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LOCATING OF URBAN FORESTS USING NETWORK ANALYSIS MODEL (ANP) AND WEIGHTED LINEAR COMBINATION (WLC) USING TOPSIS PRIORITIZATION METHOD (STUDY AREA: YAZD CITY)

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ABSTRACT
In this study, the location of suitable areas for urban forest construction has been investigated. Geographic Information System (GIS) and multi-criteria decision analysis (MCDA) were used for this purpose. Based on the opinions of experts and past research, three main criteria were selected: ecological, access to urban services and socio– political terms. Also, sub-criteria were selected for each criterion and the desired spatial layers were prepared. Network analysis (ANP) method was used to categorize each criterion. For this purpose, the relevant questionnaire was prepared and after consulting experts, the weight of each criterion was calculated. The raster layers corresponding to each layer were prepared by fuzzy normalization method and the weight of each layer was applied in the corresponding layer. Then the layers were overlapped using the weighted linear combination (WLC) method and suitable areas for urban forest construction were selected. After locating, 8 areas were selected as proposed areas. Then 7 templates were selected and prioritized to categorize them. Then, based on the TOPSIS model, 8 options were prioritized and its map was presented.

KEYWORDS: Urban Forest, Green Space, Locating, Yazd, ANP, GIS.

1. INTRODUCTION

Nowadays, people prefer living in urban areas than rural parts. Green spaces are the major part in urban environment and cover wide ranges of ecological, social, cultural, economic services. Although tree is the most important element of green space, its benefits are often overlooked. In modern urban planning, to create a more appropriate environment, the use of urban green spaces and forests is emphasized. Among the new approaches in integrated management of natural resources to meet the demands of urban, urban forestry is a multidisciplinary approach to make the planning and management of forest and tree resources in and around urban areas (Konijnendijk et al., 2005).

This topic was discussed during the 1960s as a comprehensive interdisciplinary approach in urban-environmental science. In 1970, the urban forestry in America was known as a sub-field of science. Besides, it was developed in Canada, Europe and Australia, and also in the early 1980s raise by the Netherlands, Ireland and the UK (Zaree et al., 2009). Urban forestry implies on the planning and management of projects and activities related to the protection and maintenance of forests in the urban environment. The urban forestry consists of scattered green spaces such as parks, wooded streets, around lakes, river banks, roads and ferries (Zare et al., 2009).

Reducing air quality, increasing temperature, noise pollution, and social stresses are the critical issues in most cities in Iran. The value has been accelerated by inappropriate management, so making urban forests is very important in cities of Iran. Therefore, locating forests in urban areas is one of the most eminent factors in urban forestry. The locating criteria of urban forests according to economic and ecological aspects and water resource are done using previous studies which results in the maximum ecological services. Hence, the maximum attention is on the ecological aspect.

Based on the opinions of experts and past research, three main criteria were selected: ecological functional, access to urban services and socio– political terms. Sub-criteria were also selected for each of the criteria.

Total green space area of Yazd city, is located in center of Iran, is 260.56 ha and its capitation equals 2.67m^2

which the minimum green space capitation is 7m^2 and this value for international cities is 15m^2 (Comprehensive plan of Yazd, 2007).

The per capita green space recommended by the United Nations is 20 to 25 square meters, in Latin America 15m^2 and in England 10m^2 (Pourmohammadi, 1995). According to expert studies, the international standard of green space for each person living in densely populated cities is between 15-50 and an average of 20m^2 (HosseinZadeh Delir, 1998). The minimum proposed green space per capita in the comprehensive plans of Iranian cities is 7m^{2}and the proposed per capita of the relevant devices in the national and international arenas is about 15 square meters (Yazd comprehensive plan, 2007).

2- Literature review

Gül et al. (2006) in a study with multi-criteria analysis to locating urban forests in Sparta, Turkey, identified the best place to build a new urban forest using multi-criteria analysis. Criteria according to three main aspects of the characteristics of urban forests, including recreational, ecological and structural aspects; Which have been evaluated by experts. Then, the areas with the highest score and competence enter the feasibility stage and are examined, and finally, the areas with the highest score are selected for the construction of an urban forest park. The results of this study show that the efficiency of multi-criteria analysis as a flexible and capable tool for selecting urban forests is high.

Azadinejat et al. (2007) determined three criteria including situational, special and management criteria using MCDM and GIS. They used integrated models to locate and concluded that AHP due to its application of quantitative and qualitative criteria simultaneously can be efficient in regional and urban planning.

Fakour and Shatai (2013), in a study, first calculated the per capita tree green space including tree-planted parks, parks and tree complexes available to the public in different areas of Mashhad using satellite imagery and areas in terms of per capita priority And then the location of urban forest parks by considering the location criteria in recreational, ecological and structural aspects in an area with the lowest per capita and to combine layers and weight the criteria by the Analytic Hierarchy Process (AHP) Have used. The results showed that barren and agricultural uses due to the ease of turning into urban forest parks and areas closer to the urban core, due to proximity to various residential, educational, tourism and recreational uses, as well as the ability to create boundaries and improve the quality of areas. Urban and proximity to sources of air pollution and noise pollution are highly qualified to create an urban forest park.

Kalantari and Fallah (2016) investigated the possibility of estimating ground carbon storage in urban forests using UltraCam-D data (Case study: Yazd city) And used ground survey techniques and combined with regression techniques with the help of satellite images. The AHP method was used in three stages to investigate the areas prone to green space in increasing carbon storage: criterion determination, Feature weighting and preparation of standard maps were prepared and standardized, and In the last stage, by combining weights and maps in a linear way, a map of areas prone to green space was prepared.

Donovan (2017) examined the general health benefits of trees in urban forestry management decisions. His research shows that the biophysical benefits of urban trees are often considered a reason to invest in urban forestry. However, less emphasis is placed on non-biophysical benefits, such as improving general health. In fact, the general health of trees benefits can outweigh the biophysical benefits, and therefore not paying attention to the general health benefits of these trees may lead to low investment in urban forests. In addition, the distribution of trees that enhance the biological and physical benefits may maximize public health benefits.

Gulsrud et al. (2018) investigated the management of modern urban forestry in Melbourne by the method of placing urban green spaces as a nature-based solution. And they said that urban forestry strategy as an international method can be effective in most cities. As a result, the comprehensive process of urban forestry, focusing on climate adaptation and technological strategies based on social ecological systems, such as a suitable environmental and social welfare, leads to the optimal location of urban green spaces.

3- MATERIALS AND METHODS

3-1- Study area

Yazd city with an area of 99.5 km^2 is located in the center of Yazd province and on the Isfahan-Kerman Road in the coordinates of 54 and 31 degrees north latitude and 23 and 54 degrees east longitude. The altitude of this city is 1215 meters above sea level and its air distance to Tehran is 508 kilometers. Shirkuh mountain is located in the northwest and southeast direction in 20 km of Yazd city and in the form of a mountain wall, in the southwest of the province, separates the central parts from Abarkooh plain, and it has an effective role in reducing air temperature and absorbing moisture for its surroundings.

