Analysis of the role of plant species located on marl formations in controlling erosion (Case study: Varamin County)

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Abstract - In region according to stratigraphic information obtained from combination of the stratigraphic column existing in geological maps at a scale of 1: 250,000 and sometimes 1: 100000 of sheet Varamin, Tehran, Damavand, and Semnan, and field survey, it was found that geologically in the Precambrian, Paleozoic, and Mesozoic (except Cretaceous) periods, there was a general gap in the region. All marl formations and units which specifically include three units of shale, gypsum marl, sandstone, gypsum marl unit, and brown and red marl unit with interbeded sandstone belonging to the Cenozoic period have been distributed in the northeast, east, south and southwest. From the location of marl distribution, 29 samples of marl soil were chemically and physically tested and the results did not show a significant difference because evaporative sediments were distributed in most areas. Due to solubility of salt and also rarely gypsum and lime and their capillary properties, density of vegetation was very low and the dominant vegetation type was itchy and boneye Alhagi camelorum and Aeluropus lagopoides and the species of Bromus tectorum , Hordeum marinum, Peganum harmala, Artemisia sieberi, Prosopis stephaniana, Phragmites australis, Seidlitlia rosmarinus, Capparis spinosa, Chenopodium murale, Convolvulus arvensis, Tamarix sp, Haloxylon sp, Pteropyrum aucheri, Salsoa arbuscula, Salsola tomentossa as a species with limited distribution in the region. Therefore the erodability of the region showed high erodability.

Keywords: geology, vegetation, marl, physical and chemical properties of soil, County of Varamin

Introduction

In general, marls are formations that due to their special physical and chemical properties have very little vegetation in most arid and semi-arid regions and establishment of vegetation in these areas is associated with several limitations. These formations have a lot of erosion compared to other geological formations. Due to their special structure, these fine-grained formations do not have sufficient density to withstand the effects of climatic factors and in case of exposure to adverse conditions they will rapidly be destroyed and eroded. In marl formations due to ion imbalance as well as severe salt stress, establishment, germination, and growth of vegetation are difficult and therefore, the surface of these formations mostly has less vegetation. Increased density of pebbles in marl plain is directly related to increased percentage of vegetation canopy because marls are formations that due to their special physical and chemical properties, establishment of vegetation on them is associated with several limitations.

Due to their special physical and chemical properties, marl formations have very little vegetation in most arid and semi-arid regions and establishment of vegetation in these areas is associated with several limitations. Due to their special structure, these fine-grained formations are rapidly destroyed and eroded in adverse conditions. In marl formations due to ion imbalance as well as severe salt stress, establishment, germination, and growth of vegetation are difficult and therefore, the surface of these formations mostly has less vegetation.

Many domestic and foreign studies and researches have been done on the relationship between vegetation and geological formations and soil. Here are some of them that were available:

The results by Tatian (2011) showed that soil salinity and texture are among the main factors limiting the growth of plant species in these areas and only two species of Stipagrostis plumose and Tamarix aphylla have reacted positively with soil being sandy and soil salinity, respectively. Also, the species existing in degraded areas did not have a specific reaction with soil factors and have appeared as a separate ecological group (1).

In the study by Mirzazadeh (2012), the results of chemical analysis show that the considered marl lands are among the alkaline saline soils and in terms of soil engineering, they all are among the medium-grain soils with sand with S.C.M, SP, SW, and SM. The samples are in a low range of dough properties and internal strength, so, they are very prone to erosion. According to the analysis of physical, chemical, engineering, and mechanical properties of marls, it has been found that there is a significant difference between the amounts of salt, gypsum, and lime; and these three factors can be considered as important indicators in distinguishing erosion forms. Low organic materials in the samples cause a loose structure prone to soil erosion. Low level of this parameter along with low exchange capacity makes these lands infertile and as a result, the ground is not provided for development of vegetation, which is a factor to increase erosion (2).

Salmasi and Ahmadi (2012) concluded that the highest rate of erosion and sediment production of watershed area is related to marl formations. The results of their study showed that among the measured physical and chemical properties, acidity, gypsum percentage, and sand percentage of the samples were significantly different in different forms of erosion. The highest acidity was observed in massive erosion, and for sand and gypsum percentage in gully erosion. The lowest values of these three features were also present in badland erosion (3).

Examining erodability indices of marls in Chaharmahal and Bakhtiari province, Emami et al. (2013) showed that the area of marl formations in Chaharmahal and Bakhtiari province is 1074 square kilometers, equivalent to 6.5% of total area of the province which are expanded in the center, west, and south of this province. The results of regression test show the effect of four factors of absorbable potassium, exchangeable sodium, total lime, and clay percentage, which show the highest sediment changes in marl units, respectively. The results of correlation between soil texture and sediment production indicate a positive and significant correlation between silt content and sedimentation, and a negative and significant correlation between clay content and sedimentation, and no correlation between sand and sedimentation (4).

