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Research Article

THE ROLE OF GEOMORPHOLOGIC PHENOMENA IN POPULATION DISTRIBUTION IN BOJNORD TOWN

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ABSTRACT
Settlement the establishment of population and activity system and determine the application is more important in the line with the population grow. With the increasing the population in cities and the requirement to the housing and new facilities, towns formation is constantly changing. The geomorphologic phenomena and demographic changes have a mutual relationship with each other and each have an effect on each other. Therefore, the main objective of this study is to identify geomorphologic phenomena and to evaluate the effect and role of these phenomena in the distribution of Bojnord Town population. The required information is collected by document-library method and then completed by field operations and the data is analyzed by G.I.S software. Then, it's been investigated the effects of these phenomena on distribution of Bojnord Town population by statistical information, as well as by adaptive operations, to overlay the maps and data layers with each other and create the new layers. The result of the study of all effective factors confirms that the Geomorphologic effects play a crucial role in the replacement of the population in different parts of the city and its development process. Of course, the geomorphologic effects doesn't affect on a small percentage of population that this issue follows the serious problems.

Keywords: *Geomorphologic Phenomena, Urban Morphology, Population Distribution, Bojnord Town*

INTRODUCTION
The necessity of recognizing the geomorphology different zones related to the population and activity establishment system is due to the effects that these forms have on the locating and deploying and operating system. One of the principles and necessities for planning and preparation of land is to know environmental context and its involvement in the planning and management of the land (Ranjbar, 2011, Iran Geographic Society). Geomorphology is the knowledge of land configuration, understanding and scientific interpretation of the origin and how formation of the earth's natural landscapes in terms of rough and surface forms that it's been studied mainly the configuration of the land (Rahnamaei, 1992). Forms and processes of geomorphology has had a very significant role long ago in how settlement of population and also population distribution in different parts of the world. So many human civilizations largely relate to this category. Today, geomorphology studies are the bases of the earth surveys. No matter from what are the origins of geomorphology phenomenon, they affect on the formation of population centers as the surface condition.
Geomorphologic units have always been associated with vitality and dynamism of the natural environment (Rajaei, 2008). As geomorphologic phenomena is the effective factor in the placement of cities and urban population distribution, Demographic changes are also affecting on the urban morphology; Because the city needs to housing and other facilities and equipment and the new applying with growth the population, and this takes the city to expanding vertically or horizontally (apartment living) that is considered as a kind of change in urban morphology. Thus increasing of the need to new urban appliers take the city to the surrounding land and this sometimes causes it develops in a direction that should not be extended. Urban population growth is one of the urban morphology disruptive. In this study, based on geomorphologic and the population in different regions, it has been paid to investigate the role of geomorphologic phenomena of Bojnord Town and development limits of the city. The case city is surrounded with the peaks of 2000 m to 2500 m and in the north of town by Mount Abu Mousa, as the walls are very steep and highly fault, and in the south by mountains Aladag that he northern slopes of the

hills extend to with a relatively gentle slope the southern side of the city. The average slope of the region topography is 15% with the maximum slope in the south area of the city, and the lowest dip in the river bed that is the drain place of Hydrographic networks outside the metropolitan area at the time of floods and heavy rains (Fajr Development Consulting Engineers, 2007). Regional climate with average annual rainfall of 294 mm and an average temperature of 7/23 ° C is located in cold and arid region. According to the Koppen climate classification, the case area based on synoptic stations statistics of Bojnord Town is the cold semi-arid area and from (BSK) type (Meteorological Agency of Northern Khorasan, 2010). About 56,761 people are living in Bojnord Town by the results of the Population and Housing Census in Bojnord in 2010 that100, 605 people of whom are men and 99,186 women (table1). In the urbanization system of the country, ranking of this city has not changed in the urban hierarchy system between the years 1956 to 2006 and has shifted 54th city in the year to 43th city in 2006. As this city is located in the population class of the cities with 100 to 499 thousand people, and is known as a city with the average population. in the first census (1956), Bojnord Town population were counted 19,253 people, between 1956-1996 the city's population grew about by 7 percent, which shows 5 percent growth. Bojnord Town high population growth is mainly influenced by factors such as the centrality of the region in the north of province that half of the population was rural until (1996).