Yazd city with an area of 99.5 located in center of Iran (31^o 54′ N and 54^o 23′ E).

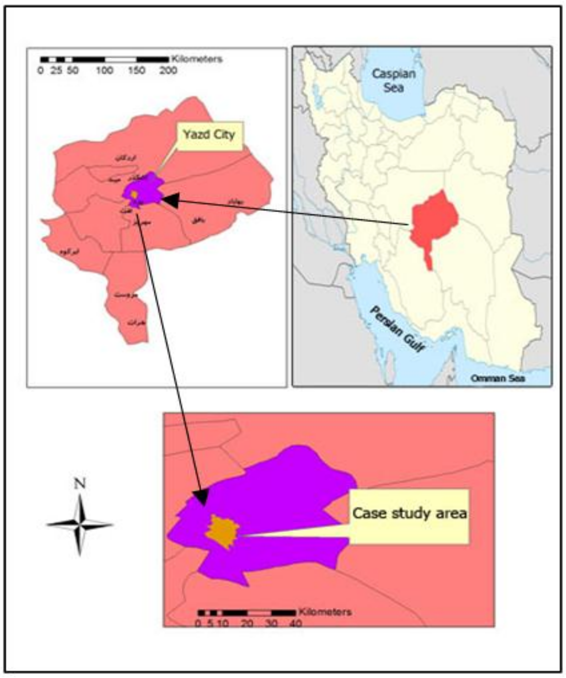
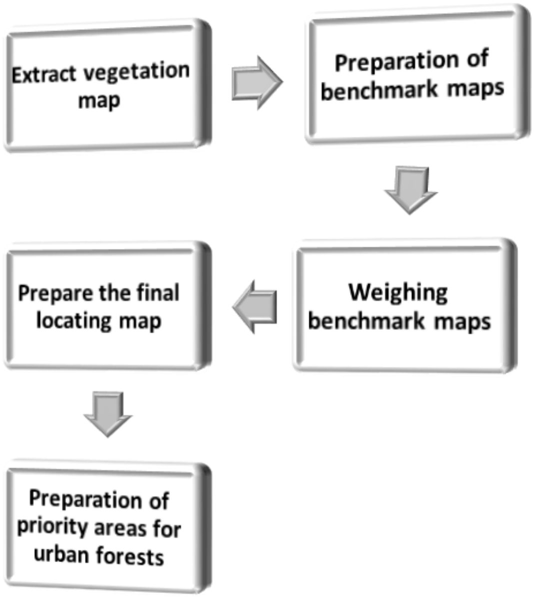


Figure 1: Map of Yazd location in the country and location of the study area.

The study area in the city of Yazd is more than 13,000 hectares, which according to the population according to the last general census of population and housing in 1395, is 656474 people, the average regional agglomeration in the city is about 30 people per hectare. The uncontrolled expansion of the city in recent years and the interference of different levels of different uses, especially the levels of large factories within the urban context, railway area and metropolitan services and large areas such as historical areas and sites of antiquities and cultural heritage. The main reason is the low population density in this city. While in most major cities of the country, the gross density is between 50 to 100 people per hectare, in Yazd, there is a density of 30 people per hectare, which indicates the abundance of urban land without a suitable population.

3-2- Research method

In this study, the location of suitable areas for urban forest construction has been investigated. Geographic Information System (GIS) and multi-criteria decision support system (MCDM) were used for this purpose. Based on the opinions of experts and past research, three main criteria were selected: ecological, access to urban services and socio– political terms. Also, sub-criteria were selected for each criterion and the desired spatial layers were prepared. Network analysis (ANP) method was used to categorize each criterion. For this purpose, the relevant questionnaire was prepared and after consulting experts, the weight of each criterion was calculated. The raster layers corresponding to each layer were prepared by fuzzy normalization method and the weight of each layer was applied in the corresponding layer. Then the layers were overlapped using the weighted linear combination (WLC) method and suitable areas for urban forest construction were selected. In this study, satellite images of Sentinel 2 series and normalized vegetation differentiation index (NDVI) were also used to detect urban green space, and vegetated areas were separated from other land uses. After locating, 8 areas were selected as proposed areas. Then 7 templates were selected and prioritized to categorize them. Then, based on the TOPSIS model, 8 options were prioritized and its map was presented.



2- Flowchart of urban forest locating route

Selection of criteria

One of the most important parts of spatial models is the selection of criteria and factors affecting the desired goal. This study is based on previous research, using the opinions of experts as well as available spatial information of 5 ecological criteria, including the following criteria: creating corridors (shading), adsorption of suspended particles, carboniferous, equalize the temperature (heat and radiation islands), protection against Storm (windbreak) - conservation of biodiversity - socio-economic including: population density and literacy ratio - urban services including: distance from educational centers, Distance from office centers, distance from residential centers, distance from garden, distance from urban green space, distance Agricultural land, distance from barren land, distance from urban passages, distance from urban facilities, distance from production centers and distance from residential areas were used. Table 1 shows the selected criteria and sub-criteria.

Table 1: Selected criteria and sub-criteria.

Criteria	Sub-criteria
Socio-economic	Population density
	Literacy ratio
Ecology	Carbon sequestration
	Biodiversity
	Surface temperature
	Shading
	Storm adjustment
	Dust absorption
City Services	Distance from educational centers
	Distance from office centers
	Distance from accommodation
	Distance from the garden
	Distance from barren land
	Distance from urban facilities
	Distance from production centers
	Distance from the passage
	Distance from green space
	Distance from arable land
	Distance from residential areas

Prioritizing factor

The importance and priority of each criterion and sub-criterion in achieving the goal are different from each other. Determining the priority and its amount can be calculated based on different weighing methods. In this study, ANP method was used for weighing. Therefore, after preparing a questionnaire and using the opinions of 20 experts, the selected criteria were compared and prioritized in pairs and finally the weight of each criterion was calculated. In this method, the weight of sub-criteria is obtained by influencing the relationships within the network, which includes the relationship between the criterion and the criterion or the criterion with the sub-criterion. Figure 3 shows the network created in Super Design software.

