1].

Therefore, the objective of the current study is to analyze the correlation between physical and chemical properties of regional soils under study with respect to drainage conditions and the elapsed time.

MATERIALS AND METHODS

Physicochemical properties of soils in Doroudzan Dam Region were analyzed in the present research. Marvdasht City is situated in Fars Province between eastern longitudes of 51˚ 44′ and 53˚ 30′ and northern latitudes of 29˚ 15′ and 30˚ 59′. This city is located 45 kilometers northeast of Shiraz over the vast and fertile plain of Marvdasht with a surface area of 4649 km^2, accounting for approximately 3% of the province′s total area. The altitude of this city is around 1610 meters from free sea level. Major surface water resources of the region include Kor and Sivand Rivers, which originate from northeastern part of the province and join each other in at Pole-Khan Bridge southern

Marvdasht. Average annual precipitation in Marvdasht City is approximately 516 mm and the summers are dry. Average annual temperature of Marvdasht Region is 17.7 ˚C. Average maximal and minimal temperatures respectively equal 23.9 ˚C and 11.5 ˚C. Based on Domarton dryness index (10<I<19.9), this city is classified among semi-arid regions of Iran [2]. The area under study is situated 55 kilometers west of Marvdasht City in Fars Province over a vast and fertile plain. Its surface area is 1054 km^2 with thermic thermal regime and xeric moisture regime. Average annual precipitation in the area is 474 mm and mean altitude from sea level is 1650 meters. The oldest lithological units date back to cretaceous and major portion of regional deposits belong to Sarvak and Pabdeh limestone formations [4].

For the present study, 5 soil series of Doroudzan Dam Region were selected according to the information acquired from aerial photos and satellite images. These series include: Takht-e Jamshid soil series, Marvdasht soil series, Kor soil series, Emädäbäd soil series, and Korbäl soil series. In the respective five series, the soil profiles were excavated and 4 soil samples were collected from each soil profile. The initial experiments were carried out in the field; these experiments included: soil color analysis, studying the soil horizons, determining the type of parent material, evaluation of secondary lime, finding the latitude and longitude using GPS device, measurement of leakage and drainage coefficients, and determining type of land use and landform units, slope and erosion status, sampling date, distance from road. The results were written in special description card of each profile. Then, samples were transferred to laboratory for conducting rigorous studies and analyses.

Complete description of profiles was performed based on instruction of Soil Conservation Service- U.S. Department of Agriculture. Control profiles were specified and samples were prepared from genetic profiles of control profiles [10] and required amounts of soil samples were removed from characteristic horizons. Distribution of particle size was measured using pipette method [7] and cation exchange capacity of soil was evaluated using Chapman technique [6]. The equivalent calcium carbonate content was determined through reverse titration method [12] and organic carbon was measured through oxidation with chromic acid using Jackson method [8]. Samples were subsequently prepared for physical and chemical tests [9], and [11].

Data acquisition procedures:
1- Soil science laboratory apparatus
2- Pedology maps, topography and geology maps
3- Computer networks
4- Satellite images
5- Research and scientific papers
6- Master theses
7- Soil sciences books

Field surveys and library studies are used in the present research for data collection and analysis. The needed complementary information such as geological and meteorological data, satellite images and aerial photos of the region under study were prepared from Marvdasht Agriculture Bureau, Soil and Water Researches Institute, and website of Iran's Meteorology Organization.

Table 1 – General specifications of studied soil profiles in Doroudzan Dam Region

Classification	Soil type	Application	Drainage	Slope (%)	Physiography	Altitude (meters)	Longitude	Latitude	Profile
Tipic Calsixerepts	Calcic Brown Soils	Fallow	Suitable	0-2	Mountainside alluvial plain	1611	52°51´22"	29°57´42"	1
Tipic Haploxerepts	Brown Soil	Wheat field	Suitable	0-2	Fluvial plain	1600	52°46´35"	29°56´41"	2
Tipic Haploxerepts	Alluvial Soils	Wheat field	Suitable	0-2	Alluvial plain	1621	52°41´46"	29°57´51"	3
Tipic Haploxerepts	Solonetz	Barren	Moderate	0-2	Alluvial plain	1620	52°46´52"	29°56´30"	4
Haplo salids	Saline &Alkaline Soils	Fallow- Barren	Poor	0-2	Low lands	1605	52°38´9"	29°52´49"	5

