

Modeling the future optimum dynamics of urban development based on spatial data for land compatibility analysis (Case study: Shahr-e-Kord)

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Extended Abstract

Objective: Today's world has experienced an unprecedented stream of urbanization, which, after its continuation, has left a large amount of agricultural and forest areas to residential and industrial areas and other infrastructures. From the perspective of the landscape, the city extension shows the trend of land use change, in which the natural landscape, such as water, soil, and plant, becomes an artificial landscape, such as cement, asphalt, chemicals and metals zones. In addition to developing the physical boundaries of cities, this situation has transformed the intrinsic texture. Reducing the area of suburban terrains, degrading the vegetation and increasing the surface temperature in urban areas are negative consequences for inland development, construction, and street transport, which has endangered the health of the environment and human beings. Therefore, the feature of the present age is the increase in urban population, urban development and, consequently, the expansion of small and large cities. In the present research, it has been tried to use the spatial analysis tools of Geographic Information System and also to compare two methods of weighted mean and Analytical Hierarchy Process, to analyze the Land Compatibility for future urban development in Shahr-e-Kord, as well as structural and developmental changes Shahr-e-Kord settlements were evaluated and finally, through the capabilities of the GIS, we determined the most suitable location for urban development in the study area.

Method: The study is applied and developmental research and its method is based on the analysis of spatial, field and interview data. The spatial analysis is based on distance and compression measurement functions, geospatial and interpolation methods in the ArcGIS 10.4.1 software. A database for baseline data, including basic maps of the topography, geology, land use, and satellite imagery of Google Earth. In order to achieve the goals, Google Earth satellite imagery, topographic maps with scale 1:25000 and field studies were used to determine the study area boundary. To this end, the combination of the above data, a broad range of Shahr-e-Kord region where the city is located and the naturally, there is the possibility of its physical development, was determined as a study area. Shahr-e-Kord is the capital of Charmahal and Bakhtiari province that is located in the geographical position of 50°46' to 51°1' east longitude and 32°15' to 32°25' northern latitude and 100 kilometers south west of the Isfahan city at the elevation of 2200M. In the next step, based on the results of similar studies and comparative studies such as Golany (1978: 83), Abhishek et al (2017: 48), Dastan et al (1392: 37), Sarvar et al (1393: 95), Mousavi et al. (1395: 75), Hatami Nezhad et al. (1396: 519), and experts' opinions based on geographic perspective, geology, geomorphology, hydrology, climatic, infrastructure and facilities, land suitability, economics, access and communication routes in the study area; 6 criteria and 24 sub-criteria were identified, including elevation from the sea level, slope, aspect, lithology (Geomorphology), the distance from the fault and the source of previous earthquakes (Seismicity), the density and distance from the streams (Flood), temperature, precipitation, relative humidity, average of wind speed, maximum speed of prevailing wind and the number of freezing

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days (Climate), density and distance from Communication roads, distance from clinics, hospitals, offices, higher education, elementary and secondary education, urban green space (Access), and type of land use and distance from protected green space (Land use). In the third stage, using Expert Choice software, a quantitative analysis of the criteria and sub-criteria was made to prioritize and compare their relative weight with a pairwise comparison. Finally, by combining the layers according to their weights, based on the methods of Weighted Mean and the composition principle of the Analytical Hierarchy Process, we prepared a zoning map of the study area in terms of areas with optimal criteria for the future development of Shahr-e-Kord. At the end, to ensure the results and to compare the two methods, the final layers of each method were evaluated based on the existing settlements. If the trend of this index be irregular, or its percentage in areas with a low proportion be higher than high proportional zones, the map provided will not be sufficiently accurate and should be re-evaluated in its results.