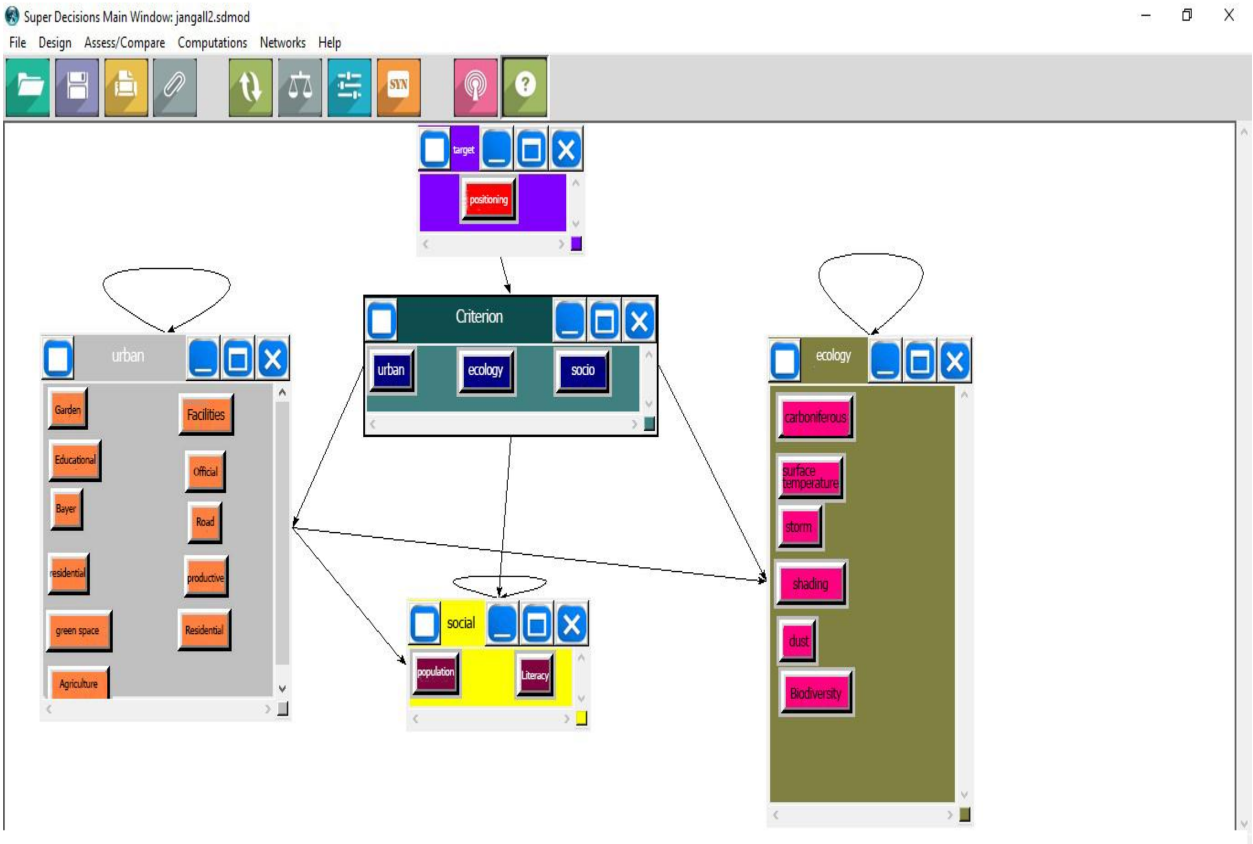


Figure 3: Network created with the help of a robot in Super Design software.

The calculation of weights is based on the average opinions of expert experts for comparison as shown in Figure 4 in the software.

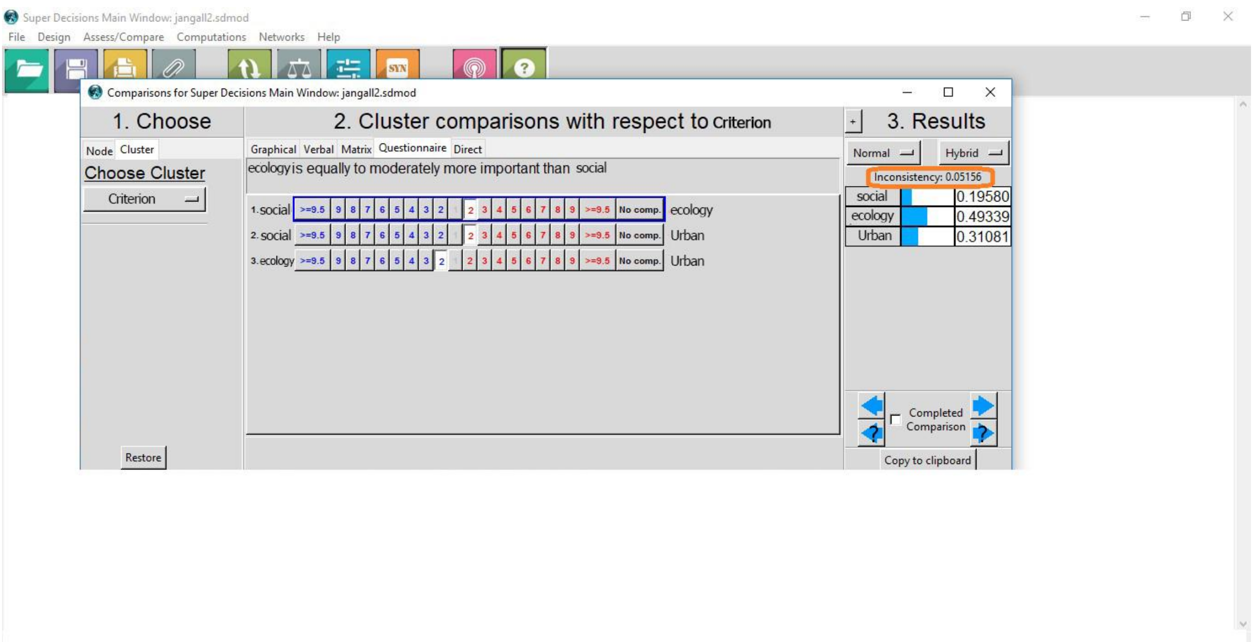


Figure 4: Weighing criteria in superdesign software.

The incompatibility factor is the correct measure of how they are prioritized and scaled, which should be less than 0.1, for example in Figure 2-4 this is 0.05156 and less than 0.1.

The total calculated weight is equal to one. Table 2 shows the weight of each criterion.

Table 2: Calculated weight of each criterion according to ANP method.

Criterion	**Sub-criteria**	**Weight**
Socio-economic	Population density	0.201933
	Literacy ratio	0.050483
Ecology	Carbon sequestration	0.092248
	Biodiversity	0.0645
	Surface temperature	0.233654
	Shading	0.026048
	Storm adjustment	0.041198
	Dust absorption	0.046262
Socio-economic	Distance from educational centers	0.016035
	Distance from office centers	0.012077
	Distance from accommodation	0.013711
	Distance from the garden	0.058591
	Distance from barren land	0.008621
	Distance from urban facilities	0.011048
	Distance from production centers	0.020254
	Distance from the passage	0.009321
	Distance from green space	0.026294
	Distance from arable land	0.036648
	Distance from residential areas	0.031073

The results of Table 2-4 show that the population density criterion with a value of 0.233654 is in the first priority and the distance from the wasteland criterion with a value of 0.008621 is in the last priority. The higher this value, the more important the relevant criterion is in modeling and the more power it has in calculating output maps.

