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**Geomorphological zoning of the city of Arak using fuzzy logic model (The approach to the future development of arak)**

Analysis of multi-criteria decision-making models in cities for geomorphological zoning in cities  
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**Abstract**

The main objective of this study was to Arak city zoning geomorphological parameters of the model using fuzzy logic. In order to realize these objectives, 10 parameters Including of Height, distance from fault, distance from the main channel, distance from sub-channel, distance from road, slope percent, distance from settlements, terrain type, erosion potential and seismic vulnerability in the form of raster and vector maps were prepared and each raster layer based on field studies and expert opinion of a defined function. But being in a range of vector layers 0 and 1 did not need to define a function. After applying the functions, operations, multiplication, addition and different values of gamma phase were also performed on the layers. So, was used of ARC GIS 9.3 and ERDAS 9.1 soft wares. In the end, comparison analysis has done between the suitable arenas to real situation of city according to the critical arenas and suitable arenas of the quantities of gammas and it was clear 0.7 fuzzy gammas have the most accordance with the most suitable lands of the situation the town. The results indicate that two stations in the West and the East of County seems suitable for the development of suitable future city of Arak and at the present time the north and northeast arena of city and is the first priority. In the end, the final map classification to 5 classes, regions as the proportion is very low with 2189, proportion at least 389, proportion class 593, proportion with 552 and 381 with a great square kilometers.

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## INTRODUCTION

In recent years, the urban population of the world for the first time, the number of residents in rural areas is equal. (Egger, 2005:2). United Nations projections indicate that by 2030 more than 60 percent of the world's population lives in cities and by 2017 the developing world would likely feature a rural town (United Nation, 2004). The application of GIS in urban planning, urban functions provide the ability to locate appropriate. The use of geographic information systems based on fuzzy logic is more flexibility. After 40 years of development in the city and its selection as one of the country's industrial hub, will grow and spread wide. In the years from 1966-1996 as its population was 3.5 times (Hoseyni & Chinichiyani, 2011:7) There are several heavy industries, heavy and light attractions around the city in the direction of the population has multiplied. However, in order to optimize the spatial distribution and location of the overflow of his is not considered a good atmosphere. It is therefore essential to the experts for optimal location of the city's influential variables by using scientific methods. In this paper, the researcher's geomorphologic zoning Arak city began using fuzzy logic model, and then based on the presence of geomorphologic phenomena around the city, the city's future development and challenges were judged.

Future growth in the region's cities are under the influence of the matter is that many studies, especially in recent years has been allocated. Physical development of land use change in Tehran on 5, showing the impact of urban development on land use change into urban green. (Vahedian Beygi et al., 2011: 44) Some researchers need to maintain the gardens and farmlands News and guiding principles for future development of the city are known. (Server, 1387: 268 and Bahram Soltani, 1992: 19) geomorphologic assessment fortunately some researchers have also studied urban development. (Hosseini et al., 2012, resident and Safari, 2008, POURJAFAR and others, 2012 Malayeri Shams,

2009) fuzzy method has been used in various studies, as Zhang and colleagues (1996) and Karam (2011), a method quantitative assessment using fuzzy logic to identify and zoning landslide prone areas were used. Some researchers have also developed techniques to study how the use of mines, and finally began to identify areas prone to the mining (Vickers & Fleming, 2009: 2) Hanson et al (2010) fuzzy model in monitoring changes in the coastline, Hosseini and others (2011) in order to assess the physical development of the city and qanavati and others (2011) have also contributed to the flood hazard zonation. Ziaeian Firoozabadi (1995) has applied fuzzy logic for the detection of changes. Some Specialists like Jesus and others (2011) and Vahidnia and others (2009) to locate hospitals have adopted this approach and have named it as Fuzzy AHP method. The purpose of this study was to find the most suitable location for the future development of the metropolitan area in the city of Arak, and geomorphologic parameter using a fuzzy approach has been.