Results: The results of the geomorphology criteria showed that the slope is up to 199% varied and its maximum extent is located in zone of less than 9.77%. From the point of view of the aspect, the octagonal directions along the flat direction are observed, which are broadly proportional to almost all aspects of the study. The elevation of the sea level fluctuates from at least 1970 to a maximum of 2,870 meters, and the highest elevation is ranges from 1970 to 2100 meters. From the perspective of lithology, there are also various types of conglomerate, limestone, marl, and fan deposits, among which the greatest extent is belonged to the fan deposits of the new lowlands. The results of the seismicity criteria showed that there is no major fault in the region, and the distance from the fault change from 1485 to 16110 meters and the distance from the earthquake focus fluctuates from 14889 to 42564 meters. So, the north and northwest regions of the region are most important for the future development of Shahr-e-Kord due to having the furthest distance. The results of the flood criteria showed that the distance from the waterway is to a maximum of 5,500 meters and its density is up to 2.26 m/m². So, the areas with the farthest distance and the lowest water drainage are most important for future growth of Shahr-e-Kord. Climate criteria results showed that the temperature ranged from 6 to 12.5 C°, the precipitation was from 315 to 330 mm, the mean wind speed was 2.8 to 2.98 knot, the maximum speed of prevailing wind was from 8.99 to 9.9 knot, the relative humidity ranges from 42.8 to 46.7 percent, and the number of freezing days varies from 88 to 191 days. As a result, from the viewpoint of the elements of temperature, precipitation, relative humidity and freezing days, the central regions of the study area have the highest importance. But the elements of average wind speed and maximum speed of prevailing wind, the eastern, southern and central regions have the highest priority. Access criteria results showed that Distance from the road is up to 10,200 meters, road density is up to 0.55 m/m², distance from the primary and secondary education centers is up to 19900 meters, higher education is up to 22200 meters, clinic centers is up to 19900 meters, hospital is up to 23100 meters, service and office centers is up to 18,600 meters, and urban green space is up to 18,000 meters. Since the proximity to these centers and their high density is desirable, the central part of the study area has the best land suitability for the development of Shahr-e-Kord. From the viewpoint of land use as you can see, farmland and rangelands are the most widely used in the study area, and considering the type and importance of productivity, poor pastures are considered to be the most suitable places for future development of Shahr-e-Kord. Because the development of the city in these land use has the least impact on nature and the least environmental stress. The distance from the protected green space is a maximum distance of 22,300 meters, with the southeast sections having the highest proportion of Shahr-e-Kord's future development. The results of paired comparison showed that among the criteria, geomorphology and land use with the weight of 0.383 and 0.215, respectively, and among the sub-criteria, the slope and lithology, with the weights of 0.133 and 0.132, respectively, have the highest priority. The incompatibility rate of 0.07, because it is less than 0.1, confirms the significance of paired comparisons matrices of effective factors in the development of Shahr-e-Kord. The results of the land suitability analysis indicated that the high and very high suitability zones have a good uniformity in the Weighted Mean method and are generally convergent in the northern and central parts of the study area, while this homogeneity and concentration in the land suitability map through Analytical Hierarchy Process are not seen. Therefore, it seems that the Weighted Mean method is visually and intuitively better than Analytical Hierarchy Process. Also, the results show that the very high suitability zone with an area equal to 71.03 and 57.69 km² (17.57% and 14.3% of the total area), in the Analytical Hierarchy Process and Weighted mean methods, are dedicated 45.66 and 65.99% of the area of the existing settlement, respectively. Observance of the order and existence

of an upward trend of the accuracy assessment index in Analytical Hierarchy Process from the very low to very high suitability zones confirm the acceptable results of the method, while this ascending order is not observed in the low and medium suitability zones of the Weighted Mean method.

Conclusion: In urban development desirability discussions, the systematic and scalable assessment of land suitability analysis has long been of interest to researchers, most of which have only an approach to problem-solving. But the study has also added a methodological assessment approach to the problem-solving approach, and its focus is more on comparing the results of Weighted Mean and Analytical Hierarchy Process based on spatial data for analyzing land suitability for future development of Shahr-e-Kord. So that more comprehensive results can be obtained in this regard, which, if realized, implies more precise decision-making. In turn, the momentum of the advanced research framework, in addition to solving the problem that identifies the desirable places of future development of Shahr-e-Kord, is based on a comparison of Weighted Mean and Analytical Hierarchy Process methods. The advantages of this view can be seen in its flexibility with regard to the more favorable outcomes, with the least impact of urban development with the environmental context and its natural attributes, and ultimately the reduction of human and environmental issues. Site selection results indicate that an area of 128.72 and 184.74 km² (31.6 and 55.22%) of the total study area, respectively, in Analytical Hierarchy Process and Weighted Mean methods has high to very high suitable for the future development of Shahr-e-Kord. These zones are extending substantially to the central and northern parts of the study area. This consistency is due to the minimum of slope and elevation, freezing days, relative humidity, wind speed, and the maximum of temperature, sedimentary constipation, precipitation, access to educational and therapeutic services, recreational services and communication way density, and land use type of poor and moderate range. As a result, the future development of Shahr-e-Kord towards the central and northern parts of the study area has the highest desirability and land suitability. If implemented, it has the highest environmental sustainability will result in the least encounter with nature and minimum environmental tensions, resulting in a greater amount of mental satisfaction and creates a mental for citizens. Although the observance of the ascending order of the accuracy assessment index from the very low to very high suitability zones in the Analytical Hierarchy Process confirms the results, but the results are reasonably due to the high accuracy of the in Weighted Mean the prediction of high and very high suitability zones, as well as uniformity and their concentration in the land suitability map. Therefore, it is suggested that these methods, along with other similar methods, should be studied in other regions and also the results of these studies should be compared with the results of the study, so that their effectiveness can be studied more comprehensively and then can be selected the best method for further research and obtaining more favorable results.

Keywords: Optimum Physical Development, Compatibility Analysis, Weighted Mean, Analytical Hierarchy Process, Shahr-e-Kord.

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