Prepare a spatial database and create maps of each criterion

ArcGIS software was used to prepare the maps of each of the relevant criteria. In weighted linear combination, each of the criteria must be converted to a raster space to be overlapping. The required data for the municipal services criterion were prepared based on the latest detailed plan of Yazd city and the relevant raster maps were created. The type of effect of each of the parameters considered in the municipal services group is based on the distance or proximity of the target to these factors, so the Euclidean distance from the desired effects is prepared and the map of factors is given below. For socio-economic criteria, population and residential census data in Yazd in 2016 were used and demographic and literacy information was extracted from political divisions based on urban blocks. The ecological group sub-criteria were also extracted from the combination of different layers such as: slope direction, wind speed, topography, Landscape Ecology, carboniferous layers, hurricane adjustment and biodiversity. To obtain the ground surface temperature, the thermal band of the Landsat 8 satellite image and the separate window method were used. Also, the air pollution map of the Sentinel satellite was selected for the dust absorption sub-criterion. A map of the items described below is provided.

4. RESULTS

For each of the three criteria, a benchmark and sub-criteria map was generated:
Socio-economic
Population density

To prepare the population density map, the number of people per hectare of land in each urban block was used. Therefore, the resulting map in Figure 5 shows the number of people per hectare, densely populated areas with green color and maximum value in pixels and areas with low population with a pixel value of 0 with purple color can be shown in the map.

Figure 5: Population density map.

Literate

To prepare a literacy map, the ratio of the number of literate people to the total population in each block was used and the relevant map was prepared (Figure 6).

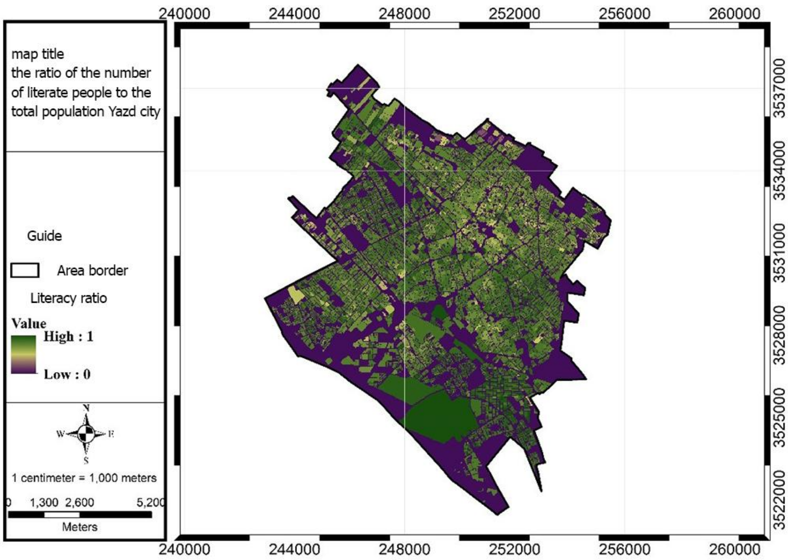


Figure 6: Literacy ratio map.

Ecological

Carboniferous(Carbon sequestration)

The resulting map was used in the study of Kalantari and Fallah (2016).

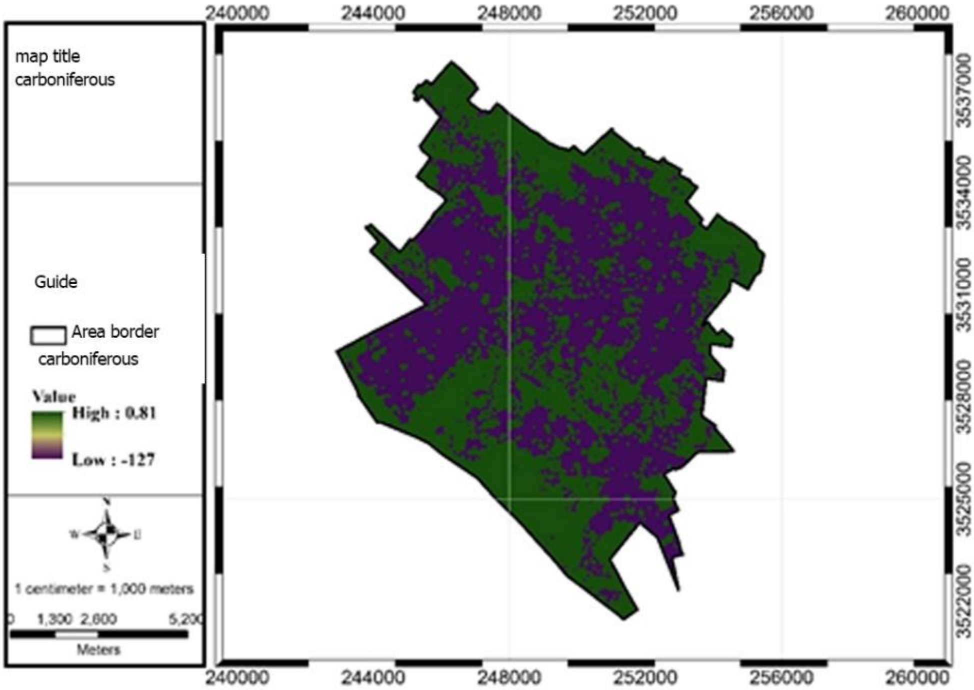


Figure 7: carboniferous map.

Biodiversity

The map obtained from the Landscape Ecology was used.

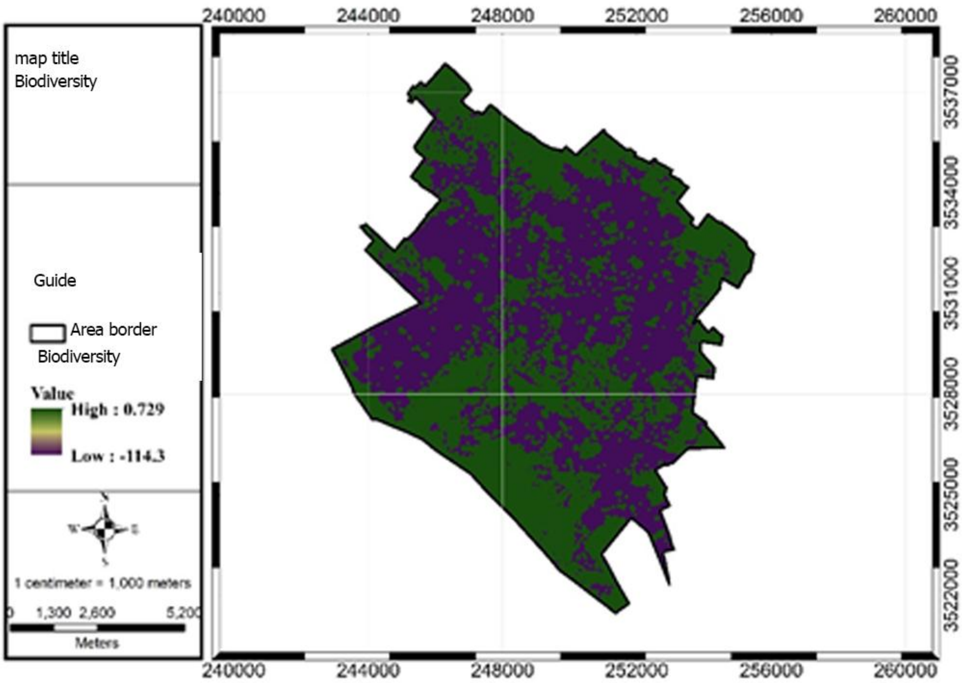


Figure 8: Biodiversity map.