Table 1: The results of formal census from 1976 to 2011, bojnord town (Iran statistical center)

2011	2006	1996	1986	1976	1966	1956	year index
199791	176726	134835	93392	47719	31247	19253	population
56761	44256	28300	19569	10075	6392	4812	families

Figure 1: Population density map of the various blocks in Bojnord

Geographical Situation of the Region

Bojnord Town coordinates are: 57°20’ longitude and 37°29’ latitude. Its elevation is 1070 meters above sea level. Its area is more than 3400 hectares. Its approximate length is 11km and its approximate width is 8.5km (council engineers of Fajr Development, 2007). The city is placed in Bodjnord Town plain; the second biggest flat catchment area in northeast after Mashhad-Shirvan one. Its altitudinal levels are 900-2900 meters (Seyedi *et al.*, 1994).

MATERIALS AND METHODS

Methodology

We’ve studied the role of geomorphologic phenomena in population dispersion of Bojnord to investigate them. Data collection was performed through documentary studies (municipality database, meteorology organization, and geology organizing and housing and urban development center), library studies, aerial satellite photos and maps. We’ve also used field studies and direct observance. We’ve studied numbers and population dispersion of the city by documents of statistics center. Then, we’ve analyzed maps, information layering, corresponding operation, overlapping layers and mapping by ArcGIS. In present study, we try to extract geomorphologic phenomena through geology, topography and geomorphologic maps and then investigate their correspondence to urban population dispersion, limitations of population inhabitation and urban development.

