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Effect of Quantitative Characteristics of Hydrology and Topography on the Spatial Distribution Pattern of Nomad Camps in Kermanshah Province

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ABSTRACT

The reason for this study was the lack of a coherent work on the role of quantitative characteristics of hydrology and topography in determining the spatial distribution pattern of nomad camps in Iran. In this investigation, Kermanshah Province, in west of Iran, was studied. Quantitative hydrology and Topography indices of the province including Heterogeneity Index (TRI), Topographic Wetness Index (TWI), Altitude, slope, slope direction, stream distance, ridge distance, spring distance, formation type, Topographic Position Index (TPI), Surface Relief Ratio (SRR), and Compound Topographic Index (CTI) were calculated. To determine the results, Pearson correlation and linear regression (for parametric data) and LOWESS regression (for non-parametric data) were used between hydrology and topography data and the camps' area. Then, the type of spatial distribution pattern and spatial pattern type radius of the camps were determined for each one of the above-mentioned factors using Moran's Autocorrelation Index and Ripleys' K Function, respectively. There was a significant relationship between the TPI index (the steep slope landform) and the camps' area. In sum, the first priority in determining the regular pattern of nomads in the Kermanshah Province considers two heterogeneity and slope indices, and the second priority is among the rest of hydrology and topography indices. The nomads' almost identical choices in selecting location of their camps are dependent on access to non-jagged lands, flat lands, the places with more than 600 m distance from the ridges and less than 500 m from the streams and 2 km distance from the springs, special ranges of TWI, CTI and SRR indices, the altitude range of 1,400 to 2,000 m above sea level, and establishment in the Landform 3 range of the TPI index and limestone formation.

Keywords: Heterogeneity index, Hydrology and topography indices, Moran's Autocorrelation Index, Surface relief ratio.

INTRODUCTION

Generally, about 2,000 years BC in the world and about 1,600 years ago in the Middle East, a new technology of coexistence with nature and climate, called nomadic life, was formed. But elsewhere, the history backs to 2004 BC coincided with the alliance of the Amorites and the Elamites in the migration to Iran's plateau. (Tignor *et al*., 2010). In the last decades, topography and hydrology have become significant challenges in many parts of the world, especially in Iran (Rajabi *et al*., 2019). Establishment of human societies on the land surface has always been in accordance with achieving the maximum natural resources, such as water resources, suitable vegetation, and access to cultivable lands. Undoubtedly, this effort is based on the principle that nowadays is considered as positioning science (Jafar-bigloo *et al*., 2014). In fact, it seems that the natural habitat may create some restrictions or opportunities related to the development of rural settlements in relation with water and

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soil factors and elements, slope and climate. In other words, natural habitat creates appropriate conditions for the establishment of rural settlements, but some of them create more-stable conditions than others (Akbaroghli *et al*., 2007). Migration is a way of life with an annual and seasonal displacement, with which a group of people, along with their livestock, migrate from winter tents to summer pastures and return to their winter camp during the cold season. A migratory phenomenon is a kind of harmony, and human compromise with the natural environment, which is partly influenced by environmental algebra (Amanollahi Baharvand, 1981). Beyond the historical issues, nomads have special characteristics that distinguish them from rural and urban communities; the most important difference is movement and migration. Indeed, instead of waiting for a change in nature, the nomads fulfill the natural needs of themselves and the livestock by migration process. What kinds of places are considered by nomads? Necessarily, the ancestral camps are the target of migration in different seasons. This factor dependency of the camps area and distribution style and pattern lead the issue to the spatial studies and the GIS as an important method. Cause and effect and impressibility (correlation) studies, spatial distribution pattern of nomads' camps (Moran's Autocorrelation Index) and studying the spatial domain of regularity or irregularity in spatial pattern (Ripley's K Index) in this project were carried out against the spatial weight of effective factors of quantitative hydrology and topography about the nomads of the Kermanshah Province. The work method and significant acquired results are described in different sections of the current paper.

Some of the world population is nomads and their lives and livelihoods depend on topography and hydrology of earth (Nourozi and Hayati, 2017). Investigating on the status of nomads' populations in the country over the past few decades shows a decrease in the proportion of nomads' population compared to the population of the country. According to the historical references, in 1867, about 38.6% of the population of the country was nomadic, and this ratio declined to 9.6% in 1967. According to the latest official census conducted by the Statistical Center of Iran, the proportion of nomads' population of the country to the total population is decreased to 1.68%, which indicates a decrease in the proportion of nomads' population of the country (Report of Organization of Iranian Nomads, 2017). About the local distribution pattern of nomads, a few investigations could be seen internally and internationally. This type of studies about the distribution pattern of the camps is so scarce that it could be said that almost nothing has been done. The few existing studies, such as Chatty and Sternberg (2015), studied the climatic effects on societies of Omani and Mogul migrant shepherds. They concluded that climate change (especially cold and hot droughts in Mongolia and Oman, respectively) along with government policies led to a change in the migrants' accommodations. Mayer (2015) studied the importance of political relations in the management of climatic migration (seasonal) in Mongolia. He describes the effects of the climatic change on the Mongolian nomads' needs in the two periods of 1969-1989 and 1989-2009. In the first period, the pressure was imposed on small cities, but in the second period, due to the climatic change, this pressure was more on Ulaanbaatar (the capital of Mongolia). Hajipour *et al*. (2016) investigated the factors affecting the nomadic migration time in Kouhdasht County in Lorestan Province by the factor analysis. They expressed the desire to access fresh forage as the most important factor. In internal studies, Mazaheri (2006) studied the migration path of Zanganeh Tribe in the Seymareh Valley between Lorestan and Ilam Provinces, using field study. He emphasized the physical geography as the most important issue in choosing the migration path. Abedi Sarvestani (2014) studied the time pattern of