The first official census in 1956 the population of the city in the sun, 58,998 people But since then due to severe Urbanization was rising rapidly, so that the population in 1345 to 71 925 people in 1977 to 116,832 people in 1986 to 265,349 Reached. Arak population based on the General Population and Housing Census in 2011 to 484,212 persons. The population of the city after the incorporation of the town of Saint-John and Karahrud rose to 526,182 people. As can be seen in the city at an interval of 25 years to double its previous population has improved. Today, there are various factories and industries within the city center from one side and on the other to attract industrial and service activities and as a result of migration from other cities and counties in the study area.



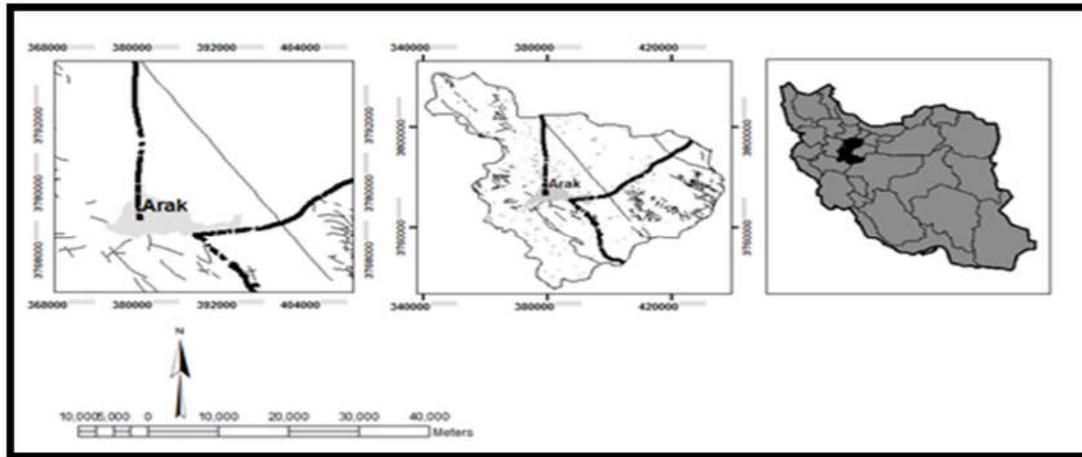


Fig 1: Geographical location of Arak research

## MATERIALS AND METHODS

To conduct research in the form of two layers of information, including maps and VECTOR and RASTER were used. The topographic map of the city of Arak in scale 1: 50000 and was digital. In order to map the current boundaries of the city and the city and the land type map image Landsat ETM satellite image of the reflection band 6 was used. Therefore, the data reflect the 6 bands of ETM images of 2814 \* 1997 pixels and a cell size of 30 m, about half warm examined. To increase the spatial resolution of the image sensor Color panchromatic band, with a pixel size of 15 m were combined and layered city and the city's current policy of the output image have been explored. Then the software ERDAS on the image to field observations, supervised classification was applied and the final result in terms of the type of terrain and the map in GIS 9.3 software was used. Geological map of the seismic potential of the country was prepared Arak city. Members of the city because there were layers of settlements and land type do not use the land use map of the study. To use all the layers needed to start all of the reference system), scale (1: 18,000) and the size of the pixels (20 × 20) are equalized in the GIS environment. Then, for each layer RASTER based on field

observations and expertise neither a function of each of the functions was applied separately on its own layer. The column was developed based on the raster layer you want to convert. The final layers are a raster layer above the range of zero to one, and were used directly in the subsequent analysis. In the process of land held for development of spatial population centers, the conceptual model and the effective variables in the model, such as communication networks and their Buffers, infrastructure, equipment, etc., identify and define the 10 layers of information, such as topography, slope, fault, network, and define the surface. Preparation of layers of form topology, correction and editing, correction of geometric drawings, applying the same coordinate system, and so on After defining the proper method to identify the composition and functions performed, followed by a layer of an integrated database table, places of interest are identified and assessed. One of the most important capabilities of GIS.

That distinguish it as a special system, data integration capabilities for modeling, locate and determine the appropriateness of the valuation of the land area of land. As a result of the integration and

combination of measures, the best choice would be the optimal point for the establishment of centers and places. There are different ways to combine measures in fuzzy or blurry logic and the most important of which is uncertain Professor Lotfi zadeh fuzzy for the first time by scientists at UC Berkeley professor of America to act in situations of uncertainty are presented. The degree of membership of, the communal, amendment, multiplication, addition and gamma can combine these models are essential.