Surface temperature

To prepare the surface temperature map, Landsat 8 satellite and two thermal bands 10 and 11 were used by separate window method. According to the map, the barren areas had the maximum temperature.

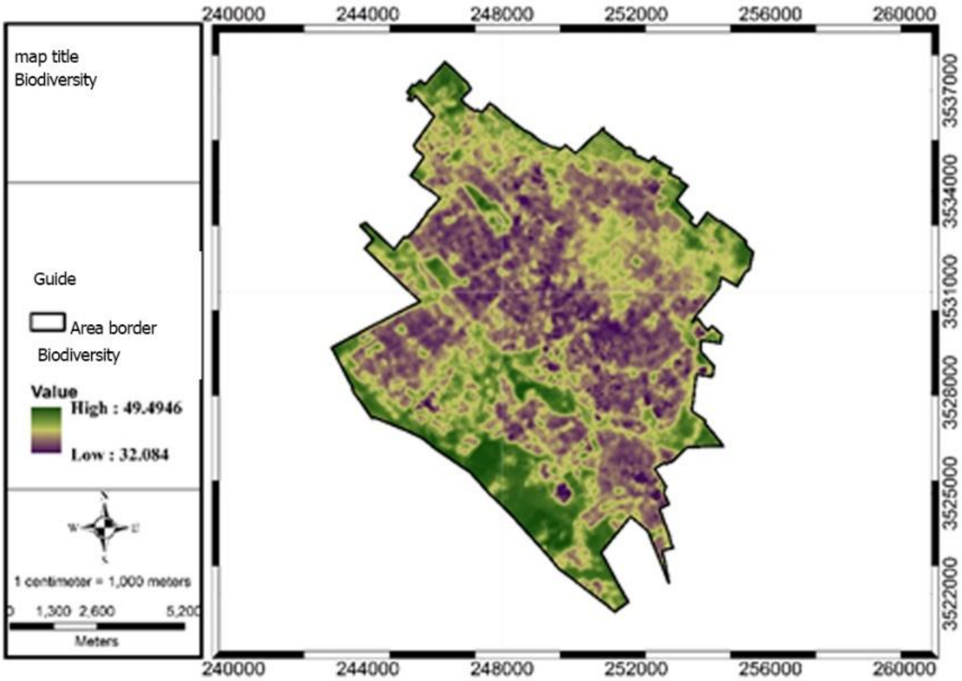


Figure 9: Earth surface temperature map.

Shading

The map obtained from the Landscape Ecology was used.

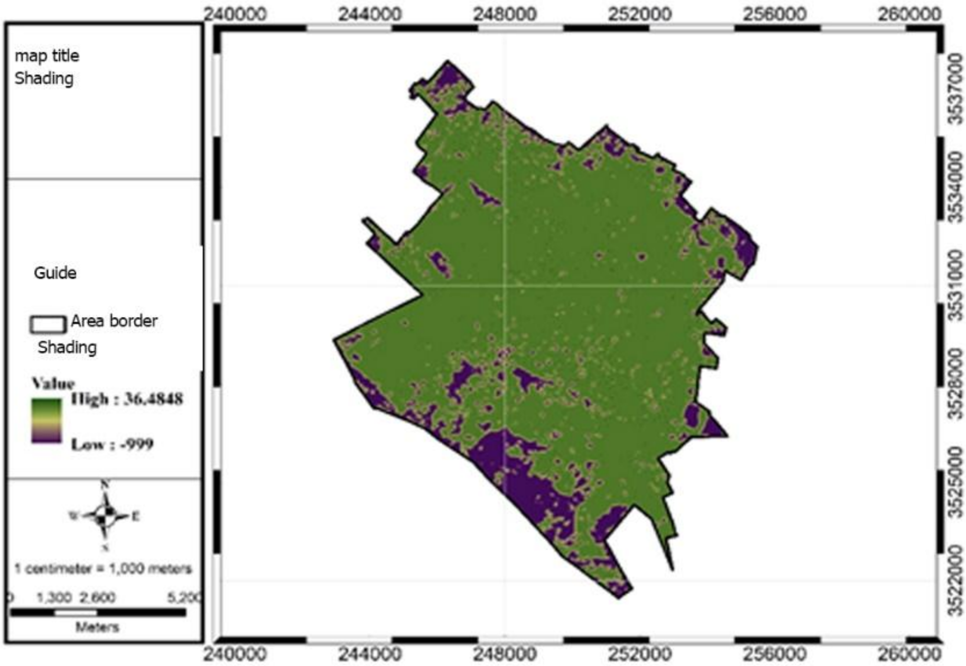


Figure 10: Shading map.

According to Figure 10, the barren areas had the least amount of shading.

Storm adjustment

The wind direction is often from southwest to northwest. Yazd DEM map was used to extract the benchmark map and the geographical map was extracted from it.

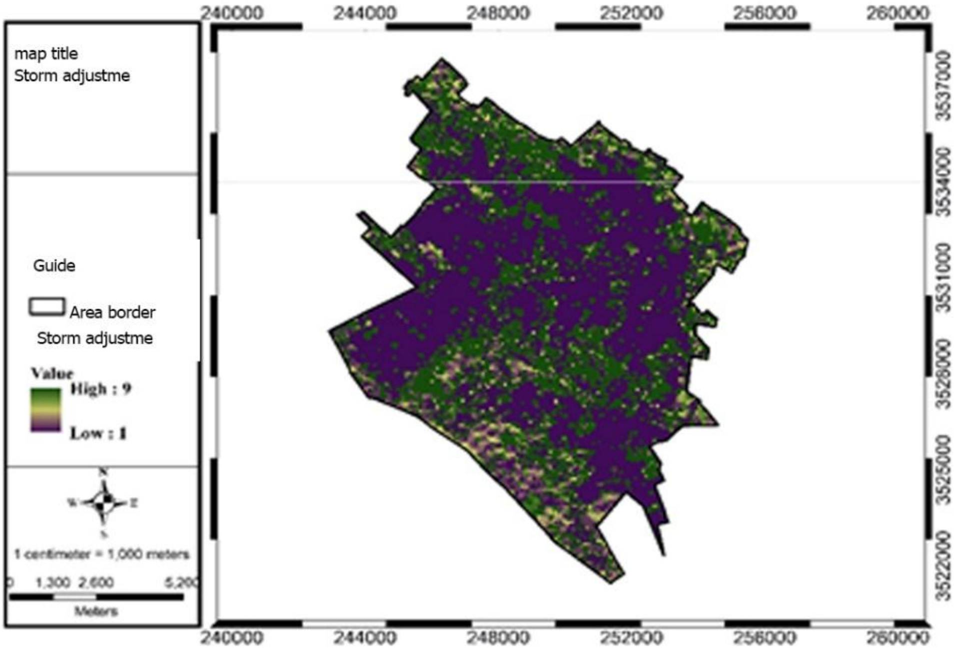


Figure 11: Storm adjustment map.