Moradi Shamsabadi (2013) in a study to investigate the effect of two different types of parent materials and type of use on some physical, chemical, mineralogical and classification properties of soils in Cheshmeh Ali-Lehderaz region of Chaharmahal and Bakhtiari province showed that the amount of apparent specific weight, soil aggregate stability, and soil organic matter for limestone parent material was significantly higher than marl, while the amount of electrical conductivity, soil erodability coefficient, and equivalent calcium carbonate was significantly higher in marl soils. In the two parent materials of limestone and marl due to change of use of grasslands to rain-fed, erodability coefficient, soil acidity, electrical conductivity, and equivalent calcium carbonate were significantly higher in rain-fed use while the percentage of gravel, apparent specific weight, soil aggregate stability, and organic matter were significantly higher in grassland use than in rain-fed use (5).

Trough chemical and physical analyses, Hosseini (2014) showed that the soils formed on the parent materials of marl limestone and dolomitic lime, due to further development and therefore more soil depth, have higher organic matter, cation exchange capacity, magnetic susceptibility, clay content, and silt content compared to the soil formed on red conglomerate. No difference was observed between pH, lime percentage, and soil aggregate stability in different parent materials. Also, the amount of organic matter, magnetic susceptibility, and clay percentage in the soils formed under vegetation, due to vegetation activities and thus the effect on biological aeration, was higher than in the area without vegetation; but there was no significant difference in the pH, cation exchange capacity, and soil aggregate stability between the areas with and without vegetation. The results of soil mineralogy showed that in general, in all the studied samples of bedrock and soil, mica, quartz, kaolinite and vermiculite minerals are present and the origin of these minerals is hereditary in the soils of the area. Smectite is also present in some soils of the region. Considering that smectite mineral was not observed in any of the bedrock samples, the origin of this mineral in the soils of the region can be attributed to soil-forming factors. In marl limestone parent material due to stronger vegetation than dolomitic lime parent material, the role of Astragalus and Daphne plants in formation of smectite mineral is more and the amount of smectite mineral in this region is more than dolomitic lime parent material. In the parent matter of red conglomerate, smectite mineral was not observed in any of the soils formed under vegetation and uncovered area due to less aeration, coarser texture, and consequently less development of this parent matter (6).

Results of the study by Sokouti Oskouee et al. (2015) showed that although in general the status of surface erosion by BLM method is in the middle level but in Qare Tappeh and Qare Aghaj regions, gully erosion has a higher score and rill erosion has had high scores in all points. The minimum surface runoff volume was 255 in Shabanloo region and its maximum was 577 cubic centimeters in Qare Tappeh region. Runoff coefficient was calculated to be between 0.23 and maximum 0.53. The minimum mud production was equal to 10 g/l in Qare Tappeh and its maximum was 180 g/l in Qare Aghaj. Also, it was found that the clay ratio index has played a decisive role (with 95% confidence) in occurrence of erosion in gully form, and runoff volume in surface and rill erosion (7).

Sehati et al. (2016) showed that marl formations have little vegetation in most arid and semi-arid regions due to special physical and chemical properties and establishment of vegetation in these areas is associated with several limitations. Also, the results of this study showed that some characteristics of waterway plan affect the density of vegetation canopy and distribution of different plant types. The inability of CCA analysis according to the results of Monte Carlo test in proper analysis of plant species distribution in relation to the morphometric factors of waterway in marl areas of this study area is another result of this study. Finally, it can be said that the results of this study indicate the role of some soil characteristics and morphometric factors of waterways as well as surface pebbles in marl areas on vegetation canopy density and distribution of plant types, but prediction of distribution of plant species using direct gradient analysis of CCA and emphasizing waterway morphometric characteristics in this study area is difficult (8).

According to the results by Jozaghian et al. (2016), permeability, stability and soil nutrient cycle were in better status than the mined areas. In clay site, except for indices of stability test against moisture, humus cover, and soil surface roughness, and in gypsum site, except for indices of cryptogam vegetation, nature and soil surface roughness, and sedimentary materials, other indicators in reference and mined areas were significantly different. The changes in the vegetation and soil status are evidence of the increasing trend of desertification in the region. The results of this study showed that through the extraction of surface mines such as gypsum and clay, vegetation and stone coverage protecting the soil surface have been completely destroyed and thus, erodibility of these areas has increased (9).

Stendhal et al. (2002) studied the effect of soil chemical properties on habitat quality in parts of Sweden and concluded that higher layers of soil had stronger relation with habitat indicators (10).