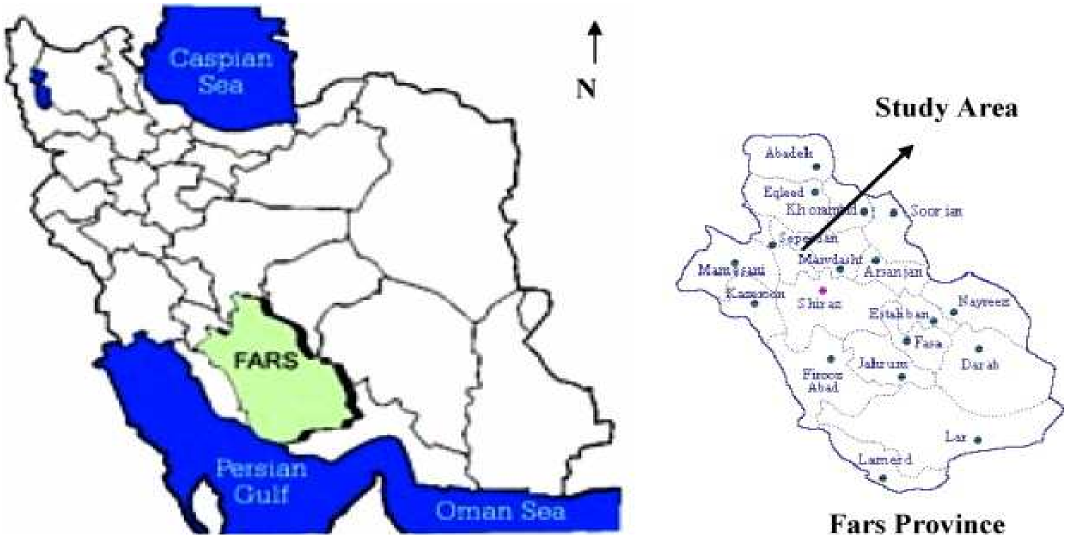

Figure 1- Geographic location of Doroudzan Dam Region in provincial and national scale

Table 2- Physicochemical properties of the studied soil profiles in Doroudzan Dam Region

SP	EC (ms/cm)	CEC	Saturation Moisture	Equivalent calcium carbonate	Organic carbon	pH	Texture	Clay (%)	Silt (%)	Gravel (%)	Depth (cm)	Horizon
48	0.62	47.8	51.44	24.6	3.21	7.99	Sicl	36	49	15	0-30	p1-Ap
44	0.83	45.2	44.5	69.3	0.43	8.05	Sicl	40	44	16	30-75	p1-Bw
56	1.15	46.3	41.2	78.1	0.16	8.15	Sicl	40	40	20	75-115	P1-Bk1
53	0.96	49.2	40.2	30.6	0.83	8.01	Sicl	36	51	13	115-135	p1-Bk2
40	0.71	36.3	43.1	47.3	0.13	8.31	clay	47	39	14	0-30	P2-AP
35	0.56	45	44	55.6	0.13	9.1	silt calay	42	40	18	30-60	P2-BW1
52	0.61	32	41.6	35.2	0.87	9.28	clay	45	37	18	60-100	P2-BW2
67	0.69	26.5	45.3	36.1	0.31	9.62	clay	47	35	18	100-130	P2-BW3
50	2.2	23.3	48.2	38.1	0.1	7.73	Sicl	15	49	36	0-30	P3-AP
46	1.05	30.5	32	20.5	1.11	7.95	Sicl	16	44	40	30-60	P3-BW1
46	2.48	34.5	31	28	0.72	7.81	Sicl	20	40	40	60-100	P3-BW2
50	1.46	31	39	22	0.29	7.86	Sicl	13	51	36	100-130	P3-PW3
29	1.94	24.2	34	48	3.15	9.48	Sicl	39	44	17	0-25	P4-A1
39	2.27	14.3	38	45	0.99	9.56	Sicl	49	34	17	25-60	P4-BW1
67	1.84	17.2	33	60.2	0.44	9.48	Sicl	46	34	20	60-100	P4-BW2
62	1.63	11.9	30	64	0.89	9.2	Sicl	44	34	22	100-130	P4-BW3
52	1.16	17.3	30	65	1.23	8.04	Sicl	25	43	25	0-10	P5-A1
64	2.85	16.5	29	78	0.88	8.45	CL	22	42	22	10-60	P5-BW2
68	10.02	11.9	28.4	75.3	0.37	7.99	CL	28	44	28	60-90	P5-BZ1
74	11.66	11.3	29.1	80	0.74	8.06	CL	29	45	29	90-120	P5-BZ2

RESULTS AND DISCUSSION

Soil type, physiography situation, percentage of equivalent calcium carbonate and other principal physical and chemical properties of the studied soil profiles are included in Tables 1 and 2.