Dust absorption

Sentinel 5 image was used to prepare the benchmark map and dust and micropollutants dispersion map was extracted.

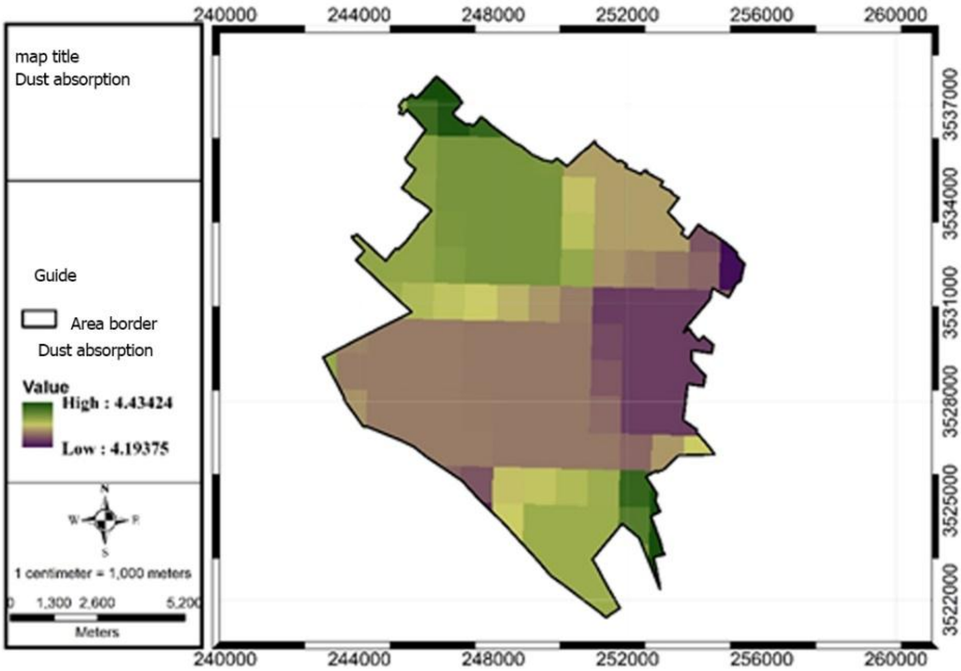


Figure 12: Dust absorption map.

City Services

Criteria for urban services include: recreational, residential, welfare, office, etc. Each of which is somehow influenced by the location of the forest under construction. These criteria were selected for the use of recreational green space due to pollution control, increase of recreational services and distribution of social justice.

Distance from educational centers

Educational centers include: elementary schools, middle schools, high schools as well as scattered educational units in the city. The proximity of training centers to forest parks is very important in order to control pollution, urban view and recreational space. In the map, 13 educational areas can be seen in blue.

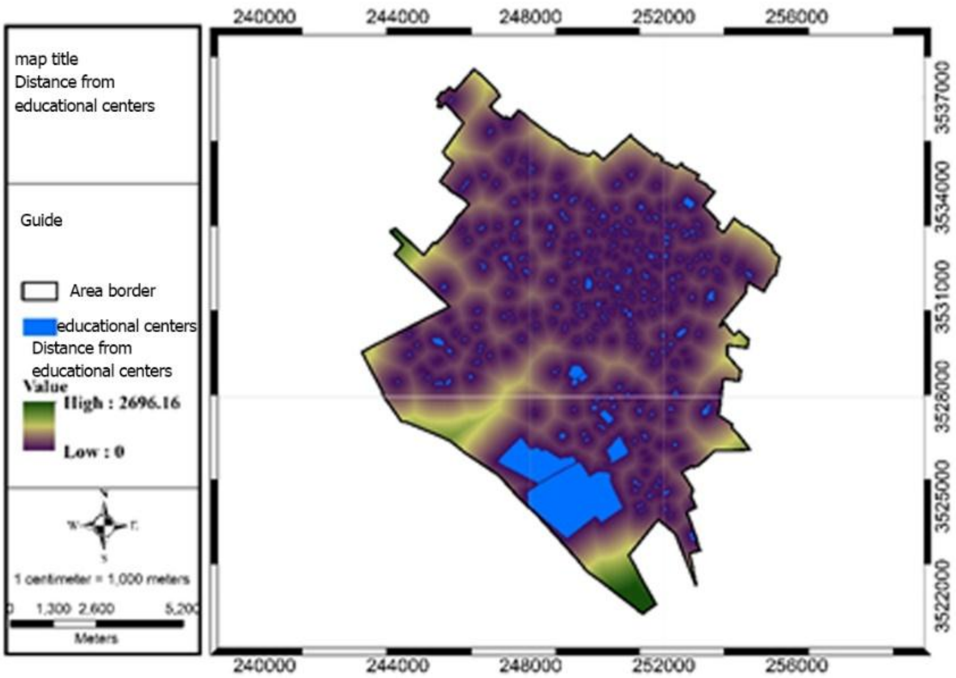


Figure 13: Distance map of educational centers.

Distance from office centers

Office centers are also crowded due to the daily visits of people. Creating recreational spaces next to these centers will improve the urban view as well as creating recreational spaces. Map 14 shows the distance from the office centers and the office centers are visible in turquoise.