Cantero et al. (2003) conducted studies on the effect of different climatic, soil, and topographic factors on vegetation of central grasslands of Argentina and showed that in addition to height variable, soil nutrients play an important role in plant distribution (11).

White and Hood (2004) in a study entitled “Relationships between species composition and environmental indicators (soil and topography) in Northern Mexico”, using non-directional comparative analysis, concluded that there was a significant difference between canopy vegetation and soil factors including soil depth, percentage of surface pebbles, soil pH, and total living matter in the habitat (12).

Enrigth et al. (2005) studied the vegetation of desert areas and the relationship between environment and vegetation in Kirthar National Park in Pakistan. Using two-way analysis classification method they identified the reagent species and classification method of nine natural plant communities and showed that groundwater depth and soil chemicals played a major role in determining species distribution (13). Quevedo and Frances (2008) by presenting a model of the relationships between soil and vegetation in arid and semi-arid areas concluded that vegetation changes in these ecosystems are formed as a result of complex relationships between soil and climate elements and changes in soil moisture (14).

Research method

To study the vegetation of the region, first having topographic maps with scales of 1.50000 and 1.25000 as basic maps, we referred to the study area and passing through all passable roads and climbing to heights and conducting various searches within the region, using GPS device and binoculars, grassland types were identified by physiognomy method; and given thee obtained coordinates and land features such as mountains, valleys, rivers, roads, and drainage divide, different grassland types were separated and marked on the maps. Naming of grassland types was done according to the two dominant species of plant composition. After completion of the fieldwork, a map of the plant types of the area was prepared in GIS environment and Ilwis and Arc GIS software programs. Then, according to the composition of vegetation and area of each plant type, the number of plots (statistically) and plot size (according to the type of dominant plant species in each plant type) were determined and were settled in each type by random-systematic method in order to measure canopy vegetation and density of each plant species.

In order to examine flora of the region based on the conventional method of floristic studies, through various field references in different growing seasons (May to October), plants from the study area were collected. In addition, during the plant growth period, the effect and characteristics of canopy vegetation and plant roots in protecting the soil from erosion was studied and monitored.

Simultaneous with collection of plant samples, notes related to the ecological status and biological form of each plant species directly on the ground were prepared. After each collection, the samples were pressed and dried using the necessary equipment and were prepared for storage in herbarium. The collected samples were transferred to the herbarium of the Agricultural and Natural Resources Research Center of Tehran Province and after being pressed and dried they were prepared as herbarium samples and were stored in the herbarium of that center. The prepared herbarium samples were identified using Iranian Flora (Asadi et al., 1990-2011) (15) and Iranika Flora (Rechingr, 1963-2010) as well as professors of botany.

In areas with vegetation and the areas without vegetation adjacent to them during the sampling BLM form was completed to assess the extent of erosion and investigate the role of vegetation located on the marls. In addition, the morphometric characteristics of the slopes in terms of the shape and dimension of the slope and type of climate and microclimate were recorded in the desert.

Sampling of marl sediments was done and analyzed at the habitat of each plant species from a depth of 20 cm and a number of 3 samples from each area.

Performing physical and chemical tests as follows:

- Physical tests:

Measurement of apparent specific weight; measurement of true specific weight; determination of soil texture by Pipette method in such a way that in each marl sample, in terms of percentage of destructive part and chemical part, the necessary measurement was done to finally identify the percentage of gypsum, lime, and salt as the chemical part and the rest of the sample was considered as the percentage of destructive part and finally the type of marl was determined.

- Chemical tests: 1) Measurement of pH in saturated mud; 2) Measurement of EC in saturated extract; 3) SP saturation percentage; 4) Measurement of organic matter by Walky-Black method; 5) Measurement of sodium and potassium cations by flame photometer device; 6) Measurement of calcium and magnesium cations by titration method by EDTA; 7) Percentage of neutralizing materials (T.N.V)

- Analysis of test results and determination of physical and chemical characteristics of each habitat

Geographical and general location

The city of Varamin is one of the cities of Tehran province. Its center is the city of Varamin, which is limited to Qom province from the south and to Semnan province from the southeast and east. This city with an area of 1580 square kilometers is located 25 kilometers southeast of Tehran and is geographically located between latitudes 35 to 30 and 35 and longitudes 30 and 51 to 52 and with an altitude of 750 to 900 meters above sea level. This city is currently limited to Pakdasht city from the north, Rey city from the west, Qom province from the south, and Pishva city from the east. Due to its being located on the edge of the central desert, it has a semi-arid and desert climate. The location of Varamin city in Tehran province is shown in Map 1.

