Geography and human relationships, vol7, no4, Winter 2025, pp:754-753

Investigation of Strategies for Branding and Exporting Pistachio in Iran Utilizing SWOT Model and Delphi Technique

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Submit date: 2024.15.05 accept date: 2024.29.06

Abstract

The specific patterns of life formed on Earth are due to interactions that exist between man and the environment. In this regard, the present study is based on field and documentary data and using MABAC model and GIS, seeks to evaluate and rank the effective natural variables in the location and spatial distribution of castle settlements of west Azerbaijan province in Iran. In order to data analysis, after forming a database, the spatial distribution of identified castle settlements evaluated and analyzed in relation to variables of distance from the river, elevation levels, slope, aspect, landform, climatic classes, land use/vegetation and soil type. Findings obtained from the data analysis in the form of MABAC model show that distance from the river, elevation levels and landform (plain and mountainous) have the most effect on location and spatial distribution of castle settlements in studied region and other natural variables such as climatic classes, land use/ vegetation, soil type, slope and aspect have been effective in spatial distribution of these settlements in terms of importance and effective, respectively.

Key Words: castle settlement, natural factors, Iran, west Azerbaijan, MABAC model.

doi: 10.22034/GAHR.2024.456187.2131 ESSN: 2645-3851

1. Introduction

Environmental capabilities provide the basis for pattern of human settlements in geographical spaces and spatial structure of every place is manifestation of interaction between human society and physical environment around it (Coates et al, 1977:253). Natural factors' effect in formation and distribution of human settlements had been more than other factors; as such natural environment is the bed of all human activities and has many effects on settlement and human settlements function. Human influence from natural environment always provides the causes of spatial distinction in terms of population density and settlement and causes to form special pattern of settlement in different historical period (Mousavi Kouhpar et al, 2011: 1). Of course, over the time, some natural factors lose their importance and some other get important, also, new necessities may cause to change and reorganize of these factors. Generally, settlement pattern in human settlements is more than anything else a reflection of natural environment characteristics which are effective on settlement pattern in the form of roughness and elevation levels, the way of access to water resources and river, climate and weather, vegetation, soil type and so on (Saeidi, 2010: 43-44).

Castle settlements as one of the first forms of human social life in the natural arena was specifically related to environmental and natural factors and discussion about why and how these settlements came into being is not possible without considering natural- environmental factors. In between, castle settlements of West Azerbaijan province which were built in different historical periods were effected by natural- environmental conditions seriously and effect of natural- environmental conditions of West Azerbaijan in emerging castle settlements is undeniable. At the same time, answering to these questions will be difficult that which natural factor was the main factor in choosing a place to build a castle settlement? Is the combination and importance of several factors simultaneously visible in these settlements? How was the spatial distribution pattern of castle settlements of West Azerbaijan province and how have natural- environmental factors been influential in this regard? In this research, these topics are findable. In fact, current study aims to evaluate and rank the natural factors affecting on the location, formation and spatial distribution of castle settlements of West Azerbaijan province based on archeological and geographical studies.

2. Research Background

Study and knowing elements and effective factors in location, formation and spatial distribution of human settlements are of the most important discussion that from the distant past attracts the attention of thinkers and researchers in related fields and various theories and models have been proposed to evaluate and rank the impact of these elements. In this regard, some researchers evaluate and analyze the effect of natural- environmental factors on spatial distribution of human settlements of past period such as cities and archaeological sites, but in no research have addressed the issue of natural- environmental variables in spatial distribution of castle settlements of west Azerbaijan province. Therefore, present study aims to evaluate and rank effective natural- environmental variables in spatial distribution of castle settlements of west Azerbaijan province by using field data and relying on the findings and

results of previous studies. (Table. 1) lists the studies that are closely related to the subject of this research.

Table. 1: Research Background

Researcher	Findings
(Mousavi Kouhpar et al, 2011)	Based on research results, among variables of elevation, weather, distance from the river, vegetation and precipitation rate, two factors of elevation and weather are the most effective environmental factors in formation of ancient settlements of Mazandaran province.
(Maghsoudi et al, 2012)	In this research, the way of distribution of ancient sites is evaluated in relation to variables of climate, slope, geology, distance from the river, geomorphology, land use and elevation and results show that in plains and foothills, the least coefficient of variations belongs to the factor of distance from the river.
(Heidarian et al, 2014)	Results show that elevation, slope, vegetation and distance from the river had more effect than other natural factors on ancient sites distribution. Although, other factors also have a role in this relation.
(Bahraminia et al, 2014)	Based on research results, among variables of elevation, slope, aspect, distance from the river, distance from the connecting road, land structure and existed faults, distance from the river factor has the most effect on spatial distribution of ancient sites.
(Aftab et al, 2014)	Study results show that access to water resources, precipitation, weather; land use and land form had the most effect on scattering ancient centers of west Azerbaijan province.
(Maghsoudi et al, 2016)	Based on research results, most of settlements are established at the end part of the alluvial fans. Among this, Transverse displacement on alluvial surface was mostly due to change of channel bed or flood events.
(Shaikhi et al, 2017)	In this research, variables of distance from springs, distance from rivers, distance from aqueducts and water wells, distance from Malraux roads and distance from cemeteries are evaluated as effective variables in scattering ancient sites. Based on research findings, distance from permanently rivers had the most effect on establishing ancient places.
(NaseriSome and Niknami, 2017)	Findings show that region characteristics, specially water resources, elevation and climate are of important factors in forming establishment patterns of BostanAbad county. In between, rivers' role causes that sites form in a line pattern method along with rivers' flow.
(Behzad and Asadian, 2017)	Based on research results, among variables of elevation, slope, geographical directions, precipitation, temperature, erosion, distance from river, distance from fault, land use and type of geological formation, three factors of precipitation, geographical direction and type of geological formation have the most effect on antiquities destruction.
(Riahiyan Gohorti et al, 2019)	Based on research results, elevation from sea and the way accessing to water resources have the most role in location and form of studied region settlements. Based on this, the role of environmental factors are important in tradition of migration and relocation within the region and evaluation of scattering the settlements are based on the chronology stone and copper which indicates an increase in population in this area.