The findings Principles based on the location of areas for urban development, are identified and desired layers, whereby they form a fuzzy function, including the establishment of areas of low slope, distance from the optional high fault, deployment in areas with gravity earthquake bottom, near the route of communication, proximity to residential areas, located in low-lying areas, the establishment of appropriate land types and located in areas with high erosion is low.

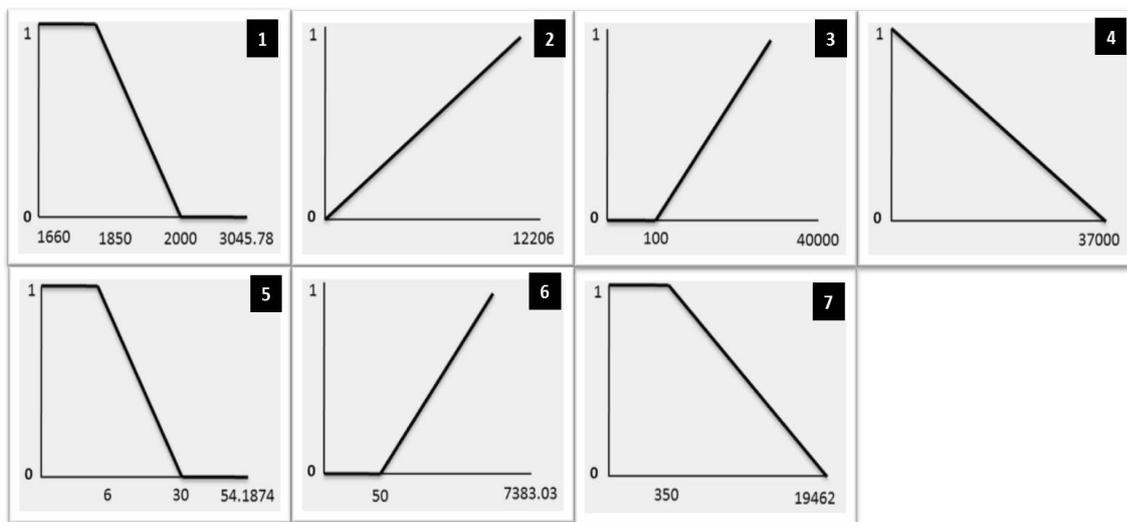


Fig 2: The function of fuzzy criteria: 1. height. 2. The distance from the fault. 3. The distance from the main stream. 4. The distance of the communication. 5-percent slope. 6. The length of the sub-streams. 7 miles away from home

Then, any raster layers in the GIS software and using the operator (Raster Calculator) is standardized layers were in the range of zero and one. With regard to the intended output layer represents the constraints and opportunities facing each topic studied (Fig. 3)