Map 1: Location of the city of Varamin in Tehran province

General vegetation of the region

Given that the desert protected area is one of the arid and desert areas and annual rainfall there is less than 175 mm, it has hot summers and cold winters. Its grassland cover is composed of a variety of drought-friendly species (xerophytes), and saline plants (halophytes) have a special place among them in the plains. These plants as the living indicator of adaptation to unfavorable ecological living conditions are exposed to water shortage part of the year, and in order to survive and adapt to unfavorable conditions and other factors limiting vegetation, they make special internal and external structures that represent drought and biological limitations. The process of adaptation of these plants is in a way that enables them to withstand harsh environmental conditions. Some are dry and thorny, some have less chlorophyll and are livid and gray, some have fleshy leaves and the rest have short stems and long roots or shallow and extensive roots. In some species, the leaf area is reduced or there are no leaves.

Images 1 and 2: An example of hill (Tappeh Mahour) unit with a rocky outcrop face and shallow soil cover and low vegetation

Vegetation and marl units in Tehran province and Varamin region

Marls are formations that have very little vegetation in most arid and semi-arid regions due to their special physical and chemical properties, and establishment of vegetation in these areas is associated with several limitations. These formations have a lot of erosion compared to other geological formations.

In the study of marls, it has been found that erosion-sensitive marls have surface erosion, rill erosion, waterway erosion, and gully erosion types, and there is a significant difference between the amounts of salt, gypsum, and lime such that solubility of salt is higher than gypsum, and gypsum is higher than lime, and this condition has caused more erosion of salt areas than areas with gypsum and lime, respectively. Also, soils with more clay are more stable and more resistant to water erosion. Also, lime makes the soil more resistant.

Due to their special structure, these fine-grained formations do not have sufficient density to resist the effects of climatic factors and in case of exposure to unfavorable conditions they will rapidly be destroyed and eroded. In Marl formations due to ionic imbalance as well as severe salt stress, establishment, germination, and growth of vegetation are difficult, and thus, the surface of these formations mostly has less vegetation.

In distribution of vegetation, salinity and soil texture are among the main factors limiting the growth of plant species in these regions.

The results of examining the relationship between pebble density and percentage of vegetation canopy in marl plain surfaces show that there is a direct and significant relationship between density of pebbles and percentage of vegetation canopy in marl plain. The *Stipagrostis plumose* species is found more in sandy soils and the *Tamarix aphylla* in saline soils. The *Salsola rigida* and *Aellenia glauca* species had high correlation with electrical conductivity and then silt and gypsum values.

The obtained results showed that there is a direct and significant relationship between surface pebble density and vegetation canopy in Marl plain. The results of this study also showed that some characteristics of the waterway plan affect the density of vegetation canopy and distribution of different vegetation types. The results of this study indicate the role of some soil characteristics and morphometric factors of waterways as well as surface pebbles in marl areas in vegetation canopy density and distribution of plant types.

Table 1: Summary of dominant types of vegetation on marl units in the city of Varamin

No.	Persian or local name	Growth type	Longevity	Scientific name	Considerations
1	Kharshotor	Permanent	P	Alhagi camelorum	Main and dominant type
2	Booneh	Permanent	P	Aeluropus lagopoides	Main and dominant type
3	Alaf Narmeh	Annual	A	Bromus tectorum	Companion
4	Jo Vahshi	Annual	A	Hordeum marinum	Companion
5	Espand	Perennial	P	Peganum harmala	Companion
6	Darmaneh Dashti	Perennial	P	Artemisia sieberi	Companion
7	Kahourak	Perennial	P	Prosopis stephaniana	Companion
8	Ney	Perennial	P	Phragmites australis	Companion
9	Eshnan	Perennial	P	Seidlitlia rosmarinus	Companion
10	Eshnan	Perennial	P	Seidlitlia sp.	Companion
11	Alaf -e Mar	Perennial	P	Capparis spinosa	Companion
12	Salmeh	Annual	A	Chenopodium murale	Companion
13	Pichak Sahrayee	Annual	A	Convolvulus arvensis	Companion
14	Gaz	Perennial	P	Tamarix sp.	Companion
15	Tagh	Perennial	P	Haloxylon sp.	Companion
16	Parand	Perennial	P	Pteropyrum aucheri	Companion
17	Yekke Tisheh	Perennial	P	Salsoa arbuscula	Companion
18	Salsola tomentossa	Perennial	P	Salsola tomentossa	Companion
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Source: Sharifi et al. (2010) (16)

Test results of marl soils sampled in the region

In order to quantify the opinions and analyzes regarding the marl formations, units, and deposits, sampling of marl soils was performed in 29 points. In this regard, in order for scientific reference to the results of soil analysis, different distributions and preferably in different points were sampled and they were sent to the laboratory. The summary of the results obtained in the four marl areas of East (10 samples), Northeast (10 samples), South (4 samples) and Southwest (5 samples) of the region is as follows:

The eastern region is insignificant in terms of vegetation and in the same small amount the species of Salsoa arbuscula and Salsola tomentossa were almost more frequent than other saline plants. Ten samples of marl soil were taken from this region as described in Table 2 in which the minimum values of EC, PH, N, P, K, Clay, Silt, Sand, Zn, Cu, Mn, Fe, and B were 1.55, 7.25, 0.009, 1.8, 148, 7, 21, 35, 0.05, 0.02, 0.41, 0.28, and 1.98, respectively, and their maximum values were 18, 8.02, 0.12, 3.1, 1012, 38, 65, 0.22, 0.23, 0.62, 0.47, and 8.87, respectively.