3. **Research Method**

The present article is a descriptive-analytic in terms of entity and research method and data gathering method is documentary and filed. The method is based on utilization of GPS in order to register the geographical coordination of castle settlements in West Azerbaijan province, utilization of GIS in order to show spatial distribution of these settlements and using MABAC (multi-attributive border approximation area comparison) model in order to evaluate and rank the effective natural factors in location and spatial distribution of castle settlements in West Azerbaijan province. MABAC method is one of the new and accurate techniques of multi-attributive decision-making which has been introduced by Pamučar, D. and Ćirović, G. in 2015 (Pamučar and Ćirović, 2015). The goal of this method is to rank alternatives in a multi-attributive decision-making model. This method analyzes data in several steps:

First step: formation of the initial decision matrix (X):
In this step, the number of m alternatives and n criteria are evaluated. Alternatives are shown in the form of vectors $A_i= (x_{i1}, x_{i2},\ldots,x_{in})$, in which xij specifies the status of i^{th} alternative in j^{th} criterion. Based on this, initial decision matrix is formed according Equation (2).

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \qquad (2)$$

Second step: normalization of the elements from the weighted matrix (N)
As it is possible that the type of every criterion be different, the matrix is normalized in this step to neutralize the effect of different scale of the criteria. For doing this and according to the type of every criterion, Equation (4) is used for normalization of positive criteria and Equation (5) is used for normalization of negative criterion. Normal decision matrix is shown by N.

$$N = \begin{bmatrix} n_{11} & \cdots & n_{1n} \\ \vdots & \ddots & \vdots \\ n_{m1} & \cdots & n_{mn} \end{bmatrix} \qquad (3)$$

The elements of the normalized matrix N are calculated using the following equations:

$$n_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \qquad (4)$$

$$w_j = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \qquad (5)$$

In Equation (4) and (5), x_{ij}, x_i^- and x_i^+ are elements of initial matrix (X) and x_i^- and x_i^+ are defined as follow:

- **X_i^+=max (x_1,x_2,…,x_m) shows the maximum value that is seen among alternatives in a specified criterion.**
- **X_i^-=max (x_1,x_2,…,x_m) shows the lowest value that is seen among alternatives in a specified criterion.**

Third step: calculation of the elements from the weighted matrix (V)
In this step, by using Equation (6) we weight the normal matrix. In fact, as these criteria have different weight in evaluation process, weighted normal matrix elements should calculated based on Equation (6).

$$v_{ij} = w_i.(n_{ij} + 1) \qquad (6)$$

In this Equation, n_{ij} is the elements of normal matrix (N) and w_i is the i^{th} criterion weight, which should be obtained from other methods such as Shanon Entropy, AHP, BWM and SWSRA methods. Also, v_{ij} is formed the elements of weighted matrix V.
Fourth step: determining the border approximation area matrix (G)
In this step, border approximation area matrix is determined for every criterion based on Equation (7). Therefore, if border approximation area matrix G is considered, geometric mean of elements of every column should be calculated in weighted matrix.

$$g_j = \left(\prod_{i=1}^{m} v_{ij} \right)^{\frac{1}{m}} \qquad (7)$$

Fifth step: calculation of distance of the alternatives from the border approximation area (Q)
In this step, alternatives distance from border approximation area is determined for matrix elements (Q) according Equation (8) which is equal difference between elements of weighted matrix (V) and value of border approximation area (G).

$$Q = V - G = \begin{bmatrix} v_{11} & \cdots & v_{1n} \\ \vdots & \ddots & \vdots \\ v_{m1} & \cdots & v_{mn} \end{bmatrix} - \begin{bmatrix} g_{11} & \cdots & g_{1n} \\ \vdots & \ddots & \vdots \\ g_{m1} & \cdots & g_{mn} \end{bmatrix} \qquad (8)$$

After determining the matrix value Q, we can determine the condition of every alternative by defining the border approximation area (G), the top limit of approximation area (G^+) and low limit of approximation area (G^-). Based on this, alternative A_i belongs to the mentioned society. In this definition, the top limit of approximation area (G^+) is an area that ideal alternative (A^+) is located and the low limit of approximation area (G^-) is an area that anti-ideal alternative (A^-) exist in it. Belonging value of alternative A_i to mentioned society is obtained based on Equation (9).

$$Q = V - G = \begin{bmatrix} v_{11} & \cdots & v_{1n} \\ \vdots & \ddots & \vdots \\ v_{m1} & \cdots & v_{mn} \end{bmatrix} - \begin{bmatrix} g_{11} & \cdots & g_{1n} \\ \vdots & \ddots & \vdots \\ g_{m1} & \cdots & g_{mn} \end{bmatrix} \qquad (9)$$

Based on the logic of MABAC method, for alternative A_i to be the best alternative in the alternatives set, it is necessary that it be closer than other alternatives to the top limit of approximation area (G^+).
Sixth step: ranking and selection of optimal alternatives
In the final step of MABAC method, the value of criteria functions for alternatives is calculated based on the sum of distance alternatives from border approximation area (q_i) according to Equation (10). In this Equation, n is criteria number and m is the number of alternatives. By calculating the sum of Q matrix elements as a fraction, the final value of the criteria functions for each alternative is determined and is the basis for ranking the alternatives.

$$S_i = \sum_{j=1}^{n} q_{ij} \qquad (10)$$

4. **Studied Area**

West Azerbaijan province without calculating Urmia Lake by area of 37412 square kilometer (2.25 percent of area of total country) between 44 degree and 3 minutes to 47 degree and 24 minutes east longitude and 36 degree and 5 minutes to 39 degree and 46 minutes of north longitude is located in northwest of Iran. This province is bounded on north by autonomous republic of Nakhchivan and Turkiye, on the west by Turkiye and Iraq, on the east and southeast by the provinces of east Azerbaijan and Zanjan, and on the south by Kurdistan province (Figure. 1). The main roughness in this province is located in its western part; i.e.

in =the border areas of Iran with Turkiye and Iraq. In fact, these heights are extended along Armenia Mountains which are extended on north to south and finally they lead to northern Zagros mountain chain (National Planning and Budget Organization, 2016).