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nomads' migration in the Fars Province, using field study, and mentioned the access to water resources and forage shortage as the most significant reasons for changing the migration pattern. However, more studies could be considered about the investigations focusing on the distribution pattern of human settlements. Seto and Fragkias (2005) investigated the significant effect of geographical factors on human population balance and agricultural zones in the coastal part of eastern China. The purpose of this study was spatial-demographic planning of the area and they acknowledged that differences in geographic access have changed the population distribution. Li *et al*. (2011) studied the spatial differences in the distribution of settlements in three areas in Gorges Pool Area in central China, and concluded that the most important factor in the spatial distribution pattern of the residential areas was the roughness factor. Wei *et al*. (2013) studied the population distribution pattern of the human settlements in the Xiang River Basin and concluded that this pattern was strongly influenced by the natural characteristics of the region, among which some factors like desert area, roughness, and climatic change are very important. Zhang *et al*. (2014) investigated the distribution pattern of the human settlements in relation to the geographical status in the east coast of China using Geographical Information System (GIS), and used Ripley's K Equation and Monte Carlo Simulation to determine the dispersion pattern. Their results and regression equations proved that roughness, slope, and slope direction factors in the jagged areas had a positive relation, but in the southern hillsides, there was a normal distribution.

With regard to local investigations in Iran, studies of Rahmani (2004) could be considered. He worked on the analysis of the effect of natural environmental factors on the spatial distribution pattern of settlements and rural population of Amol County, using the descriptive method and topographic maps, and concluded that dispersion pattern and spatial structure of rural settlements depend on several factors. In fact, this structure is the objective representation and the function of ecologic and socio-economic natural trends, and the levels of subordination and impressibility of the variables of natural environment factors are different from each other based on their location in the geographical/spatial surface. Mousavi *et al*. (2013) evaluated some natural factors such as altitude, slope, landform, climate, water resources and land use by Moran's autocorrelation method in order to determine the dispersion pattern of urban parts of West Azerbaijan Province, and concluded that the climate and access to the resources had the most effects on the distribution of urban parts. Fazelnia *et al*. (2012), in relation with an analysis of natural factors affecting the dispersion and establishment of rural settlements in Sirjan County, selected five natural criteria including altitude, slope, slope direction, and climatic elements (precipitation and temperature) as the factors affecting establishment of settlements. These criteria were analyzed using statistical methods in the GIS environment and the Moran's index, and due to the lack of significant correlation between natural factors in the location selecting of the rural settlements, the Moran index was used as a spatial autocorrelation functions to extract the distribution pattern. However, lack of attention to capabilities of spatial pattern definition models and the obscure issue of nomad camps in the Kermanshah Province persuaded the present authors to study the effects of the geohydrological and quantitative geomorphologic factors for the first time in the country. In other words, they answer some questions to define the fundamental framework of the current investigation. The main aim of the research was to determine quantitative geohydrological properties that affect the spatial distribution pattern of nomadic centers in Kermanshah province. The research sub questions were as follows:

- What factors are effective in choosing nomad camps?

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- In what territory has the nomadic pattern been observed?

MATERIALS AND METHODS

Study Area

In this study, Kermanshah Province Area was investigated. This province, with an area of 24,622 km^2, is approximately 1.5% of the total area of Iran and is situated between 33° 40' N to 35° 17' N and 45° 25' E to 48° 07' E. Kermanshah Province is located in the west of the country; its north, east and south borders neighbor Kurdistan, Hamedan and Lorestan Provinces, and Ilam Provinces respectively, and its west border neighbors Iraq Country. In general, considering the heights, the morphologic roughness is such that the province is jagged. The direct distances between the nomad camps of the province are 4.9 km in average. Considering the impacts and potentials of hydrological basins in compression and dispersion of these camps, in the current investigation, hydrologic and topographic characteristics of watershed basins of the province and their role in the distribution pattern of rural areas are considered. Kermanshah Province has 74 camps (including summer and winter quarters) with a total area of 539.64 km^2 (Figure 1).