Table 2: Summary of marl soil test results in the eastern part of the region

Sampling location	Ec dS.m^{-1}	pH	T.N.V %	O.C %	Total N %	P(ava) mg.kg^{-1}	K(ava) mg.kg^{-1}	Clay %	Silt %	Sand %	Texture	Zn(ava) mg.kg^{-1}	Cu(ava) mg.kg^{-1}	Mn(ava) mg.kg^{-1}	Fe(ava) mg.kg^{-1}	B(ava) mg.kg^{-1}
	Saturated extract	**Saturated mud**	**Titration**	**Walky-Black**	**Kjeldahl**	**Olsen**	**Flame photometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**DTPA**	**DTPA**	**DTPA**	**DTPA**	**Azomethine H**
Mostafa Abad	48.8	7.25	26.8	0.09	0.009	1.8	158	19	21	60	Sandy loam	0.22	0.17	0.55	0.3	4
Abardej 1	55.1	7.5	27.2	0.1	0.01	2	161	23	22	55	Sandy clay loam	0.17	0.2	0.62	0.32	3.69
Abardej 2	53.5	7.65	28	0.07	0.007	2.4	148	21	21	58	Sandy clay loam	0.18	0.22	0.55	0.28	3.8
Madan Gach 1	8.74	7.66	24.44	0.07	0.007	2.08	282	26	34	40	Clay loam	0.15	0.23	0.57	0.33	8.45
Madan Gach 2	8.5	7.7	25.1	0.08	0.008	1.88	302	35	30	35	Clay loam	0.05	0.05	0.48	0.47	8
Abardej 3	8.7	7.74	24.6	0.08	0.008	1.9	274	21	38	41	Loam	0.08	0.06	0.41	0.38	8.87
Madan Gach 3	16.52	7.97	20.37	0.09	0.009	2.74	961	16	24	60	Sandy loam	0.11	0.18	0.53	0.44	2.26
Abardej 4	17.2	8.02	19.88	0.11	0.01	2.5	1012	17	26	57	Sandy loam	0.05	0.07	0.51	0.29	2.5
Rah Ahan 1	16.84	7.95	23.1	0.09	0.009	3.1	875	7	28	65	Sandy loam	0.04	0.05	0.61	0.34	2.1
Rah Ahan 2	18	8	25.6	0.12	0.01	2.85	921	10	30	60	Sandy loam	0.06	0.07	0.49	0.38	2.98
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Sharifi et al. (2010) (16)

The northeastern region is insignificant in terms of vegetation and in the same small amount the species of Haloxylon sp. was almost more frequent than other saline plants. Ten samples of marl soil were taken from this region as described in Table 3 in which the minimum values of EC, PH, N, P, K, Clay, Silt, Sand, Zn, Cu, Mn, Fe, and B were 2.65, 7.30, 0.005, 1.5, 140, 16, 18, 5, 0.08, 0.09, 0.35, 0.20, and 4.10 respectively, and their maximum values were 53.30, 7.80, 0.02, 5.10, 350, 41, 55, 66, 0.20, 0.16, 0.53, 0.41, and 7.50, respectively.

Table 3: Summary of marl soil test results in the northeastern part of the region

Sampling location	Ec dS.m^{-1}	pH	T.N.V %	O.C %	Total N %	P(ava) mg.kg^{-1}	K(ava) mg.kg^{-1}	Clay %	Silt %	Sand %	Texture	Zn(ava) mg.kg^{-1}	Cu(ava) mg.kg^{-1}	Mn(ava) mg.kg^{-1}	Fe(ava) mg.kg^{-1}	B(ava) mg.kg^{-1}
	Saturated extract	**Saturated mud**	**Titration**	**Walky-Black**	**Kjeldahl**	**Olsen**	**Flame photometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**DTPA**	**DTPA**	**DTPA**	**DTPA**	**Azomethine H**
Farrokh Abad 1	18.32	7.41	22.77	0.05	0.005	1.82	261	36	50	14	Clay silt loam	0.09	0.13	0.43	0.38	7.32
Mohammad Abad 1	19.2	7.5	23.5	0.06	0.006	1.5	255	41	52	7	Silt loam	0.08	0.1	0.41	0.2	7.5
Yousef Abad 1	20.4	7.8	24.2	0.05	0.005	2	284	40	55	5	Silt loam	0.09	0.11	0.42	0.27	6.7
Farokh Abad 2	2.65	7.61	28.97	0.21	0.02	4.7	363	16	18	66	Sandy loam	0.17	0.11	0.36	0.41	4.61
Yousef Abad 2	2.74	7.58	30.1	0.18	0.01	5.1	347	19	20	61	Sandy loam	0.1	0.09	0.35	0.4	4.10
Farrokh Abad 3	3.1	7.3	29.4	0.2	0.02	4.84	350	17	22	61	Sandy loam	0.11	0.12	0.47	0.35	4.68
Mohammad Abad 2	13.15	7.61	26.82	0.07	0.007	1.58	292	30	20	50	Sandy clay loam	0.16	0.13	0.37	0.39	6.58