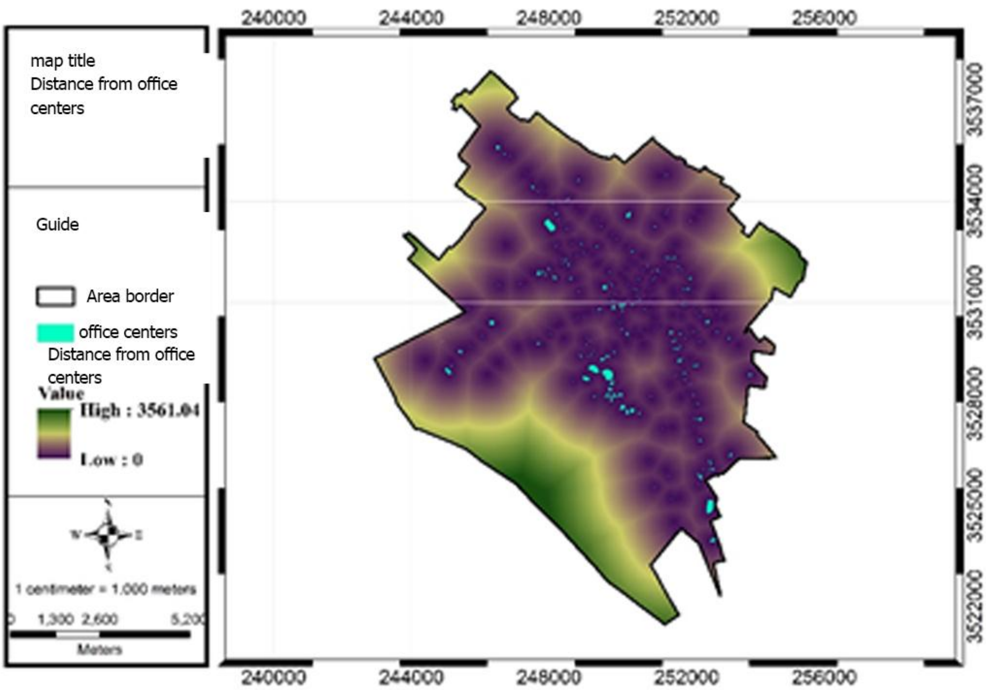


Figure 14: Distance map of office centers.

Distance from accommodation

Existence of green space and recreational places adjacent to accommodation and reception centers will preserve the urban view and increase the productivity of this place. Figure 15 shows the distance map of accommodation and reception centers.

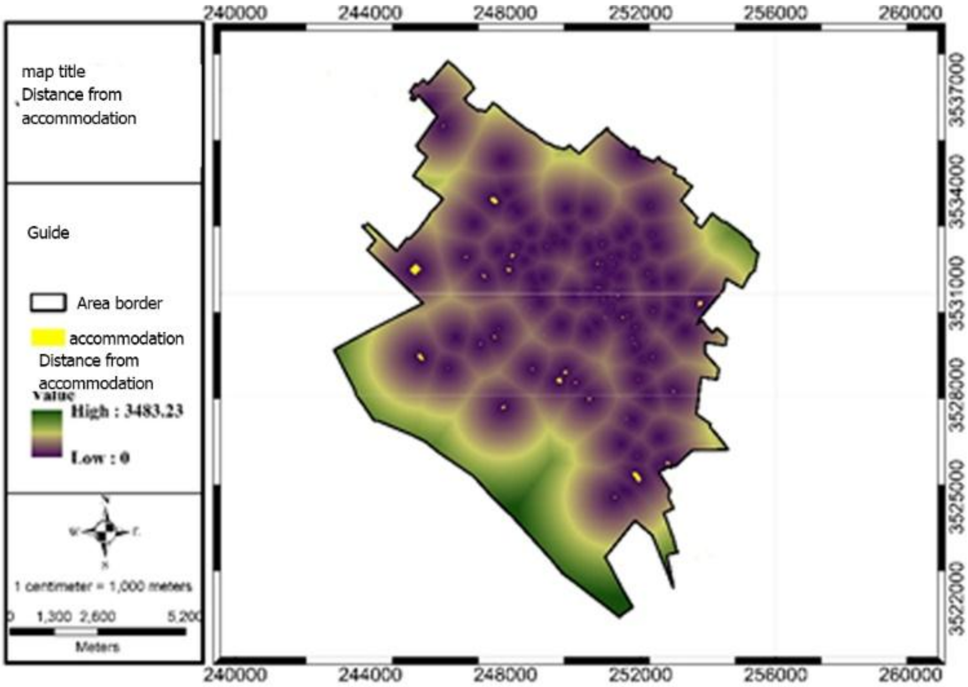


Figure 15: Distance map of accommodation centers.

Distance from the garden

The construction of new green spaces should be in such a way that the deprived areas have the maximum use. The construction of urban forests in the vicinity of existing gardens overlaps the performance of the two uses and reduces productivity. It is better to have the forests under construction farther away from the garden, so that the access to these green spaces is more balanced. Figure 16 shows a distance map of existing gardens.

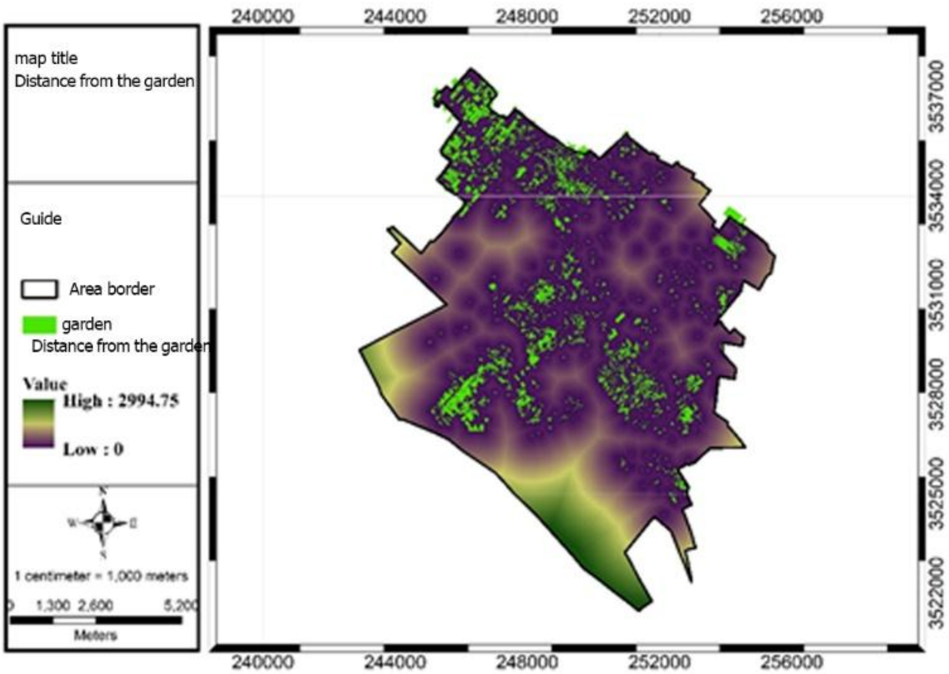


Figure 16: Distance map of gardens.

Distance from barren land

Land use change is one of the major urban problems. Barren land is more important due to the lack of construction to change the use. Therefore, the placement of urban forests in these lands will create less problems in changing the urban structure. Therefore, the use of these lands and adjacent users is the recommendation of this research. The distance map of barren lands is shown in Figure 17.