Methodology

At the first step, the digital layer with precision of 30×30 m was considered as the base of studies. In the first part of the studies, characteristics and geohydrological quantitative indices of the province such as Heterogeneity Index (Topographic Roughness Index: TRI), Topographic Wetness Index (TWI), altitude, slope, slope direction, ridges distance, Topographic Position Index (TPI), Surface Relief Ratio (SRR), Compound Topographic Index (CTI), streams distance, formation type, and spring distances were calculated.

Heterogeneity or roughness index is derived by calculating the difference in the present pixels of the studied neighborhood window. If for each of the pixels, an assumptive alphabetical 3×3 window is considered and for the central pixel an

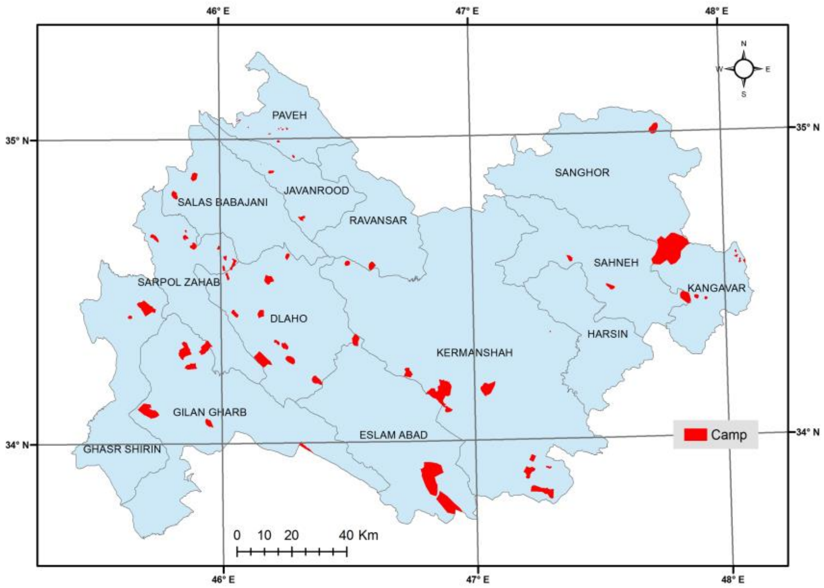

Figure 1. Distribution map of nomads' camps in the Kermanshah Province (Organization of Management and Planning, Kermanshah Province, 2017).

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alphabetic name A is assumed, the equation is as follows (Riley *et al*., 1999):

B	*C*	*D*
I	*A*	*E*
H	*G*	*F*

$$TRI = \sqrt{(\sqrt{A-B}) + (\sqrt{A-C}) + \cdots + (\sqrt{A-I})}$$

The Topographic Wetness Index (TWI) is also obtained by Equation (2):

$$TWI = \ln \alpha \,/ tan\beta \quad (2)$$

Where, α is the local area of the top of the hillside that drains through certain paths and β is the slope of effective drained local hillsides in the hydraulic gradient of the drainage path (Endreny and Wood, 2003). The altitude, slope and slope direction are also provided by DEM digital layer with a 30 m precision in the province. It should be noted that all operations of geohydrological indices are based on the precision of this layer. Evaluation of the ridge distances is obtained based on the reverse digital layer. In other words, using this reverse layer, the streams network was extracted. In this case, the streams network is only a fancy concept of the reality of the ridges. The Topographic Position Index (TPI) is derived according to its general form in Equation (3) (Weiss, 2001):

TPI: <Scale factor>= int [(Dem-Focalmean (Dem, Annulus, Irad, Orad)]+0.5 (3)

Where, Focalmean= Focal mean; Scale factor= External radius based on map unit; Irad: Internal radius in concentric cells, Orad= External (outer) radius in concentric cells.

Then, the final classification is performed using the 4-cluster system of Dickson and Beier, which is based on resolution and the neighborhood rule, and is more consistent with the actual situation (Maleki *et al*., 2016). In order to calculate the surface relief ratio, the SRR index is used, which indicates the relief and continuous surface strength of the land; it is obtained by Equation (4) (Pike and Wilson, 1971):

$$SRR = (z(mean) - z(min)) / (z(max) - z(min)) \quad (4)$$

The CTI index was used to calculate the roughness of compound state of the basins, in which the slope and the upstream flows contribution were considered as the flow direction, based on the orthogonal area. This index is shown in Equation (5):

$$CTI = ln\,(As / (tan\,(beta))) \quad (5)$$

$$As = (flow\ accumulation + 1) * (pixel\ area\ in\ m2) \quad (6)$$

Where, *As* is the calculated value from Equation (6) and *beta* is the gradient in degree (Gessler *et al*., 1995). Finally, the mean Euclidian distance from the streams and springs of the province was also calculated. After preparing the primary geohydrological layers of the area, the pixel values were connected to the spatial location of the nomad camps. In conclusion, at the first, the amount of Pearson correlation between geohydrological data with camps area was calculated. In order to determine the effect of quantitative geohydrological factors on the area of nomad camps, two