Moha mmad Abad 3	14.5	7.6	27.2	0.06	0.006	1.65	300	30	21	49	Clay loam	0.2	0.14	0.45	0.32	7.2
Farrok h Abad 4	13.76	7.68	27.8	0.07	0.007	2.1	320	30	22	48	Clay loam	0.18	0.1	0.38	0.4	6.6
Yousef Abad 3	53.3	7.19	27.54	0.07	0.007	1.82	140	20	18	62	Sandy clay loam	0.12	0.16	0.53	0.36	4.3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Sharifi et al. (2010) (16)

The southern region is insignificant in terms of vegetation and in the same small amount the species of Pteropyrum aucheri was almost more frequent than other saline plants. Ten samples of marl soil were taken from this region as described in Table 4 in which the minimum values of EC, PH, N, P, K, Clay, Silt, Sand, Zn, Cu, Mn, Fe, and B were 24.90, 7.80, 0.02, 5.80, 294, 18, 55, 16, 0.32, 0.60, 3.50, 1.87, and 3.68 and its maximum values were 27.50, 8.03, 0.04, 7.20, 353, 20, 64, 26, 0.20, 0.78, 5.10, 2.50, and 5.20, respectively.

Table 4: Summary of marl soil test results in the southern part of the region

Sampling location	**Ec dS.m^{-1}**	**pH**	**T.N.V %**	**O.C %**	**Total N %**	**P(ava) mg. kg^{-1}**	**K(ava) mg.kg^{-1}**	**Clay %**	**Silt %**	**Sand %**	**Texture**	**Zn(ava) mg. kg^{-1}**	**Cu(ava) mg.kg^{-1}**	**Mn(ava) mg.kg^{-1}**	**Fe(ava) mg. kg^{-1}**	**B(ava) mg.kg^{-1}**
	Saturated extract	**Saturated mud**	**Titration**	**Walky-Black**	**Kjeldahl**	**Olsen**	**Flame photometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**DTPA**	**DTPA**	**DTPA**	**DTPA**	**Azomethine H**
Davazdah Emam	26.8	8	19	0.32	0.03	7	321	20	57	23	Clay silt loam	0.32	0.74	5.1	2.5	3.68
Shokr Abad 1	24.9	7.8	19.2	0.3	0.04	6.8	345	19	55	26	Clay silt loam	0.3	0.78	4.7	1.87	4.10
Shokr Abad 2	25.6	8.03	18.7	0.34	0.03	6.9	353	20	64	16	Clay silt loam	0.26	0.62	4.15	2.36	4.68
Shokr Abad 3	26.2	8	19.2	0.28	0.02	7.2	351	18	62	20	Clay silt loam	0.3	0.71	3.8	2.01	5.2
Mobarakieh	27.5	7.9	19.8	0.22	0.02	5.8	294	19	58	23	Clay silt loam	0.2	0.6	3.5	1.86	4.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Sharifi et al. (2010) (16)

The southwestern region is insignificant in terms of vegetation and in the same small amount the species of Pteropyrum aucheri, Salsola tomentossa, and Haloxylon sp. were almost more frequent than other saline plants. Ten samples of marl soil were taken from this region as described in Table 5 in which the minimum values of EC, PH, N, P, K, Clay, Silt, Sand, Zn, Cu, Mn, Fe, and B were 6.16, 7.88, 0.02, 2.76, 140, 28, 46, 16, 0.27, 0.69, 2.50, 1.98, and 1.05 respectively, and their maximum values were 8.10, 8.02, 0.04, 3.84, 425, 36, 52, 20, 0.36, 0.80, 3.10, 2.35, and 1.75.