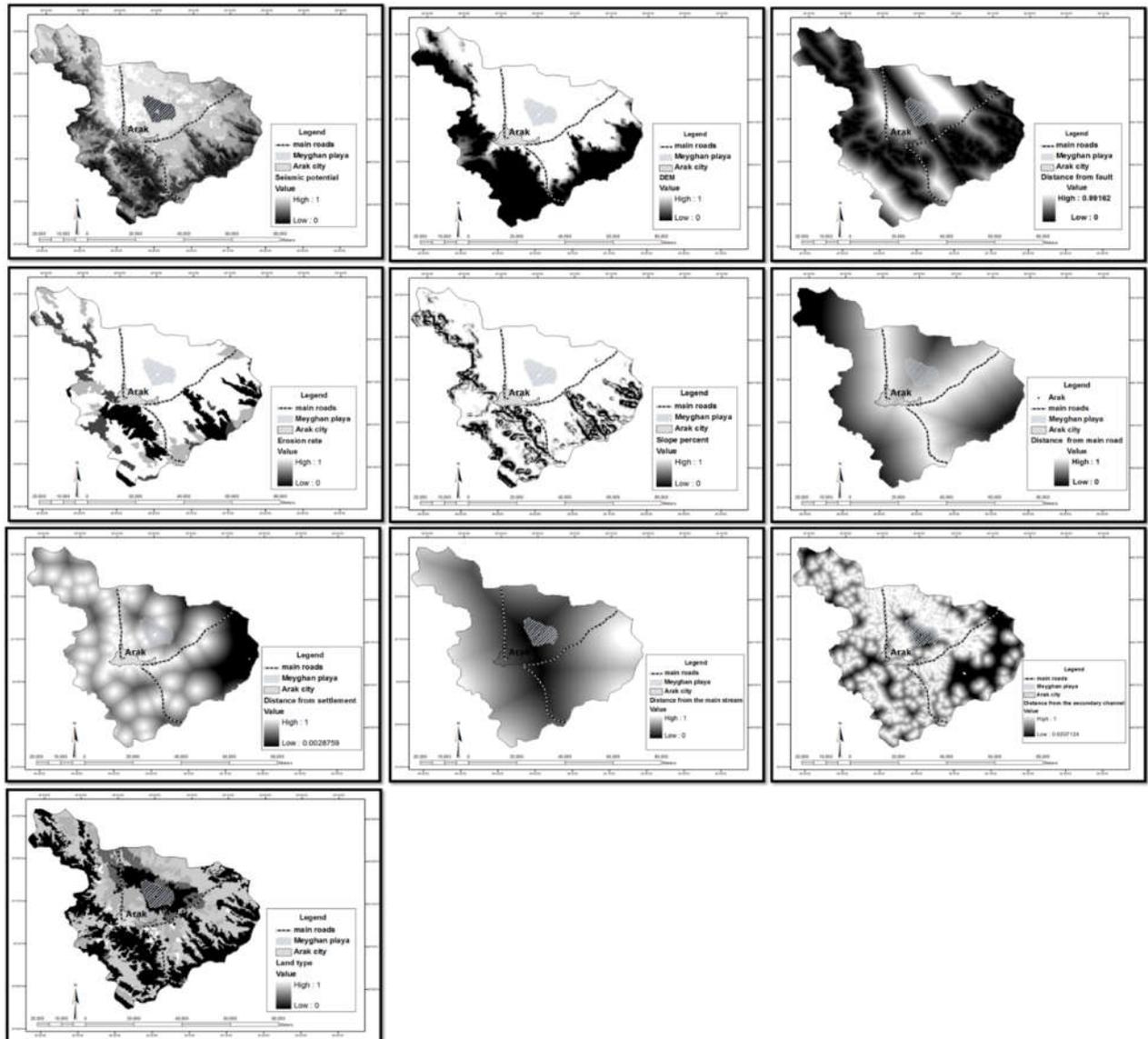


Figure 3: Fuzzy layer based on fuzzy functions: 1. Seismic potential. 2. Height. 3. The distance from the fault. 4. The rate of erosion. 5. Percent slope. 6. The distance from the main road. 7. Distance from main settlement. 8. The distance from the main stream. 9. distance from the secondary channels. 10. Sub-type of land

**RESULTS AND DISCUSSION**

In the multiplication phase, all the factors affecting gene were multiplied Arak city geomorphologic zoning (Fig. 4). The results indicate that the layer of 7.0 gamma phase, and low-risk areas prone to cause

maximum compliance with the current range of population centers in the city of Arak, as the most appropriate zoning layer proportion of land in the study area were introduced