Table1. Table of quantitative hydrology and Topography indices.

row	indices	Variable Type
1	Heterogeneity Index (Topographic Roughness Index: TRI)	independent
2	Topographic Wetness Index (TWI)	independent
3	Altitude	independent
4	Slope	independent
5	Slope direction	independent
6	Ridges distance	independent
7	Topographic Position Index (TPI)	independent
8	Surface Relief Ratio (SRR)	independent
9	Compound Topographic Index (CTI)	independent
10	Streams distance, Formation type	independent
11	Spring distances were calculated	independent

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models of parametric linear regression (for parametric data) and LOWESS non-parametric regression (For nominal data: TPI model and slope direction) were used.

In the next step, the camps pattern for each of these factors was determined through two indices of Moran's Spatial Autocorrelation and Multi-Distance Spatial Cluster Analysis under the Ripleys' K Function algorithm. The Moran index indicates the dispersed distribution, Random distribution, and significant clustered distribution that is obtained through Equation (7) (Arc GIS 10.2 software guide):

$$I = \frac{n}{S_0}\frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij} z_i z_j}{\sum_{i=1}^{n} z_i^2} \tag{7}$$

Where, z_i is the result of the subtraction of the descriptive table of the phenomenon from the mean of $[(X)]i-\bar{x}$), w_{ij} is the spatial weight between the i and j phenomena, n is the total number of phenomena, and S_0 is the Sum of all the spatial weights. The method for calculating S_0, z_i, E[I], V[I] is shown in Equations (8-11), respectively:

$$S_0 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij} \tag{8}$$

$$z_I = \frac{I - E[I]}{\sqrt{V[I]}} \tag{9}$$

$$E[I] = -\frac{1}{n-1} \tag{10}$$

$$V[I] = E[I^2] - E[I]^2 \tag{11}$$

Multi-Distance Spatial Cluster Analysis is under the Ripleys' K Function algorithm. The minimum number of samples for this test is 30. In this test, the observed K line located in the upper part of the probable K line indicates the compression pattern and, in contrast, the K line below the mentioned line represents dispersed distribution in the horizontal radius. The equation of this method is as follows (Arc GIS 10.2 software guide):

$$L(d) = \sqrt{\frac{A\ \sum_{i=1}^{n}\sum_{j=1, i\neq j}^{n} k_{i,j}}{\pi n(n-1)}} \tag{12}$$

Where, d is the distance, n is the number of phenomena, A is the Area where the phenomena are in, and $k_{i,j}$ is the weight. In this graph, the y-axis is always the quantity of $L(d)$ and the x-axis is always the horizontal radius in meters.

RESULTS AND DISCUSSION

In the first step, the area of the nomad camps of the province was extracted based on square kilometers. Then, quantitative geohydrological layers including heterogeneity index layers, topographic wetness index, altitude, slope, slope direction, stream distance, ridge distance, topographic position index, spring distance, formation type, SRR and CTI indexes were drawn and the values of each one of the indices were extracted for all nomad camps of Kermanshah Province (Figure 2). According to the histogram of the extracted results of quantitative hydrologic indices of nomad camps of Kermanshah Province, it is concluded that most nomad camps occupy a small area. After approximately 600 m ridge distance, as the distance deceases the number of camps increases. Less than an approximate stream distance of 500 m and springs distance of 2,000 m, the distance decrease, increases the number of camps. Neglecting the small number of camps with heterogeneity index values of less than 0.05, the index values decrease, increases the number of camps. The slope percentage of less than 15% includes the dominant number of the nomad camps. The main areas of the nomad camps of the province have TWI index values of -13 to -18, CTI index values of 5 to 8.5, and SRR index values of 0.48 to 0.52. The altitudinal range of 1,400-2,000 m above the sea level, the landform 3 zone (equal to the steep slopes) and southern, southwestern southeastern directions, and limestone formation are also dominated by the nomad camps (Figure 3).

Then, using the extracted data from nomad camps, the correlation between the camps area and studied geohydrological factors