Table 5: Summary of marl soil test results in the southwestern part of the region

Sampling location	**Ec dS.m^{-1}**	**pH**	**T.N.V %**	**O.C %**	**Total N %**	**P(ava) mg. kg^{-1}**	**K(ava) mg.kg^{-1}**	**Clay %**	**Silt %**	**Sand %**	**Texture**	**Zn(ava) mg.kg^{-1}**	**Cu(ava) mg.kg^{-1}**	**Mn(ava) mg.kg^{-1}**	**Fe(ava) mg. kg^{-1}**	**B(ava) mg.kg^{-1}**
	Saturated extract	**Saturated mud**	**Titration**	**Walky-Black**	**Kjeldahl**	**Olsen**	**Flame photometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**Hydrometer**	**DTPA**	**DTPA**	**DTPA**	**DTPA**	**Azomethine H**
Ezzat Abad	6.16	7.97	23.98	0.30	0.03	3.84	413	36	46	18	Clay silt loam	0.27	0.71	2.67	2.26	1.69
Ghale Salarieh	7.5	8.02	24.21	0.35	0.02	3.4	425	36	48	16	Clay silt loam	0.36	0.8	2.5	2	1.75
Mehdi Abad 1	8.1	8	25	0.29	0.03	2.76	389	34	50	16	Clay silt loam	0.34	0.76	3.1	1.98	1.05
Mehdi Abad 2	6.72	7.88	23.8	0.3	0.04	3.68	401	28	52	20	Clay silt loam	0.29	0.69	2.85	2.35	1.5
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Sharifi et al. (2010) (16)

Discussion

Most geomorphological units (mountains, hills (Tappeh Mahour), plains) in the region are erodible and have an effective role in sediment production and vegetation reduction of the region. The most important work in reducing the amount of erosion and sediment production in the region is comprehensive management of use of lands as appropriate to their function and in the next stage, grassland management as a factor to control livestock grazing and optimal utilization of grasslands in order to preserve water and soil and vegetation and maintain environmental balance which is necessary and of particular importance. In terms of vegetation in the marl units and formations of the region, the dominant known type is Aeluropus lagopoides and Alhagi camelorum and about twelve companion species that its restoration and establishment in the form of modeling the nature itself will be an important and achievable issue. However, in addition to the mentioned causes of limited vegetation density in marls, studies have shown that erosion-sensitive marls have surface, rill, waterway, and gully erosion types, and it has been found that there is a significant difference between the amounts of salt, gypsum, and lime where solubility of salt is more than gypsum, and gypsum more than lime. This has caused more erosion of salty areas compared to areas that have gypsum and lime, respectively. It was also found that soils with more clay are more stable and more resistant to water erosion. Also, changes in the prevailing microclimate and lack of a balance between livestock and grassland as well as attention to land management and land use have been added to natural and intrinsic factors, and as a result, limitation of vegetation density in most areas has multiplied. It will be of special importance and necessity to pay attention to this issue and determine a unique solution.

Conclusion

The following points are considered as the results of the present study:

- Geologically, in the Precambrian, Paleozoic, and Mesozoic times (except Cretaceous) there was a general absence in the region.

- Dominant geological formations and units in the region in terms of lithology have evaporative sediments and establishment and restoration of vegetation on them will be difficult.

- A large part of the region, based on BLM factor, has high erodability and will be one of the main factors in reducing vegetation density in the region. In this regard, the thick layer and mass limestone unit had the lowest BLM value and river and evaporative deposits had the highest BLM value.

- Hydrodynamic, permeability, and flood exposure were determined in the form of BLM factor. The dominant lithological units of thick-layered resistant limestone in the region were in the low permeability group, and the dominant lithological units of weathered shale with thin mid-layers and veins of evaporative sediments were in the high permeability group, and finally, seasonal riverbed alluvium of agricultural fields and quaternary deposits and debris were in the very high permeability group.

- Examinations showed presence of evaporative sediments, especially saline, due to their capillary properties has caused salt trapping in the land surface and has made the soil of the region prone to being leached and subsequently has severely reduced density of vegetation.

- There are different geomorphological units in the region and in most of them vegetation is insignificant, but the plain unit in the region has a significant expansion compared to other units.

- According to examinations of ecological issues, Aeluropus lagopoides and Alhagi camelorum are known as the two dominant types in the region.

- 16 species were identified in addition to Aeluropus lagopoides and Alhagi camelorum which are listed in Table 1.

- Lime formations and units, thick-layer sandstones and to some extent shale in the region had the least role in sediment production, and evaporative formations and units and deposits had the most role in this regard.

Recommendations

The following are recommended regarding the present study and conducting similar researches in future:

- Due to importance of the subject of marl (high erodability), preparation of a large-scale map of marl and scrutinizing it according to distribution of plants in the region is considered.

- With implementation of the first paragraph, an effective step in preserving water and soil and for sustainable development of the region is taken and its implementation is recommended.