In semi-arid regions with more precipitation, calcium carbonate is rinsed to the extent that physical movement of clay particles followed by formation of argillic horizon is a common phenomenon (especially at more stable levels). The analyses indicate that the transformations in Marvdasht Region are affected by aquifers and NaCl is permanently added to the soil and exchange occurs based on Mass Action rule. Natric horizon is formed in the long term during which calcium carbonate replaces Na and argillic horizon is generated, which marks the ultimate soil evolution. Such phenomena are absolutely evident in Marvdasht and Doroudzan Dam regions. Analysis of physical and chemical properties of the respective soils shows that their lime content is high and the soils are typically limy.

Also, Profile 1 (Takht-e Jamshid soil series taken from 200 meters southeast of Shnsabad Borzu Village), referred to as calcic brown soil, can be cultivated and exploited thanks to its suitable drainage of class IS in spite of its high lime content. Profile 3 (Marvdasht soil series taken from 200 meters north of Hesamabad), referred to as brown soils, can be also cultivated and exploited thanks to suitable drainage of class IIS in spite of its high lime content. Profile 4 (Kor soil series taken from 3km west of Fathabad), referred to as alluvial soils, is also cultivatable and producible thanks to suitable drainage having class IIS in spite of its high lime content. Soil alkalinity is high in Profile 4 (Emadabad soil series, taken from 1.5km west of Fathabad), referred to as Solontez or black soil. This soil has been sterile during the previous years but seems currently to have been revived as a result of drainage; its class improved from VI A to III A. The alkalinity and salinity levels are high in Profile (Korbal soil series, taken from 1km south of Gondashtlou Village), referred to as saline and alkaline soils, which are barren and cannot be improved due to poor drainage; only halophilic plants can grow and the soil class in VI A.

REFERENCES

[1] Owliaie, H.R. (**2012**), *Journal of Soil and Water (Agriculture Sciences and Industries)*, 26 (2), 427-439

[2] Bostanipour, L. (**2003**), Assessment of Spatial Status and Locations of Educational Spaces in Marvdasht City using GIS, *Mater The*sis, Geography Group, University of Tehran, Tehran, Iran

[3] Jafari, M. and Sarmadian, F (**2008**), *Fundamentals of Soil Sciences and Soil Classification*, Second Edition, Tehran: Publications of University of Tehran

[4] Statistical Yearbook of Fars Province (**2009**), Planning Deputy of Fars Provincial Governor- Bureau of Statistics and Information

[5] Varavipour, M. (**2010**), *General Soil Sciences*, Second Edition, Tehran: Payam-e Nour Publications

[6] Chapman, H.D.(**1965**) Cation exchange capacity. In: Black. C. A (ed) , Methods of soil analysis part 2. *American Society of Agronomy, Madison, Wl*. PP. 891-901.

[7] Day, P.R.(**1965**) Particle fractionation and particle-size analysis. In:Black. C. A. (ed), Methods of soil analysis, part 1. *American Socaiety of Agronomy, Madison, Wl*. PP. 545-567.

[8] Jackson, M.L.(**1975**) *Soil chemical analysis-advaced course*. Univ. of Wisconsin, College of Agric. Dept. of Soil Sci., Madison, Wl.

[9] Klute, A.(**1986**) *Methods of Soil Analysis. Part I- Physical and Mineralogical Methods*. 2nd ed. Soil Science Society of America, Madison, Wisconsin, USA. 1188 p.

[10] National Soil Survey Center, Natural Resources Conservation Service. (**1998**) *Field Book for Describing and Sampling Soils*. U.S. Department of Agriculture, Lincoln, Neberaska,173 p.

[11] Page, A.L. (**1982**) *Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties*.SSSA Publisher, Madison, Wisconsin, USA. 1159p.

[12] Richards, L.A. (ed).(**1954**) *Diagnosis and improvement of saline and alkali soils*. USDA Handb. No. 60. U.S. Gov. Print. Office, Washington, DC.

[13] Schaetzl, R., and Anderson, S.(**2005**) *Soils Genesis and Geomorphology*. Cambridge University Press, NY, 817p.

[14] Sommer, M., and Schlichting, E.(**1997**) Archetypes of catenas in respect to matter – a concept for structuring and grouping catenas. *Geoderma*, 76: 1-33.

[15] Wright, V.P.(**1987**) A micromorphological classification of fossil and recent calcic and petrocalcic microstructures, Fedoroff N., Bresson, L. M. and Coutry, M. A. (Ed.) *soil Micromorphology, AFES, Paris*. PP. 401-407.