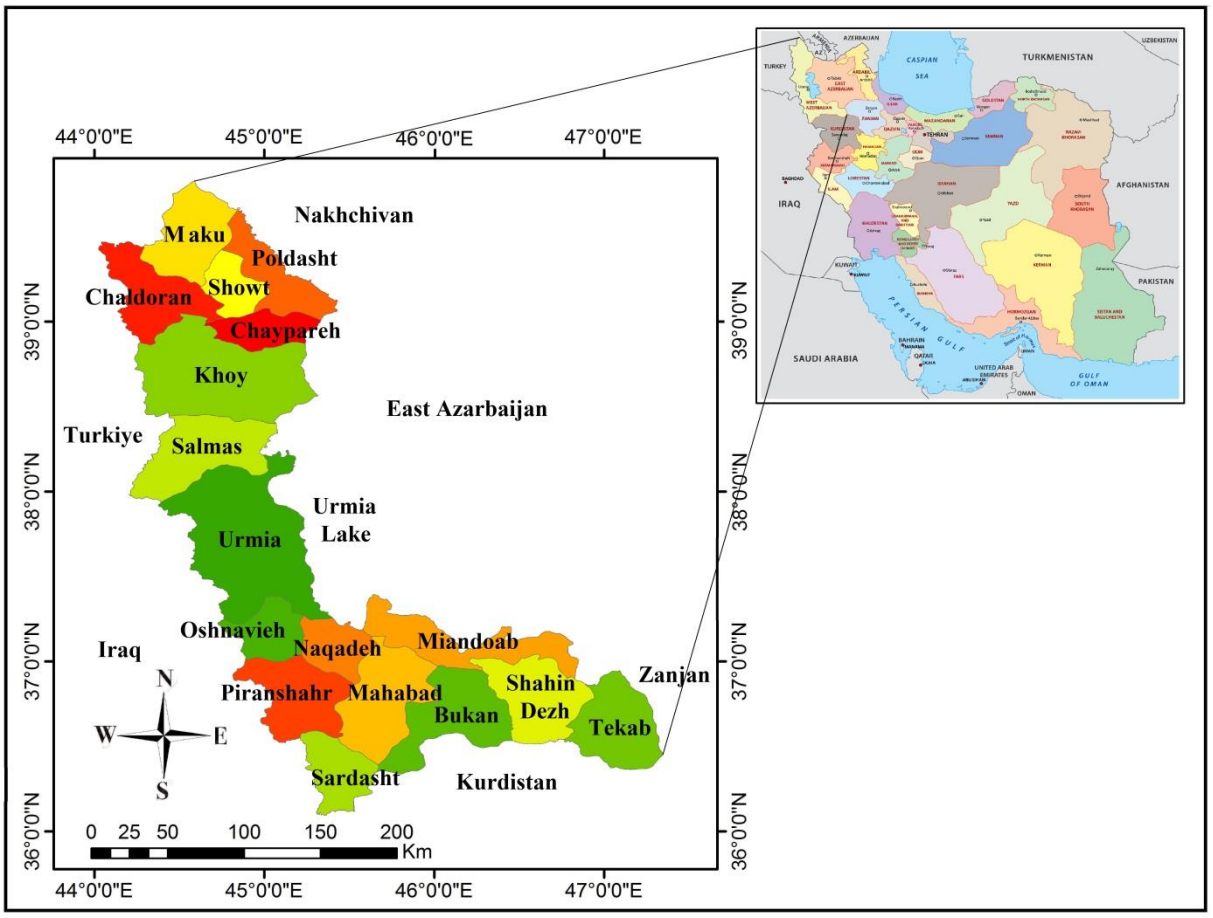

Figure. 1: Location of West Azerbaijan Province in Iran

5. Research Findings

1.5. Spatial and Temporal Distribution of Castle Settlements of West Azerbaijan Province

Based on library and field surveys and by using data and statistical reports of general directorate of cultural heritage, handicrafts and tourism of west Azerbaijan province, 100 castle settlements in west Azerbaijan province were identified and evaluated. These castles have been shown by digitizing on polygon maps by using GIS software with different colors. Some of castle settlements are single-period and are characteristics for a special period, but many of castles have several settlement periods which numbers and their percent are listed separately in (Table. 2), and all percentages are based on the total summation of province castle settlements.

Table. 2: Distribution of Castle Settlements in West Azerbaijan by County, Area and Period

County	Area (km2)	Per.	Number of castles	Per.	Prehistoric	Per.	Historic	Per.	Islamic	Per.
Maku	1931	5.16	4	%4	2	6.06	1	1.53	1	1.96
Poldasht	1508	4.03	1	%1	0	0	1	1.53	0	0
Showt	931	2.48	1	%1	0	0	1	1.53	0	0
Chaldoran	1991	5.32	1	%1	0	0	1	1.53	0	0
Chaypareh	1036	2.77	3	%3	0	0	2	3.07	1	1.96
Khoy	4521	12.08	14	%14	2	6.06	8	12.30	9	17.64
Salmas	2553	6.82	10	%10	2	6.06	10	15.38	2	3.92
Urmia	5312	14.19	15	%15	4	12.12	7	10.76	13	25.49
Oshnavieh	1187	3.17	3	%3	1	3.03	2	3.07	2	3.92
Naqadeh	1140	3.04	3	%3	0	0	2	3.07	2	3.92
Piranshahr	2178	5.82	6	%6	3	9.09	4	6.15	2	3.92
Miandoab	2174	5.81	1	%1	0	0	1	1.53	1	1.96
Mahabad	2632	7.03	4	%4	4	12.12	4	6.15	1	1.96
Sardasht	1385	3.70	4	%4	2	6.06	4	6.15	0	0
Bukan	2502	6.68	12	%12	7	21.21	10	15.38	5	9.80
Shahin Dezh	2256	6.03	4	%4	2	6.06	1	1.53	2	3.92
Tekab	2175	5.81	14	%14	4	12.12	6	9.23	10	1.96
Total	37412	100	100	100	33	100	65	100	51	100

2.5. Effective Natural-Environmental Factors in Location and Spatial Distribution of Castle Settlements of West Azerbaijan Province

Various environmental- natural factors have an impact on the location, formation and spatial distribution of castle settlements in west Azerbaijan province, which 8 cases of these factors are evaluated in spatial distribution of these settlements in the following:

1.2.5. **Distance From the River**

Rivers are the main source of water supply for humans and other creatures (Esfandyari & nezafat taklhe, 2023: 43). General situation of west Azerbaijan province is approximately suitable in terms of access to water resources; because in this province, watery rivers such as Zarrineh River, Simineh River, Shahr River, Nazlou River, etc. are flowing. In evaluation the spatial distribution of castle settlements in west Azerbaijan province, the location pattern of these settlements in relation to main water resources (seasonal and permanent rivers) has been evaluated. Based on obtained data from hydrographic layer of this province, the most number of castle settlements are located at the distance less than 2000 meters from the river (34 percent) and as distance from the river and water resources increase, the number of castle settlements decrease (Table. 3). This problem shows that in this province, proximity to water resources and rivers is of basic needs of castle guards and castle dwellers. Based on this, distance of castle settlements of west Azerbaijan province from rivers has been shown in (Figure. 2).

Table. 3: Distribution of West Azerbaijan Castle Settlements in Relative Distance from the River

Distance from river (m)	Area (km2)	percent	Number of castles	percent
0- 2000	10667.8646	28.68	34	34
2000-4000	9050.6898	24.33	22	22
4000-6000	6899.8743	18.55	21	21
6000-8000	4761.1701	12.80	15	15
Over 8000	5805.6821	15.61	8	8

2.2.5. **Elevation Levels**

Form and land face and especially elevation factor is very effective in distribution and formation human settlements. Basically, very high altitudes do not attract people. Generally, very high elevation is undesirable and difficult for settlement due to slope, lack of soil formation, difficulty in communications, pressure decreasing and low oxygen (Istalaji and Ghadiri Masoom, 2005: 126). Sites distribution in different elevation levels is one of the important factors that are important in ancient centers. The elevation factor, in addition to argue roughness or smoothness of ancient settlements bed, also effects on amount of precipitation and vegetation by decreasing temperature and thus the richness of vegetation. According to direct relationship of the elevation increase in decreasing temperature and frosting, ancient sites compaction will be very low in very high areas (Rezaloo et al, 2018: 351). Elevation factor effects on climatic factors such as temperature, precipitation and evaporation and can effect directly on location of settlements. In addition to effect on climatic elements, elevation is effective in soil production and suitable or unsuitable situation of settlement. West Azerbaijan province has been located in moderate mountainous to semi-arid geographical conditions and its height varies between 620 meters at the exit of the Zab River from Iran to 3622 meters in Khoy County. The mountains chain of this province is extended in north-south and southeast direction and Urmia Lake is located in the east. In evaluation of spatial distribution of castle settlements in west Azerbaijan province, place situation of these settlements are evaluated in relation to sea level. Based on obtained data in relation to elevation points of this province, most of spatial distribution of castle settlements are located in elevation between 1000 to 2000 meters (78 percent) and as this elevation increases, the number of castle settlements decreases; so that at elevation of less than 1000 meters (3 castles) and at elevation of more than 2500 meters (3 castles), castle settlements can rarely be found (Table. 4). This is due to provide better defensive conditions in more elevation which castles builders have paid attention to this issue from the long past. Based on this, elevation of these settlements from sea level has been shown in (Figure. 3).

Table. 4: Distribution of West Azerbaijan Castle Settlements at Different Elevation Levels

Elevation floors (m)	Area (km2)	percent	Number of castles	percent
0-1000	1799.5779	4.90	3	3
1000-1500	11899.7321	32.42	38	38
1500-2000	13199.9317	35.96	40	40
2000-2500	7349.0334	20.02	16	16

Over 2500	2455.1255	6.68	3	3

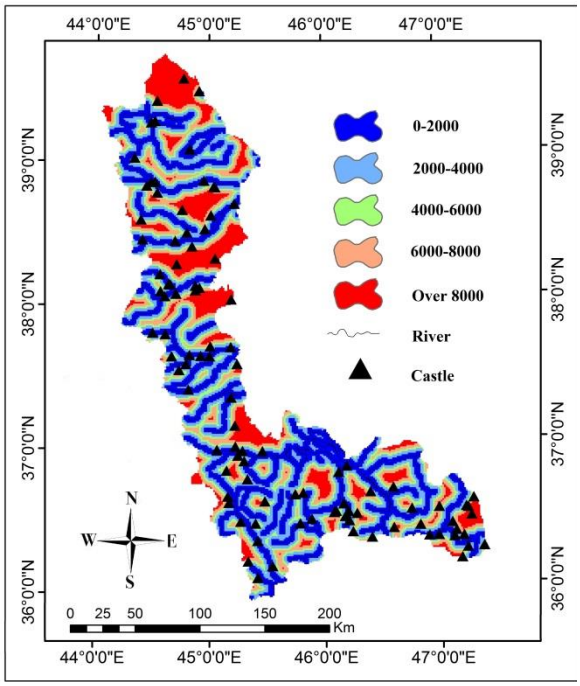

Figure. 2: Spatial Distribution of West Azerbaijan Castle Settlements in Relative Distance from the River

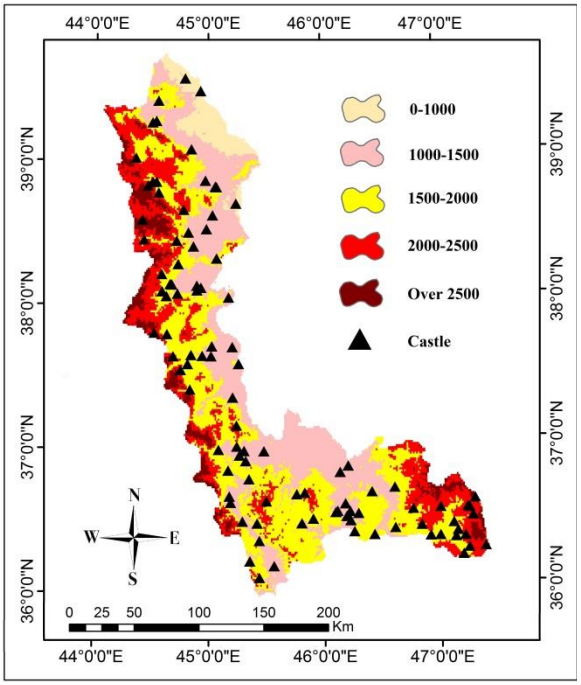

Figure. 3: Spatial Distribution of West Azerbaijan Castle settlements at Different Elevation Levels