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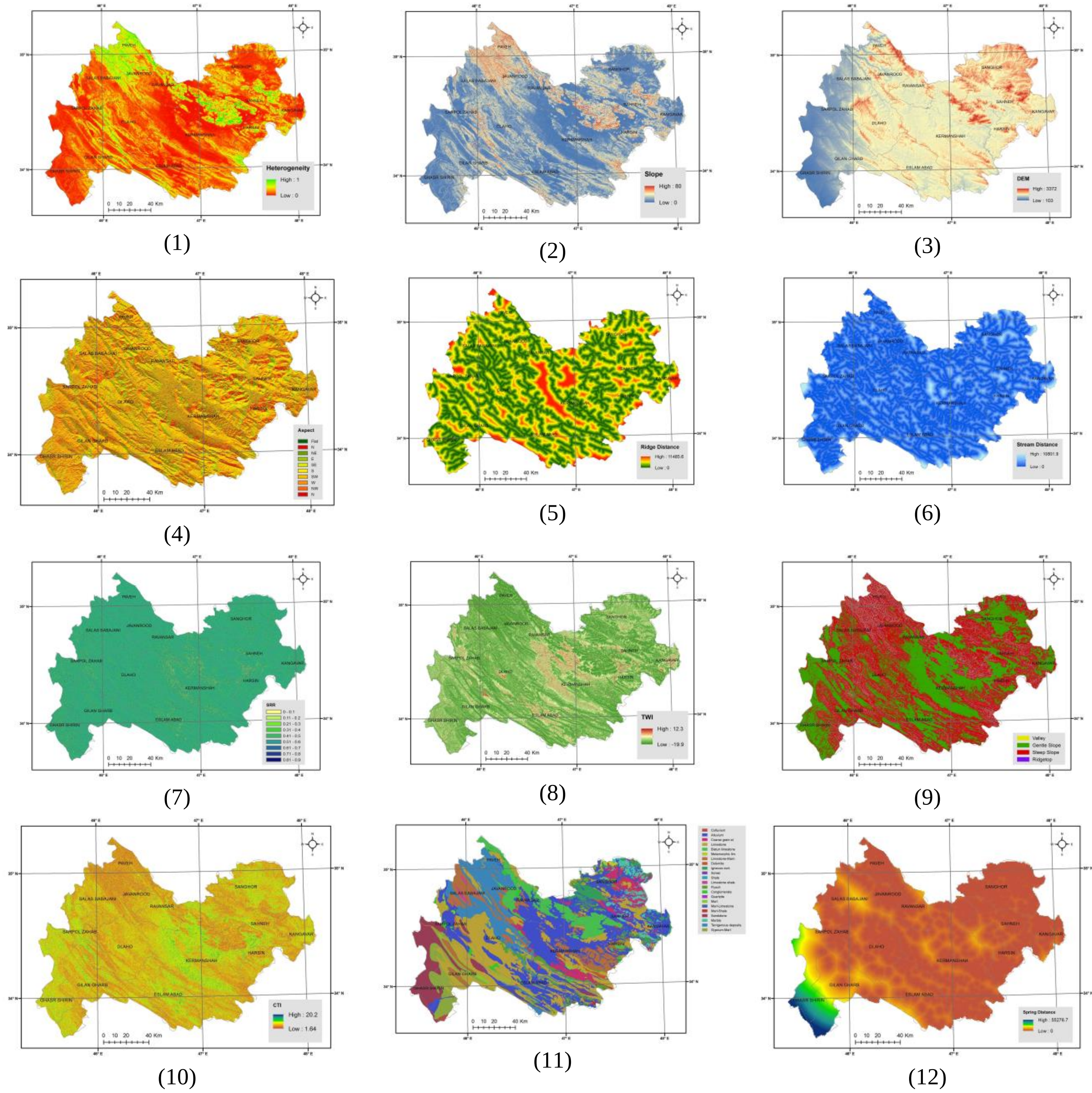

Figure2. hydrology and topography layers extracted from 30 m DEM of Kermanshah Province: 1-Heterogeneity index, 2- Slope, 3- Altitude, 4- Slope direction, 5- Ridge distance, 6- Stream distance, 7- SRR, 8- TWI, 9- TPI, 10- CTI, 11- Formation type, 12- Spring distance.

was calculated. The results indicate that there is no significant relationship between the camps area and the mentioned factors. In other words, there is no significant relationship between confidence levels of 0.05 and 0.01 (Table 2).

Considering the slope of the line resulting from the linear regression equation between the above-mentioned factors and the camps area, it could be concluded that the effect of these factors on the camps area is negligible. It should be noted that in all equations, y is the camps area and x represents each one of the geohydrological factors (Figure 4).