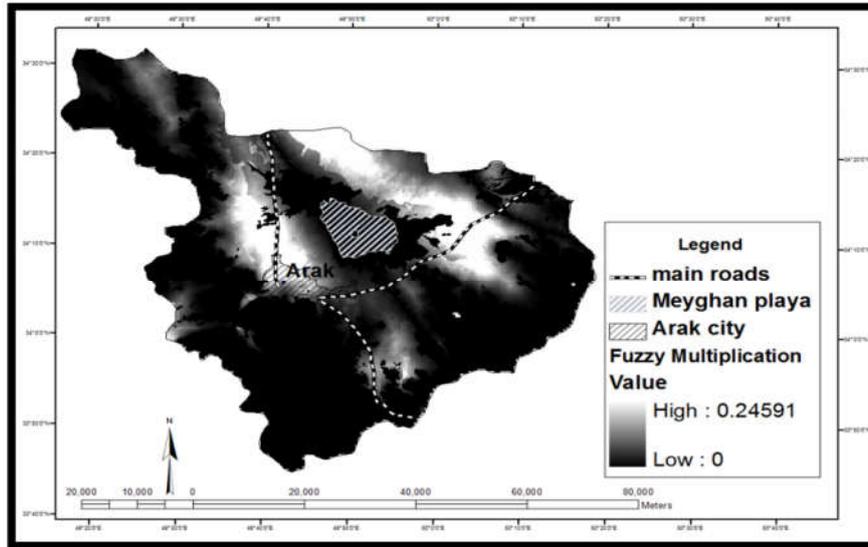


Figure 4: Layers of fuzzy algebraic product

In sum fuzzy complement is calculated by multiplying the amendments set. For this reason, the output map, unlike the fuzzy algebraic product

pixel values tend towards 1. (H refuge, 2000: 126), (Figure 5)

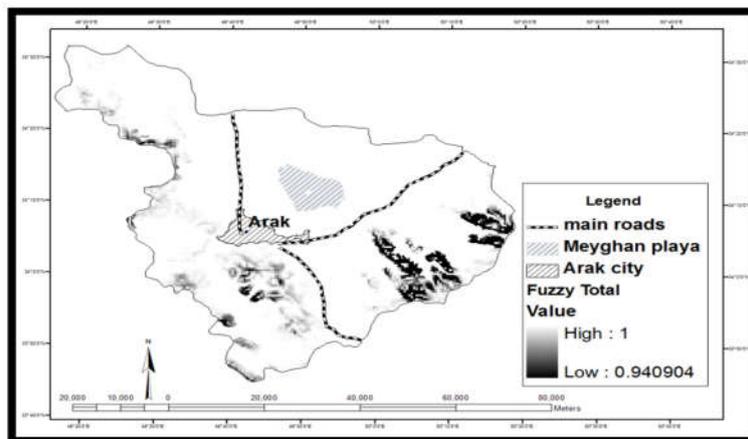


Figure 5: The sum of fuzzy layer

To adjust the sensitivity of the very high sensitivity and very low phase multiplied by the sum of the phase operator, operator called gamma phase, is introduced at the interface between the operator acts. (Figure 6) To select the appropriate gamma, to select the final layer, it is necessary according to the situation of the city and taking appropriate zones,

with each zone suitable for different values of the gamma match is made. Compare maps of phase steps and their compliance with land use and geological layers in the region, showed that the gamma phase layer 0.7 can be the best proposal for the development of population centers are located in the city of Arak.