3.2.5. **Slope**

One of the characteristics that had been effective in location human settlements since ancient times is slope of the earth. The amount (percent) and aspects of a region have affected on soil quality, water resources control, degree of erosion, vegetation, how to build settlements and etc. Differences in the slope of ground sometimes indicate their various uses (Rezaloo et al, 2018: 352). Based on given standard from international geographical union, the maximum slope for the establishment of human settlements shouldn't exceed 11 degree; of course this value varies depend on environmental conditions. Based on obtained data from slope layers in west Azerbaijan province, most of castle settlements are located in layers between 0 to 12 percent and layers 5-8 percent have been the most normal place for location and formation of castle settlements and defensive fortifications (Table. 5). In evaluation of spatial distribution of castle settlements of this province, location pattern of these settlements are evaluated in terms of land slope percent. Based on this, the effect of land slope percent in spatial distribution of castle settlements in west Azerbaijan province has been shown in (Figure. 4).

Table. 5: Distribution of West Azerbaijan Castle Settlements in Relative Slope

Slope (%)	Area (km2)	percent	Number of castles	percent
0-2	7459.8046	20.32	19	19
2-5	9907.6664	26.99	21	21
5-8	7906.5212	21.54	25	25
8-12	6375.6996	17.37	21	21
12-15	2337.0906	6.36	5	5

15-30	2653.0609	7.22	9	9
Over 30	63.5572	0.17	0	0

4.2.5. **Aspect**

Geographical directions and slope have an important role in ecological environment of a region. Its first effect is on climate and mass movements. Another effect is the amount of sunlight received and formation of slope convection that can have a significant impact on the ecological environment and human settlements (Aftab et al, 2014: 46). Based on obtained data from aspect layer in west Azerbaijan province, most of castle settlements are located in lands with east aspect and the least number of castles are located in flat lands and without slope (Table. 6). In evaluation of spatial distribution of castle settlements in west Azerbaijan province, location pattern of these settlements in terms of aspect was examined. Based on this, the effect of aspect on the spatial distribution of castle settlements in west Azerbaijan province has been shown in (Figure. 5).

Table. 6: Distribution of West Azerbaijan Castle Settlements in Relative Aspect

Aspect	Area (km2)	percent	Number of castles	percent
Flat lands	3.6318	0.009	0	0
North	4757.7137	12.96	18	18
Northeast	6602.6897	17.98	14	14
East	6190.4756	16.86	19	19
Southeast	4498.0370	12.25	11	11
South	4049.5044	11.03	7	7
Southwest	3506.5439	9.55	6	6
West	3452.0663	9.40	17	17
Northwest	3642.7380	9.92	8	8

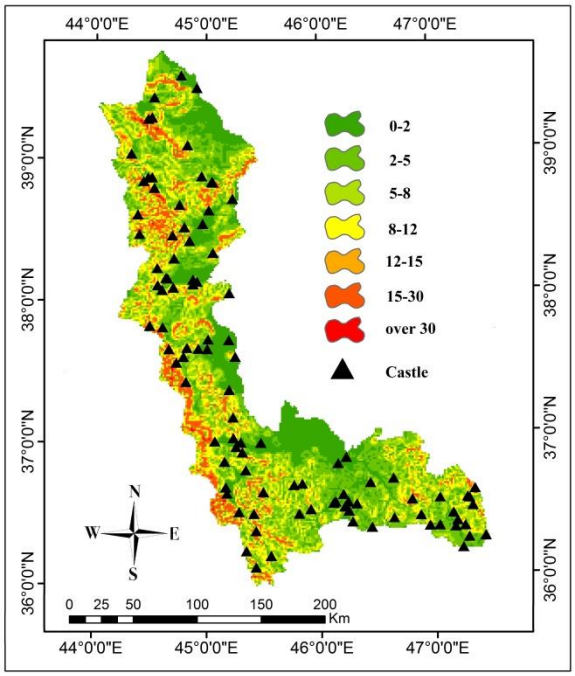

Figure. 4: Spatial Distribution of West Azerbaijan Castle Settlements in Relative Slope

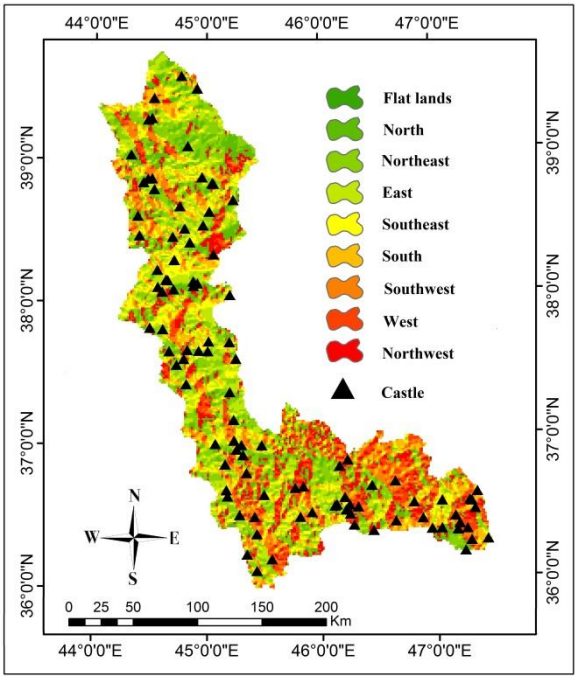

Figure. 5: Spatial Distribution of West Azerbaijan Castle Settlements in Relative Aspect

5.2.5. **Landform**

Landform is a land complication or land face that its formation is structured by natural processes in a way that can be defined and described by index complications and if identified, the landform shows information about its structure together with combination, texture or integrity. Existence of different types of landforms and their diversity mainly is controlled by changing in the shape and position of the land. Therefore, classification and identifying different regions is essential according to their morphometric characteristics (Mokarram & Negahban, 2015: 57). Land area of Azerbaijan region in terms of topography is a relatively high plateau which splits into two unequal east and west parts by Urmia hole subsidence area. In terms of natural conditions, west Azerbaijan province has been significantly affected by the location of the border mountains chain of Iran and Turkiye. According to northern-southern trend, these mountains chain have been effective on geographical and natural conditions of the province by different ways. Based on obtained data from landform evaluation in West Azerbaijan province, most area of this province is covered with mountains and highlands (71%) and by dividing this province into two parts of mountainous and plain, the number of castle settlements in mountainous region (60 castles) is more than plain regions (40 castles) (Table. 7). Based on this, spatial distribution of castle settlements of West Azerbaijan province in relation with land form (plain and mountainous) has been shown in (Figure. 6).