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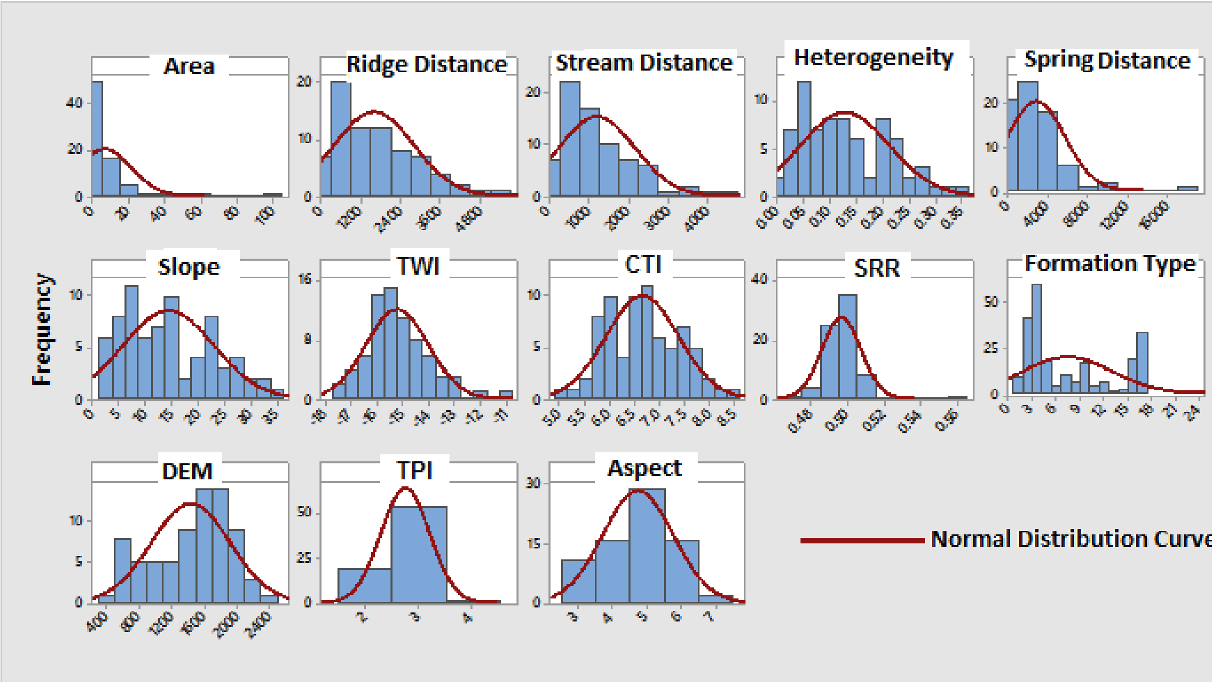

Figure 3. Histogram of extracted data of geohydrological indices in the nomad camps of the Kermanshah Province.

It is worth noting that TPI index, slope direction, and formation type statistically have a nominal nature, thus at this stage, the evaluation of non-parametric regression relationship under the LOWESS method was also used, and its results are given in Table 3. According to the TPI index, the highest correlation of the area of tribal nomads with the slope area is 73%. Also, in terms of slope direction, the highest correlation with south direction is 39%. Also in terms of Formation type, the highest correlation with calcareous Formation is 25%.(Table 3).

In the next part situated in the center of the distribution pattern, by examining the Moran's autocorrelation output, we conclude that the presence of regular dispersion pattern of nomad camps is due to heterogeneity, slope, CTI, altitude, spring distance, stream distance, ridge distance, TWI (at a significance level of 0.99), TPI (at a significance level of 0.95), and SRR (at a significance level of 0.90). Regarding the area condition, the type of formation and the slope direction, a random pattern was obtained (Table4).

In the next step, by studying the output of Multi-Distance Spatial Cluster Analysis under the Ripleys' K Function algorithm, it is concluded that heterogeneity indices, slope, and spring distance in the nomad camps of the Province have a well-organized pattern in the maximum study radius. TPI, TWI, SRR, slope direction and CTI indices

Table 2. Correlation evaluation and estimation ability of geohydrological layers in the nomad camps area.

Index	Pearson Correlation	Predictability (%)	Index	Pearson Correlation	Predictability (%)
Heterogeneity	-0.081	0.66	Ridge distance	-0.002	0
Altitude	0.033	1.77	Stream distance	0.033	0.11
Spring distance	0.106	1.13	Formation	-0.09	0.16
Slope direction	-0.109	1.19	TPI	-0.093	0.86
Slope	-0.09	0.81	CTI	0.112	1.26
TWI	0.108	1.17	SRR	0.045	0.2

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Table 3. Evaluation of non-parametric relations of geohydrological layers in the nomad camps area.

Formation Type			Slope Direction			TPI		
Correlati	%	Cluster	Correlati	%	Cluster	Correlati	%	Cluster
-0.059	4	Colluvium	0	0	Flat	0	0	Valley
-0.005	1	Alluvium	0	0	North	0.082	26	Gentle
0.118	1	Coarse	0	0	Northea	-0.066	73	Steep
0.150	2	Limestone	0.006	1	East	-0.058	1	Altitudes
-0.026	8	Limestone-	0.116	2	Southea			
-0.015	2	Bistun	0.001	3	South			
-0.052	4	Igneous	-0.097	2	Southw			
-0.048	3	Schist	-0.066	2	West			
0.003	6	Flysch	0	0	Northw			
-0.036	1	Conglomer						
0.071	2	Gypsum-						
-0.022	3	Marl						
-0.016	0	Marl-						
0.009	1	Marl-Shale						
0.003	3	Sandstone						
-0.051	5	Marble						
-0.078	1	Terrigenou						
0		R^2	0		R^2	0.659		R^2

in the 58-60 km radius are observed as a dispersed pattern. Similarly, the altitude index in radius of 56 to 58 km, formation type in radius of 50 to 52 km, stream distance in radius of 42 to 44 km, ridge distance in radius of 40 to 42 km, and the area in distance of 2 to 4 km are observed as a dispersed pattern (Table 5 and Figure 5).