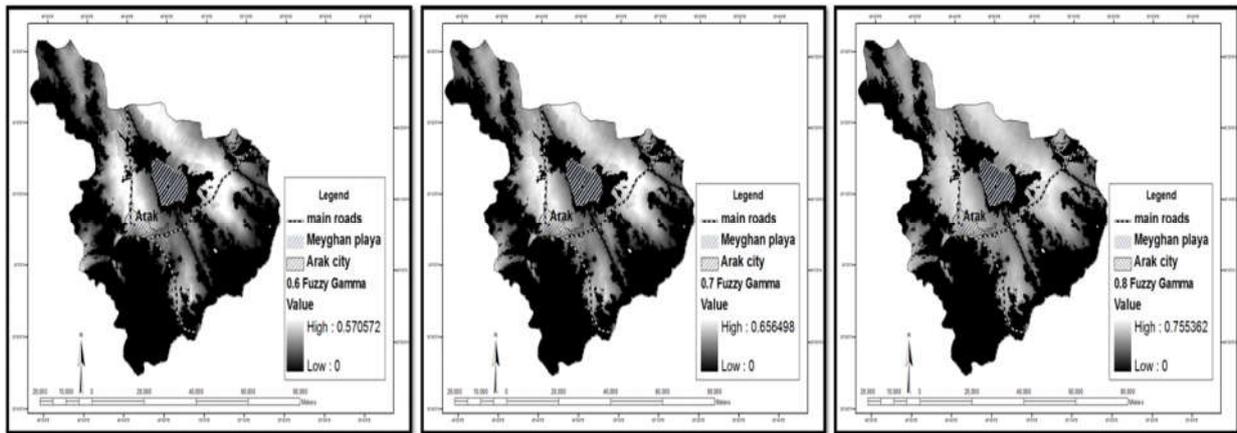


Figure (6): in order from left to right, layers of 0.6, 0.7 and 0.8 Fuzzy gammas

In the final layer of the values 0.8, 0.7 6.0 Gammas .Gamma 0.7 Fuzzy determined that the most appropriate compliance with the current development of population centers in the city of Arak (and the city) is. (Figure 7) While the gamma phase 0.8, appropriate zones in most of the areas are dangerous intersection in the gamma phase is 0.6 percent less than the areas prone to physical development of cities is considered, for example, the layer related to the gamma, a large part of the southern half of the city is considered unsuitable for development. Current status of the city, shows that the village is located in the city studied, Shams Abad, inappropriate and unsuitable for slope and height of the type of land (plateau and mountainous terrain and slope debris), and Masoomiye Because of the near fault Tabarteh adjacent desert Meyghan (salt type) and poor drainage due to the very low slope, the proportion is lower. The meeting will be followed by earth, corresponded. Also, the low proportion of steep and

High Mountain areas in the margins or on the floor comply with the debris zone, is also visible.

The average proportion of city zones, including areas that have two or more conflicting factors are located in the vicinity, for example, in the southeast of the city near the fault Tabarteh and the establishment of industries (as negative factors) Based on land suitability maps (based on 0.7 steps), a large part of the city in terms of use, very good area of town is only a small part of the south of the city, due to the fault of privacy, steep, shows the average proportion of part of the West, because of the high altitude and slope, a very poor fit (Khalajs garden area in the city). According to the map, desert Meyghan along part of its policy to develop the city is inappropriate because of the high level of water in the desert (1 meter above the ground), is. The development of the city in the East and North East should be given to the use of inappropriate (salt of the earth), seismic zone, the energetic thrust faults, extending Meyghan desert,

water shortages and low Groundwater levels limited (Fig. 7) Generally, as can be seen in Figure 7; 3 geomorphologic zones, as critical areas of land suitability analysis, most of the other factors have influenced the expression in detail in the following chapter: 1. playa Meyghan:

The Playa area of 129 square kilometers is located in the North East of the city, with an area of over 5,000 square kilometers of drainage basin and effective role in the fate of each of the towns and villages surrounding environment playas.

Three parts of geomorphologic currently visible on the playa:

A lake (Meyghan Lake): Meyghan seasonal lake with an area changing elevations of 1660 to 1700 meters above sea level and is related to the Quaternary period. In summer, the lake is completely dry and the salt layer, the stratum polygons phenomenon can be

seen clearly so that the diameter of the polygons to 60 meters long. (Hamoun Study Group, 1991)

B: evaporation deposits: The land consists of flat terrain (slopes less than 0.5%) and hollowed that there is no active stream erosion and surface water, before they came into the land. C floodplain deposits, including deposits from numerous floods sequestration and have different textures (no gravel) are. Generally it can be said Davoodabad adjacent territory, ten salt, Vismeh, Meyghan, Rahzan, Tamezd and Mobarakabad and frequented weak and sparse vegetation and salt-loving plants (halophyte) are grown in these soils. The most important minerals in saline soils are mica, chlorite, and quartz. (Ghahroudi and others, 2012) due to the expansion of the desert saline soils due to the high water table, enter the desert and irrigation is Waterways. (Baghdadi, 1987)