Table. 7: Distribution of West Azerbaijan castle Settlements in Plain and Mountainous Areas

Landform	Area (km2)	percent	Number of castles	percent
Plain	10883.0244	28.93	40	40
Mountainous	26724.9176	71.06	60	60

6.2.5. **Climatic Classes**

Climatic is effective in settlement system of geographical settlements directly or indirectly. In fact, climate effects on weather directly and effects on roughness, water resources and vegetation indirectly and finally determine the livelihood system (Saeidi, 2010: 5). Climatic importance in formation of human settlements is so that a little change in climatic elements can disturb the environmental balance of the settlement. Therefore, climate has always been considered as one of the most effective factors in providing environmental comfort. Studying the climate effect in human settlements establishment is not a new subject and historically, it dates back to the fourth century BCE and probably much earlier. West Azerbaijan province mainly is affected by humid air flow of Mediterranean Sea and Atlantic Ocean, but in some winter months, cold air masses from the North have affected the Mediterranean air and cause to decrease temperature considerably. In addition to above air flow, other factors such as palace height, mountain direction, wind blow and distance from open seas have an important role in temperature and atmospheric precipitation. As such it puts the climate between the climate of Caspian Sea coasts and internal semi-desert climate. In the meantime, mountain's role in the West Azerbaijan province is very important in atmospheric precipitation. Based on obtained data, the most climatic extension in West Azerbaijan province is semi-arid climate (62.71%) and after that Mediterranean climate (23.15%) and the highest distribution

of castle settlements is in these two climates (85 castles). The least climatic extension of this province is related to very humid climate (2.71%) which in this type of climate, there are three castle settlements (Table. 8). Based on this, spatial distribution of castle settlements of West Azerbaijan province in relation with climatic classes has been shown in (Figure. 7).

Table. 8: Distribution of Castle Settlements of West Azerbaijan in Different Climatic Classes

Climate classes	Area (km2)	percent	Number of castles	percent
Semi-arid	23307.3495	62.71	65	65
Mediterranean	8605.6509	23.15	20	20
Sub-humid	1899.4536	5.11	6	6
Humid	2340.7225	6.29	6	6
Super-humid	1009.6522	2.71	3	3

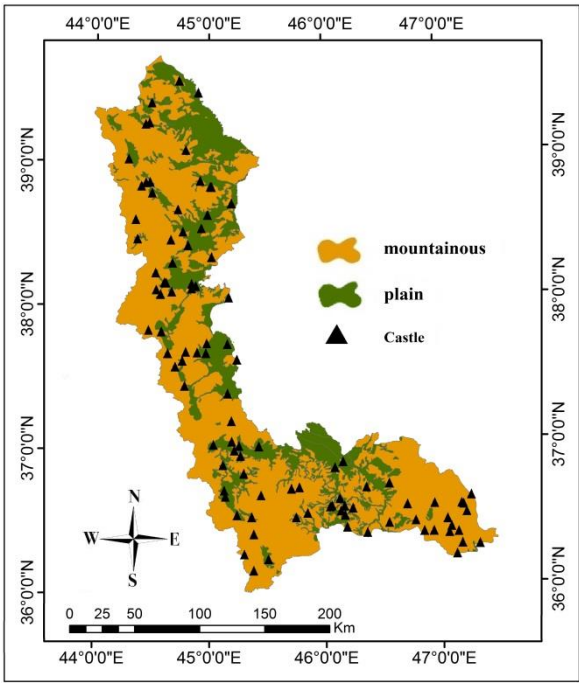

Figure. 6: Spatial Distribution of West Azerbaijan Castle Settlements in Plain and Mountainous Areas

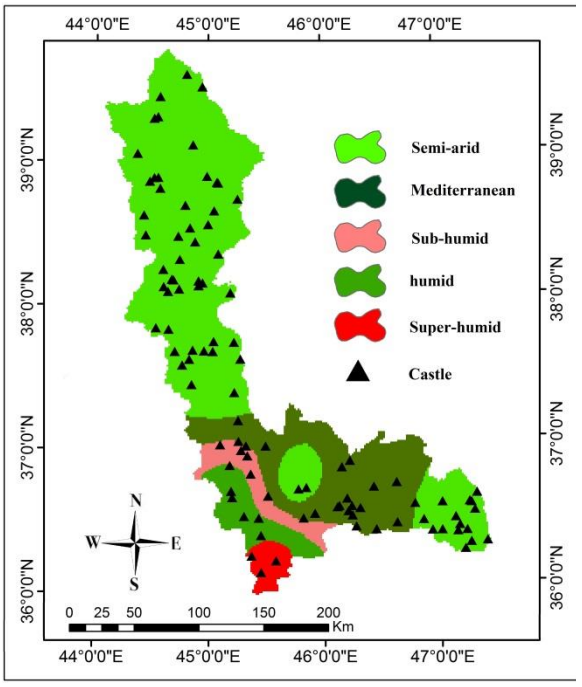

Figure. 7: Spatial distribution of Castle settlements of West Azerbaijan in Different Climatic Classes

4- 7.2.5. Land Use and Vegetation

Studying the pattern of ancient centers distribution in relation to land use is noteworthy because it is likely that the area that currently used as pastures or agricultural lands had suitable lands for cultivation and uses of pastures for nomads. Therefore, it is argued that in the past, pastures and agricultural lands provided suitable conditions for human habitation; because in the past, humans were depended on places that along with enough lands for their cultivation could also hunt and gathering food (Seyed Sajjadi, 2005: 122). In studied region, Based on obtained data, pastures (53.47%) and agricultural lands (41.47%) have the most extension of land use in West Azerbaijan province and the most distribution of castle settlements in these lands, i.e. pastures (49 castles) and agricultural lands (44 castles) are seen

(Table. 9). Based on this, spatial distribution of castle settlements of West Azerbaijan province in relation with land use and vegetation type has been shown in (Figure. 8).