RESULTS AND DISCUSSION

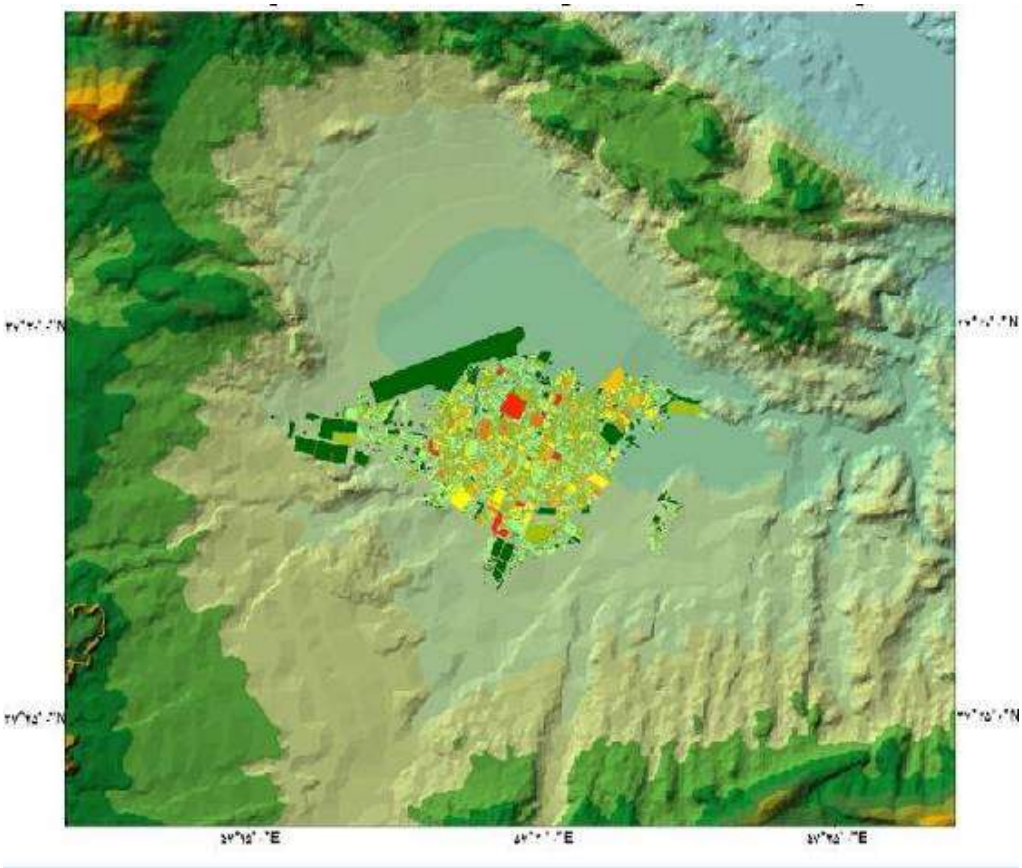

Figure 2: Distribution of city population to height level map

Population Density Compared to Topography: Bojnord is enclosed by mountains in Bojnord plain. It has moderate topography and beautiful mountainous landscapes. It has Babamousa Mountain like a strong

fault wall in its north side. Its elevation is 700meters above plain level. The mountain covers northern margin totally and exhibits an eye-catching beauty with its laminated stone facade and its steep slopes (Ansari and Masoumi, 2010). Aladagh mountain covers Bodjnord south front, extended its northern hillsides to the southern edge of the town with a mild slope. Bodjnord primary context' topography needs to be developed based on physical development of the city. As shown in table 2, its old context is placed in 1150-1170 meters elevation level, having a population of 14578 (7.29%). The development is done in peripheral altitudinal levels and elevation domains depend on needs and physical development conditions in different topographic systems, about 49.31% of Bojnord Town population lives in 1170-1190 elevation levels, 42.17% in 1190-1210 elevation levels and about 1.23% in 1210-1230 elevation levels. This shows that housing is happened mostly in higher topographic levels.

Table 2: Density of population blocks to high levels of bojnord (based on statistics center data)

Population percent	Area of region (hectare)	population	Height level (meter)	row
7.29	140	14578	1150-1170	1
49.31	1507	98524	1170-1190	2
42.17	968	84268	1190-1210	3
1.23	785	2421	1210-1230	4
100	3400	199791	total	5

2- Population Density of Watercourse: Urban development leads to change of earth coverage; its' most important one is the change in region's hydrology and increase of torrents and flowing waters (Fookes, 1986). Drainage system of the city is an important geomorphologic scale which should be taken into account because ignoring it leads to many problems for officials so that they have to implement variant plans such as: widening watercourses and establishment of water deviator channels in case of overflow. Bojnord Town is enclosed by rather high surfaces. Mountainous runoffs, besides surface waters, also enter the urban area through rivers and watercourses.

Table 3: Density of population blocks to the stream of bojnord town (based on the statistical center of Iran)

Population percent	Area of region (hectare)	population	Distance from stream (meter)	row
7.21	130	14371	Radius less than 100	1
17.26	420	34494	Radius 300	2
17.29	856	34557	Radius 500	3
58.24	1994	116369	More than 500	4
100	3400	199791	total	5

On the other hand, there were built some channels alongside the rivers and watercourses because of lands' high value. It increases damage possibility in case of torrents. One could say that Bojnord Town is placed in both sides of the river and watercourse which forms one part of its morphology. But, its urban development in both sides makes it more vulnerable to dangerous torrents. In spite of that, 7.21% of its

population lives in areas placed in less than 100meters to watercourses, 17.26% in 100-300 meters to watercourses and 17.29% in 300-500 meters to watercourses. So, 58.24% of its population lives in areas placed in less than 500meters to watercourses. Then, we have to plan according to principles for those who are at high risk of torrents (those who lives in areas in less than 100meters to watercourses).