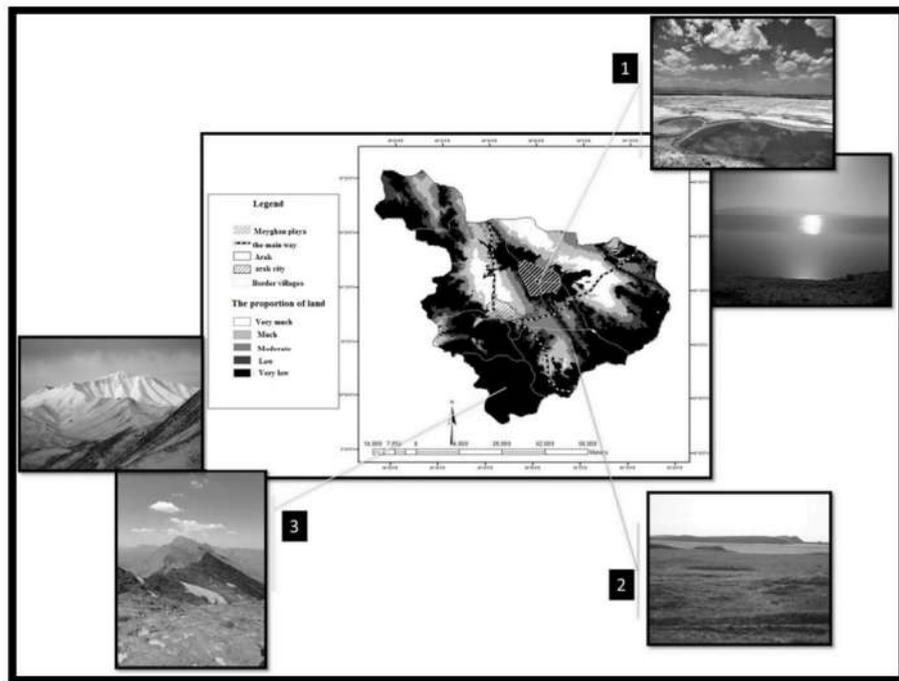


Fig 7: The final maps of land suitability classification Arak city. Photos order: 1.Playa Meyghan 2.Trust Tozlogol close to Tamezsd village 3-mountains of White Mountain and Shabbaz



2. System faults: a) Tabarteh fault b) Talkhab fault c) 3 Fault Tozlogol. South-West of the mountains in the southwest, Saki Heights, Surrey Sir, Khansar, Shahsavari and Sefid Khani, Kermanshah, which in addition to the high altitude and slope, fan-shaped pebbles of debris (including land, usually with gentle to moderate slopes on the slopes of the hills by the seasonal watercourse and Generally this type of gravel deposited .In its place. Landform other major city in the South West tip plateau is observed. Landform The land slopes up to 30 percent and has a large pebble.

### Conclusion

the results indicate that the layer of 7.0 gamma phase, and low-risk areas prone to cause maximum compliance with the current range of population centers in the city of Arak, as the most appropriate zoning layer proportion of land in the study area were introduced .Respectively. However, it should also be noted that due to the presence of dark matter and some geomorphologic phenomena (including Playa Meyghan, the mountainous southwest of the city and also the fault of Talkhab, Tabarteh and Tozlogol) and their undeniable role on the groundwater, the formation of some specific types of land (such as surface debris or saline), the formation of certain types of sediments and soils (such as evaporative deposition) and increases the potential seismic or high erosion rate, etc. He has caused a large part of the city, which contains over 2578 square kilometers, in relation to spatial development in low and very low proportion of classes with them. The results of the present study was, however, the city of Arak has two main urban centers in the West and East of the city for Spatial Development (Arak and Davood abad) Since currently only 4% of agricultural land is devoted to the activities of the central provinces, Can be found in the city, with optimal use change, in some sectors, leading to major cities such as Arak physical development in the near future, be. So that the city can be traced to the Northern lands. Without a doubt, the city due to the polluting industries in the East and

West, the future of the space he will not be able to develop, For example, petrochemical and refinery in the East and a lot of heavy industry and heavy and the industrial towns, (e.g. industrial town Kheirabad) in West Town, have taken place. The lands north of the city, based on fuzzy logic models, and geomorphologic parameters employed for the future development of the city have been deemed acceptable.

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