Table. 9: Distribution of West Azerbaijan Castle Settlements by Land Use and Vegetation Type

Land use	Area (km2)	percent	Number of castles	percent
Agriculture	15556.9841	41.74	44	44
Jungle	833.8382	2.23	2	2
Pasture	19847.0844	53.47	49	49
Rock	11.5902	0.03	0	0
Residential	198.6012	0.53	5	5
Water body	80.7264	0.21	0	0
Wasteland	656.5149	1.76	0	0

8.2.5. **Soil Type**

Soil is influenced by climate, geological features, roughness, water resources and vegetation in every region has different capabilities for different agricultural products and as a result it effects on region livelihood structure and settlement pattern of human settlements. Therefore, in the distribution of ancient settlements, soil quality and quantity has been very important for its further exploitation. Based on the layer data related to soil type, west Azerbaijan province has seven types of soil, which "Rock Outcrops/Entisols" have the most expansion (43.94%). The most distribution of castle settlements of this province is first in the soil of "Inceptsols" (50 castles) and then in the soil of "Rock Outcrops/Entisols" (40 castles); whereas, in the soil of "Water Body" and "Entisols/ Inceptisols" no castle settlements has not been seen (Table. 10). In evaluation of spatial distribution of castle settlements in west Azerbaijan province, location pattern of these settlements are evaluated in terms of soil type. Based on this, the effect of soil type in location and spatial distribution of castle settlements of west Azerbaijan province has been shown in (Figure. 9).

Table. 10: Distribution of West Azerbaijan Castle Settlements by Soil Type Classes

Soil type	Area (km2)	percent	Number of castles	percent
Aridisols	3207.8798	8.67	4	4
Entisols/Aridisols	180.5607	0.48	1	1
Entisols/Inceptisols	195.363	0.52	0	0
Inceptisols	13664.2969	36.89	50	50
Rock Outcrops/Entisols	16247.7341	43.94	40	40
RockOutcrops/Inceptisols	3066.8021	8.29	6	6
Water Body	434.4587	1.17	0	0

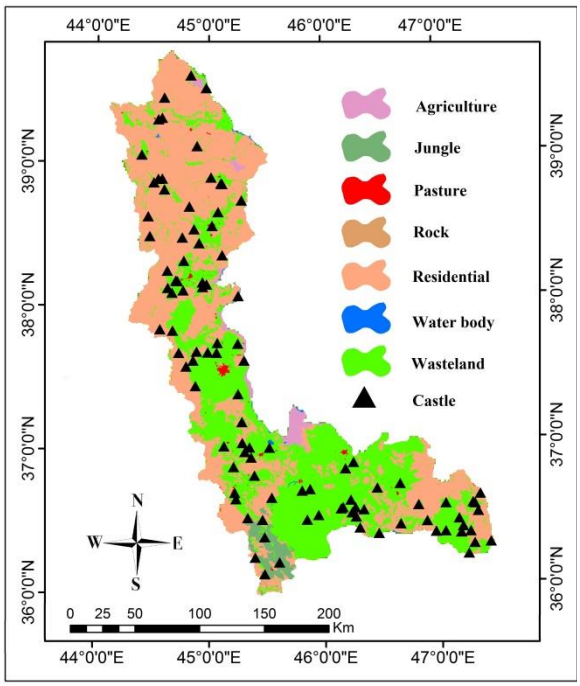

Figure. 8: Spatial Distribution of West Azerbaijan Castle Settlements by Land Use and Vegetation

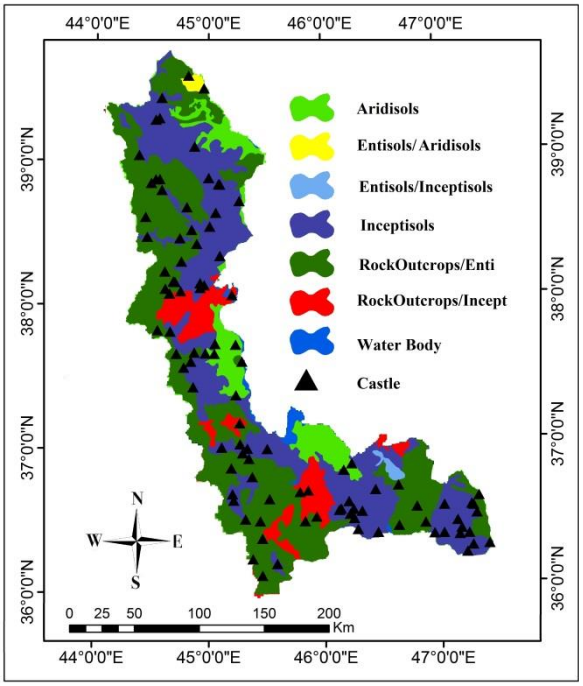

Figure. 9: Spatial Distribution of West Azerbaijan Castle Settlements by Soil Type

6. Ranking of Natural Variables in Location and Spatial Distribution of Castle Settlements of West Azerbaijan By MABAC Model

Using MABAC model, natural variables (distance from the river, elevation levels, slope, aspect, landform, climatic classes, land use/ vegetation and soil type) were ranked and scaled based on experts' opinion during following steps. In this regard, at the first step, initial decision matrix was formed according to Equation (2). In fact, Initial decision matrix of this method is evaluation of 8 index (alternative) based on experts' opinion in which 10 experts scored every alternative based on 1 to 5 spectrum (1=very low to 5=very much). Initial decision matrix showed in (Table. 11), which experts are determined by E1 to E10.