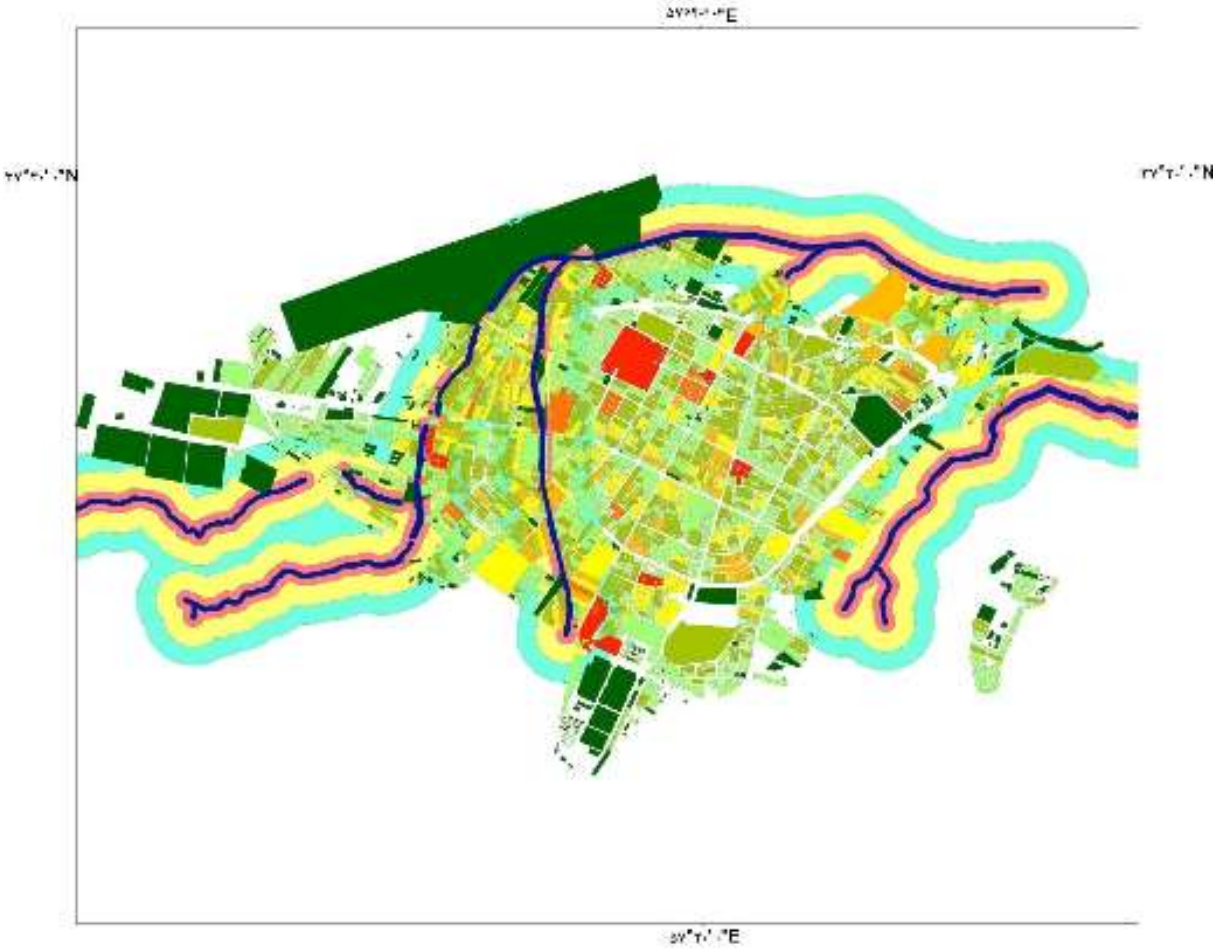

Figure 3: Distribution map of the city's population, compared to the distance from the stream

3- Population Density towards Geology and Fault: Many factors affect morphologic features of a city, but kind of formations used in urban development are more important. The kind of formations of inner development and peripheral development could be the determiner of appropriate sites for future development of the town. Bojnord Town consists of variant formations such as: Formation of Quaternary age and the second geology age. Orbitolina gray limes of Tirgan Formation related to the Cretaceous period have formed northern and eastern sectors of central part. Old terraces of alluvial plains cover the north-west-south part of Bojnord Town. Red Marl and neogene covers the south part and areas near the alluvial valleys. Turquoise is extended to the north. It brought sandstone and Shurijeh' red marl of Cretaceous period on limes of Jurassic period. Most urban population density (96.15%) lives in formation of old alluvial terraces (table 4). According to faults' placement, old context of the city has a more secure place (more than 5km distance) than the other parts. However, urban development gets nearer to vulnerable areas because of population absorption and development of peripherals without considering immigration absorption and population of Bojnord itself. About 1.95% of the population belongs to the peripherals. They live in 3-5km far from fault. Also, 33.04% of Bojnord Town lives in 3-5km far from fault (table 5). In spite of this, urban development of the city needs planning based on principles and basics.