CONCLUSIONS

In this research, besides human, cultural, communicative, economic reasons etc., it is attempted to clarify the role of quantitative geohydrological factors in determining the dispersion and spatial distribution pattern of

Table 4. Results of distribution pattern of nomad camps in the Kermanshah Province using Moran's Autocorrelation Index.

Index	Moran's Index Number	Standard Number	probability Value	Confidence Percent	Distribution Type
Heterogeneit	0.729	9.698	0	99%	Regular
Altitude	0.44	5.94	0	99%	Regular
Slope	-0.108	-1.123	0.220110	--	Stochastic
Slope	0.73	9.695	0	99%	Regular
TWI	0.26	3.63	0.000280	99%	Regular
Stream	0.40	5.49	0	99%	Regular
Ridge	0.33	4.48	0.000008	99%	Regular
TPI	0.18	2.53	0.011196	95%	Regular
CTI	0.49	6.62	0	99%	Regular
SRR	0.11	1.77	0.076629	90%	Regular
Formation	-0.04	-0.764	0.444794	--	Stochastic
Spring	0.38	5.58	0	99%	Regular
Area	0.082	1.5	0.13	--	Stochastic

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Table 5. Results of the spatial distribution pattern of Ripleys' K of nomad camps of the Kermanshah Province.

Index	Sum of dispersed distribution pattern	Beginning radius of dispersed distribution pattern (km)
Heterogeneity	0	Maximum
Altitude	2120	56-58
Slope direction	783	58-60
Slope	0	Maximum
TWI	576	58-60
Stream distance	21977	42-44
Spring distance	0	Maximum
Formation type	12802	50-52
Ridge distance	28290	40-42
TPI	309	58-60
CTI	1018	58-60
SRR	776	58-60
Area	26282	2-4

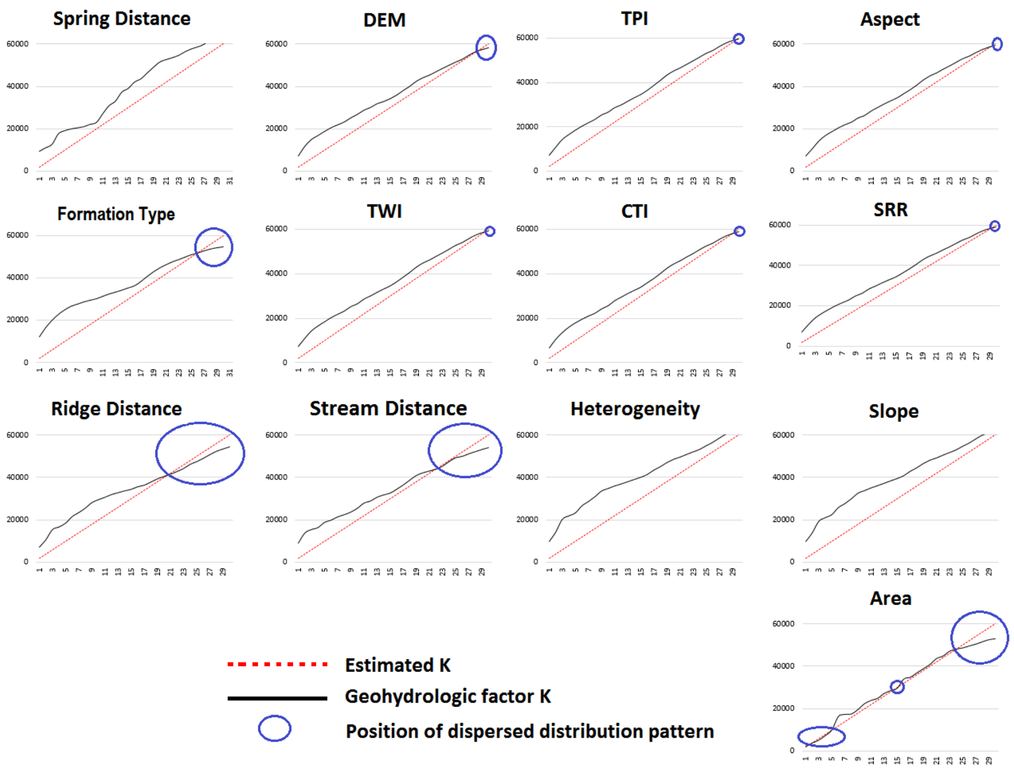

Figure 5. The spatial distribution pattern of Ripleys' K of nomad camps of the Kermanshah Province.