Table. 11: MABAC Initial Decision Matrix

Alternative	Criterion									
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Slope	1	1	3	4	1	2	4	2	3	2
Elevation levels	4	2	4	4	5	5	5	3	3	5
Climatic classes	1	2	2	2	5	3	3	3	4	5
Distance from river	5	5	3	5	2	5	2	5	5	4
Land use	1	1	3	4	3	2	5	5	3	1
Landform	4	3	5	3	3	2	1	4	3	4
Soil type	3	2	2	5	3	2	4	1	1	1
Aspect	3	2	2	1	3	3	1	2	1	3

In the next step, by using Equations (4) and (5), initial decision matrix is normalized (Table. 12), and then based on Equation (6), it multiplies in alternatives' weight that obtained from SWARA method to obtain weighted matrix. Then by using Equation (7), border approximation area matrix (G) is calculated for every alternative (Table. 13).

Table. 12: Normalization of Initial Decision Matrix

Alternative	Criterion									
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Slope	0.000	0.000	0.333	0.750	0.000	0.000	0.750	0.250	0.500	0.250
Elevation levels	0.750	0.250	0.667	0.750	1.000	1.000	1.000	0.500	0.500	1.000
Climatic classes	0.000	0.250	0.000	0.250	1.000	0.333	0.500	0.500	0.750	1.000
Distance from river	1.000	1.000	0.333	1.000	0.250	1.000	0.250	1.000	1.000	0.750
Land use	0.000	0.000	0.333	0.750	0.500	0.000	1.000	1.000	0.500	0.000
Landform	0.750	0.500	1.000	0.500	0.500	0.000	0.000	0.750	0.500	0.750
Soil type	0.500	0.250	0.000	1.000	0.500	0.000	0.750	0.000	0.000	0.000
Aspect	0.500	0.250	0.000	0.000	0.500	0.333	0.000	0.250	0.000	0.500

Table. 13: MABAC Weighted Matrix & Border Approximation Area (G)

Alternative	Criterion									
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Slope	1.000	1.000	1.333	1.750	1.000	1.000	1.750	1.250	1.500	1.250
Elevation levels	1.750	1.250	1.667	1.750	2.000	2.000	2.000	1.500	1.500	2.000
Climatic classes	1.000	1.250	1.000	1.250	2.000	1.333	1.500	1.500	1.750	2.000
Distance from river	2.000	2.000	1.333	2.000	1.250	2.000	1.250	2.000	2.000	1.750
Land use	1.000	1.000	1.333	1.750	1.500	1.000	2.000	2.000	1.500	1.000
Landform	1.750	1.500	2.000	1.500	1.500	1.000	1.000	1.750	1.500	1.750
Soil type	1.500	1.250	1.000	2.000	1.500	1.000	1.750	1.000	1.000	1.000
Aspect	1.500	1.250	1.000	1.000	1.500	1.333	1.000	1.250	1.000	1.500
BAA (G)	1.388	1.283	1.295	1.587	1.498	1.278	1.480	1.492	1.432	1.480

In the following by using Equation (8), alternatives distance from border approximation area matrix (Q) is determined (Table. 14) and finally by using Equation (10), final score of alternatives has been calculated and scored (Table. 15). According this, distance from the river, elevation levels and landform have obtained first, second and third ranks, respectively.

Table. 14: Alternatives Distance From Border Approximation Area Matrix (Q)

Alternative	Criterion									
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
Slope	0.388-	0.283-	0.039	0.163	0.498-	0.278-	0.270	0.242-	0.068	0.230-
Elevation levels	0.362	0.033-	0.372	0.163	0.502	0.722	0.520	0.008	0.068	0.520
Climatic classes	0.388-	0.033-	0.295-	0.337-	0.502	0.055	0.020	0.008	0.318	0.520
Distance from river	0.612	0.717	0.039	0.413	0.248-	0.722	0.230-	0.508	0.568	0.270
Land use	0.388-	0.283-	0.039	0.163	0.002	0.278-	0.520	0.508	0.068	0.480-
Landform	0.362	0.217	0.705	0.087-	0.002	0.278-	0.480-	0.258	0.068	0.270
Soil type	0.112	0.033-	0.295-	0.413	0.002	0.278-	0.270	0.492-	0.432-	0.480-
Aspect	0.112	0.033-	0.295-	0.587-	0.002	0.055	0.480-	0.242-	0.432-	0.020

Table. 15: Ranking of Alternatives

Alternative	Q	rank
Slope	1.378-	7
Elevation levels	3.205	2
Climatic classes	0.372	4
Distance from river	3.372	1
Land use	0.128-	5
Landform	1.038	3
Soil type	1.212-	6
Aspect	1.878-	8

7. Conclusion

During different periods of human life, complications and natural- environmental phenomena have been had much effect on location, formation, spatial distributions, sphere of influence, communication and form and visual and physical appearance of human settlements. Castle settlements also were not exception and like other human settlements were formed under the effect of different natural- environmental factors. In this regard in present study, in order to evaluate and rank the effective natural factors in spatial distribution of castle settlements of west Azerbaijan province, 8 natural variables (distance from the river, elevation levels, slope, aspect, landform, climatic classes, land use/ vegetation and soil type) were evaluated and analyzed as effective variables in location, formation and spatial distribution of these settlements.

Statistical data from natural- environmental variables effect analysis in spatial distribution of castle settlements of west Azerbaijan show that distance less than 2000 meters from the river (abundance of 34 castles), elevation of 1500 to 2000 meters (abundance of 40 castles), slope of 5-8 percent (abundance of 25 castles), east aspect (abundance of 19 castles), mountains region (abundance of 60 castles), semi-arid climate (abundance of 65 castles), pastures (abundance of 49 castles) and inceptisols soil (abundance of 50 castles) have the most abundant of castle settlements among evaluated eight natural variables classes. Results of evaluation and ranking of effective natural factors in spatial distribution of castle settlements of studied region by using MABAC model show that distance from the river, elevation levels and landform (plain and mountainous) have more effect on spatial distribution pattern of these settlements and other natural variables such as climatic classes, land use/ vegetation, soil type, slope and aspect are also effective in spatial distribution of these settlements in terms of importance and impact, respectively. Therefore, statistical and environmental data show that access to water resources and river and location in highlands and mountainous area were of the most important natural elements in location, formation and spatial distribution of castle settlements of west Azerbaijan and other factors in turn, also were effective in this regard.

Acknowledgment

The authors would like to thank the two anonymous reviewers for their helpful comments.

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