- Implementation of research projects on flood monitoring and control in Marl regions is recommended.

- For restoration of marl regions, it is recommended to pay attention to the time of implementation of the plan or project regarding the study and analysis of vegetation.

- By implementing such a plan based on soil and plant analysis and identification of physical and chemical factors of soil, some species can be suggested to stabilize marl regions.

- Erodability of geomorphological units in the region is very significant and thus, the most important issue to control or reduce it is implementation of grassland protection projects in the region, which is recommended to the relevant executive departments.

- Preservation and restoration of the two types of Aeluropus lagopoides and Alhagi camelorum along with twelve companion species on marl formations is suggested to the relevant executive departments.

References

[1] Tatian, M., R., A., Zabihi, R., Tamrtash, M., Shabani (2011), Identification of plant species introducing some soil properties in grasslands of Qom Salt Mountain using classification technique; Journal of Ecology, 37th Year, No. 58, Summer 2011, pp. 21-28.

[2] Mirzazadeh, S., M., Karimpour Reyhan, M., R., Espahbod (2012), Sedimentology and identification of erodability indices of upper red formation marls in Ivanaki area; Scientific-Research Quarterly of Environmental Geology, 6th Year, No. 19.

[3] Salmasi, R., A., Ahmadi (2012), The relationship between geological features of marls and different forms of erosion in Talkheh Rood basin; Geography and Environmental Sustainability (Geographical Research Journal), Summer 2012, Vol. 2, No. 3; pp. 11-23.

[4] Emami, N., Peyrovan, H., R., Ghayumian, j. (2013), Classification and identification of erosion indices of marls in Chaharmahal and Bakhtiari province; Soil Conservation and Watershed Management Research Institute, p. 158.

[5] Moradi Shams Abadi, S. (2013), Comparison of soil types and some of their characteristics in two parent materials of limestone and marl in grassland and rain-fed land uses in Cheshmeh Ali-Lehderaz region of Chaharmahal and Bakhtiari province; MA Thesis in Shahrekord University, Faculty of Agriculture and Natural Resources.

[6] Hosseini, S., M. (2014), The effect of some grassland plants and parent materials on vertical distribution of the most important physical, chemical, and clay mineralogical properties of soils in Koohrang; Isfahan Industrial University, Faculty of Agriculture and Natural Resources, 2014, MA Thesis, p. 122.

[7] Sokouti Oskouee, R., H., R., Peyrovan, D., Nik Kami, M., H., Mahdian (2015), Investigating the relationship between erodability, erosion forms, and soil losses resulted from three marl types in West Azerbaijan; Journal of Watershed Engineering and Management, 7th Year, No. 4, 2015, pp. 379-388.

[8] Sehati, M., A., Nohegar, E., Esmailpour, H., Gholami (2016), Bio-geomorphological study of marl geological formations with an emphasis on vegetation (case study: the city of Lamerd- Fars province); Vol. 6, No. 2, Fall and Winter 2016, pp. 25-38.

[9] Jozaghian, A., H., Boshra, A., Pahlavan ruy, M., Ajorlu (2016), The effect of clay and gypsum mine extraction on vegetation and soil status of ecosystems in arid regions (case study: Isfahan Segzi Plain); Applied Ecology, 5th Year, No. 15, Spring.

[10] Stendhal, J., et al .2002. Influence of soil mineralogy and chemistry on site quality within geological regions in Sweden. Forest Ecology and Management, 170: 75-88.

[11] Cantero,J.J., et al . 2003. Species richness, alien species and plant traits in central Argentine mountain grasslands. Vegetation Science, 14: 129-136.

[12] White,D.A. , C.S.,Hood .2004. Vegetation patterns and environmental gradients in tropical dry forests of the northern Yucatan peninsula. Vegetation Science, 15: 151-160.

[13] Enrigth,N., J.,Miller, R.,Akhtar .2005. Desert vegetation-environment relationships in Kithara national park, Snide, Pakistan. Arid Environments, 61: 397-418.

[14] Quevedo,D.I. , F.,Frances .2008. A conceptual dynamic vegetation-soil model for arid and semiarid zones. Hydrology and Earth System Sciences, 12, 1175–1187.

[15] Asadi, M., Masoumi, A.A., Khatamsaz, M. Mozaffarian,., (1398-2007). Flora Iran (Vol. 51-1). Publications of Forests and Rangelands Research Institute, Tehran.(in Persian)

[16] SharifiI Rrahman , Hamidreza Peyrowan , Moslem Mozaffari- Ebrahim Farahani, Masoumeh Shiri.(2019). Investigation on the role of plant species on marl formations in erosion control, Case study:(Varamin twonship). Agriculture and Natural Resources Research and Education Center of Tehran Province. .(in Persian).