Table 4: Density of population blocks to the structures of geology in bojnord town (based on statistical center of Iran, 2011)

Population percent	Area of region (hectare)	population	Type of formation	row
96.15	3392.5	192101	Terrace of the slop Alluviums	1
0.1	1.5	210	Extensive crones	2
2.89	3,8	5788	Neogene	3
0.86	2.2	1692	Tirgan	4
100	3400	199791	total	5

Table 5: Density of population blocks to the faults around bojnord town (based on statistical center of Iran, 2011)

Population percent	Area of region (hectare)	population	Distance from the fault (meter)	row
0	0	0	0-1	1
1.95	2	3868	1-3	2
33.4	1150	66026	3-5	3
65.01	2248	129897	More than 5	4
100	3400	199791	total	5

Table 6: Density of population blocks to the slope of bojnord (based on the statistical center of Iran, 2011)

Population percent	Area of region (hectare)	population	Slope (percent)	row
98.22	3397.65	196238	0-3	1
1.78	2.35	3553	3-5	2
0	0	0	5-15	3
0	0	0	More than 15	4
100	3400	199791	total	5

Table 7: Percentage of population to the geomorphologic effects of bojnord town

Description			Effect
1190-1210	1170-1190	1150-1170	**The height level (meter)**
42.17	49.31	7.29	**Population percent in the height level**
300-500	100-300	100	**Distance from the stream (meter)**
17.29	17.26	7.21	**Population percent of stream**
Neogene	Extensive crones	Terrace of the slop Alluviums	**Geological formations**
2.89	0.1	96.15	**Population percent**
3-5	1-3	0-1	**Distance from the fault (km)**
33.04	1.95	0	**Population percent from fault distance**
5-15	3-5	0-3	**Slope rate (percent)**
0	1.78	98.22	**Population percentage on the slop**

4- Population Density toward Area' Slope: Slope itself is the most important factor in urban development and placement. Based on IGU standards, flat surfaces with mild slope are appropriate places to live in. maximum slope was determined to be less than 11˚ (Zomorodian, 2004). Best slope for urban development is 5-6%. The 9% slope is also accepted, but slopes higher than 9% make urban development too difficult (Ziari, 1990). According to IGU standards, we found that Bodjnord' urban developments were done in appropriate slopes. 98.22% of its population lives in the areas with 3% slope. But due to vast development in recent years, 1.78% of the population lives in 3-5% slope.

Conclusion

According to enclosed situation of Bojnord Town in northeast part and its development towards the north hillsides extended to southern margin, about 49.31% of Bojnord Town population lives in 1170-1190 elevation levels, 42.17% in 1190-1210. So, 91.48% of it lives in 1170-1210 elevation levels. Also Studies show that 75.53% of population lives 300meters far from watercourses and 96.15% of housings are placed on alluvial terraces. 65.01% lives in areas 5km far from fault. 98.22% of Bojnord urban areas have a slope less than 3%. So, taking present condition and population blocks into account, geomorphologic factors have an important role in population dispersion (table 7). However, due to development condition of the city, 1.23% of population lives on high areas; levels between 1210-1230 meters. 7% lives in areas in less than 100meters to watercourses. 2% lives in areas in less than 3000meters of fault (at risk of geological disasters).

Taking situation and kinds of morphological phenomena into account, maximum physical development of the city should be as follows:

1. North and North-east: anatomic limit of northern part, development in this part is possible irregularly and in lands of Kalate Esmayil and Golestan town.
2. East and south-east: rivers, risk of torrents and the existence of fertile agricultural lands limits the development to the available extent. Detached development in this path begins where the agricultural lands ended (Valiasr town with 2600 hectars area) and in western parts of Hamzanloo (250 hectares).
3. South and South-west: these parts development limits to the extension of Malkesh and Hesar Shirali. Its detached development is also possible at Takht E Arkan.

4. West and north-west: due to industrial estate's applications, airport and highlands adjacent to the city, no development is possible in these parts.

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