the nomad camps of Kermanshah Province, which led to considerable results. Studying the relationship between the nomad camps area and the mentioned factors led to no significant relation; the only considerable result was the presence of 73% of the nomad camps in the landform area with a steep slope and the effective factor (R^2 value equal to 0.66) on the nomad camps area. In addition, in this regard, the selection of mainly southern, southwestern, and southeastern (76%) hillsides and settlements

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in limestone-bearing areas (25%) are considerable. In general, an environment that is a steep landform located in a sunshiny hillside of limestone formations mainly widens the nomad camps area of Kermanshah Province. However, the selection of nomad camps according to the quantitative geohydrological factors has a clear arrangement and regularity, such that it has organized the values of the heterogeneity index, slope, CTI, altitude, stream distance, spring distance, ridge distance, and TWI as the first priority, the TPI values as the second priority, and SRR values, arrangement and spatial distribution of migrants and nomad camps as the third priority in Kermanshah Province. However, the radial distance from the spatial area of this arrangement is calculated in a way that the values of heterogeneity, spring distance, and slope indices of the nomad camps of the province are in an arranged spatial pattern in the maximum study radius. In addition, other indices of TPI, TWI, SRR, slope direction, CTI (as the second priority), altitude (as the third priority), formation type (as the fourth priority), stream distance (as the fifth priority), ridge distance (as the sixth priority), have been effective in distribution of radius of spatial arrangement of nomad camps in the province. In sum, the first priority in determining the regular spatial pattern of the nomads of Kermanshah Province include heterogeneity and slope indices, while the other geohydrological indices rank the second priority. As a result, the nomads' almost similar selection of their camps' location is dependent on non-jagged lands, gentle lands, the places with more than 600 m distance from the ridges and less than 500 m from the streams and 2 km distance from the springs, special ranges of TWI, CTI and SRR indices, the altitude range of 1,400 to 2,000 m above sea level, and establishment in the Landform 3 range of the TPI index and limestone formation. The results of the investigation suggest that these selections are not statistically stochastic but also indicate regularity in choosing such settlements.

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تاثیر ویژگی های کمی هیدرولوژی و توپوگرافی بر الگوی توزیع فضایی اتراقگاه های عشایری استان کرمانشاه

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چکیده

در مورد نقش خصوصیات کمی ژئوهیدرولوژی در تعیین الگوی توزیع فضایی اتراقگاه‌های عشایر در کشور تقریباً کاری منسجم انجام نپذیرفته و علت اهتمام به این پروژه نیز فقدان مطالعات پیشین در این حیطه است. در این پژوهش محدوده استان کرمانشاه مورد بررسی قرار گرفته است. در وهله نخست شاخص‌های کمی ژئوهیدرولوژی استان از قبیل شاخص ناهمگنی (TRI)، شاخص رطوبت توپوگرافی (TWI)، ارتفاع، شیب، جهت شیب، فاصله از آبراهه، فاصله از خط الرأس‌ها، فاصله از چشمه، نوع سازند، شاخص موقعیت توپوگرافی (TPI)، شاخص نسبت زبری زمین (SRR) و شاخص آمیختگی توپوگرافی (CTI) محاسبه گردید. برای تعیین نتایج از همبستگی پیرسون و سنجش وایازش خطی (برای داده‌های پارمتریک) و وایازش LOWESS (برای داده‌های ناپارمتریک) میان داده‌های ژئوهیدرولوژی با مقادیر مساحت اتراقگاه‌ها استفاده گردید. سپس نوع الگوی پراکنش فضایی و شعاع نوع الگوی فضایی اتراقگاه‌ها در مورد هریک از عوامل یادشده به ترتیب از طریق شاخص خود همبستگی موران و معادله کا-ریپلیز تعیین گردید. نتایج بیانگر این بوده است که ارتباط معناداری بین شاخص TPI (لندفرم شیب‌های تند) و مساحت اتراقگاه‌ها وجود دارد. در مجموع اولویت اول در تعیین الگوی منظم فضایی عشایر استان کرمانشاه لحاظ دو شاخص ناهمگنی و شیب بوده و اولویت دوم با دیگر شاخص‌های ژئوهیدرولوژی بوده است. در نتیجه انتخاب تقریباً همسان عشایر در مکان‌گزینی اتراقگاه‌های خویش تابع دسترسی به زمین‌های غیر متضرس، زمین‌های کم شیب، در فواصل بیش از ۶۰۰ متری از خط الراس‌ها و کمتر از ۵۰۰ متری از آبراهه‌ها و ۲ کیلومتری از چشمه‌ها، بازه‌های خاصی از شاخص‌های TWI، CTI و SRR، محدوده ارتفاعی ۱۴۰۰ تا ۲۰۰۰ متری از سطح دریا و استقرار در محدوده لندفرمی ۳ از شاخص TPI و سازند آهکی بوده است.

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