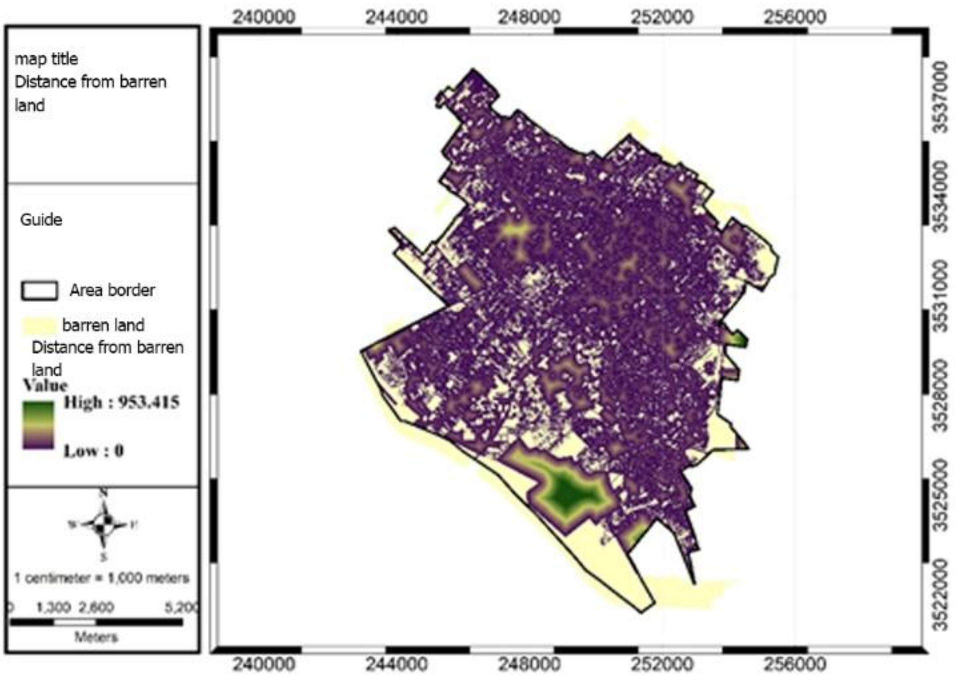


Figure 17: Distance map of barren land.

As shown in Map 17, the major urban uses are scattered on the outskirts of the city and in the southern parts towards the center.

Distance from urban facilities

Urban facilities are very important due to the ease of service and provision of services required by urban forests, including lighting, water, transportation, communications, etc. It is better to build urban forests near these facilities, in order to receive more services at a lower cost. Figure 18 shows the distance map of urban facilities.

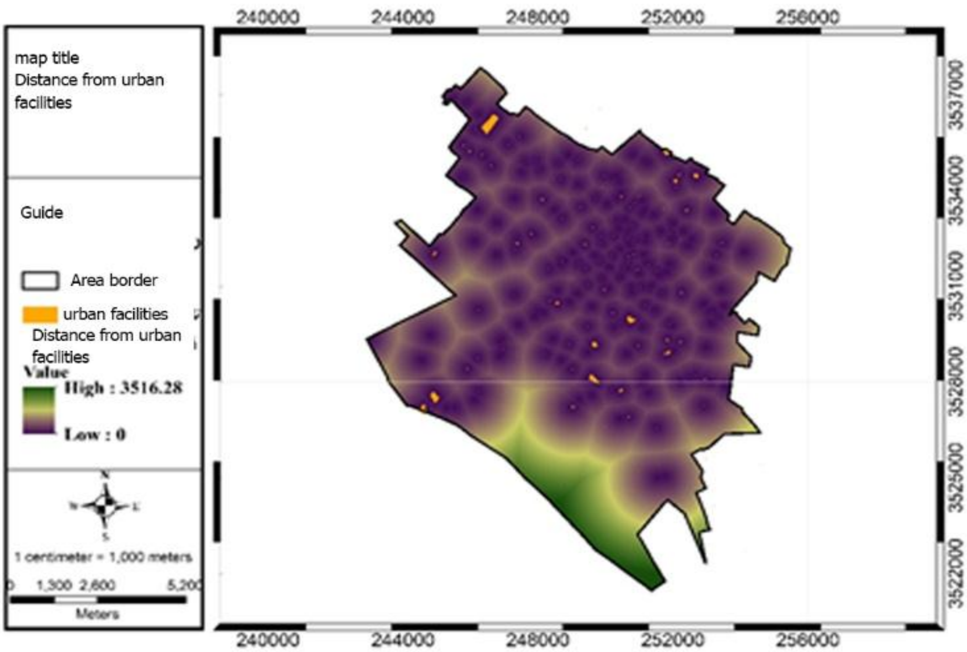


Figure 18: Distance map of urban facilities.

Distance from production centers

Production centers are problematic users for recreational spaces and urban forests due to pollution and various disturbances for the population of the city, so the proximity to this use should be controlled and the planted forest should be away from these centers. The distance map of the production centers is shown in Figure 19.

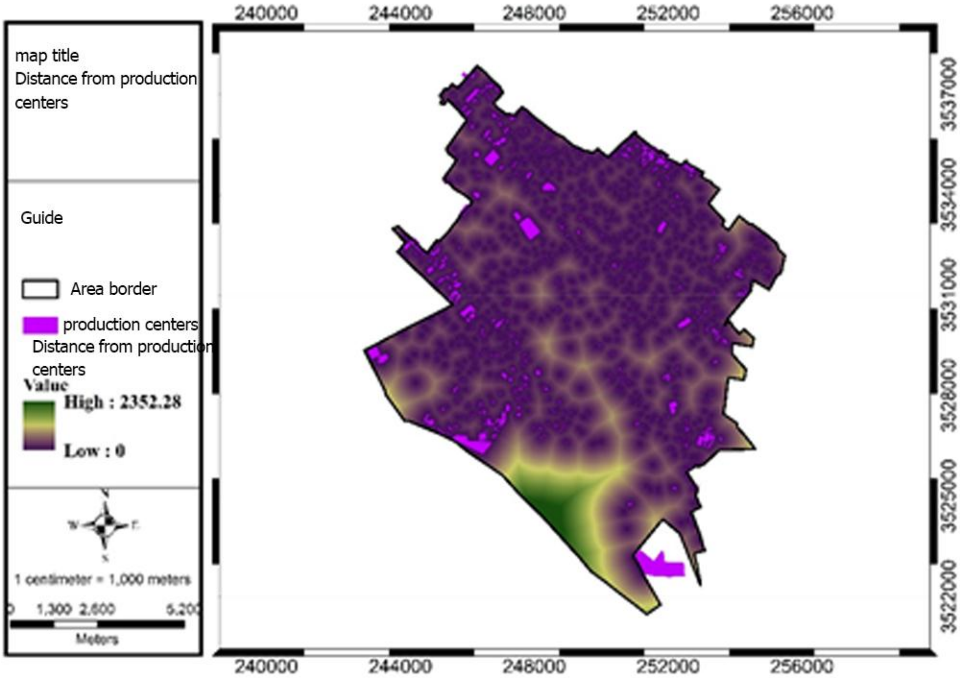


Figure 19: Distance map of production centers.

Distance from the passage

Important points are access to the urban forest and proximity to the urban transport network. Therefore, the planted urban forest should have the most access and proximity to the passages. In this research, the distance from the main passages has been investigated, which is shown in Figure 20 of the distance map from the passages.

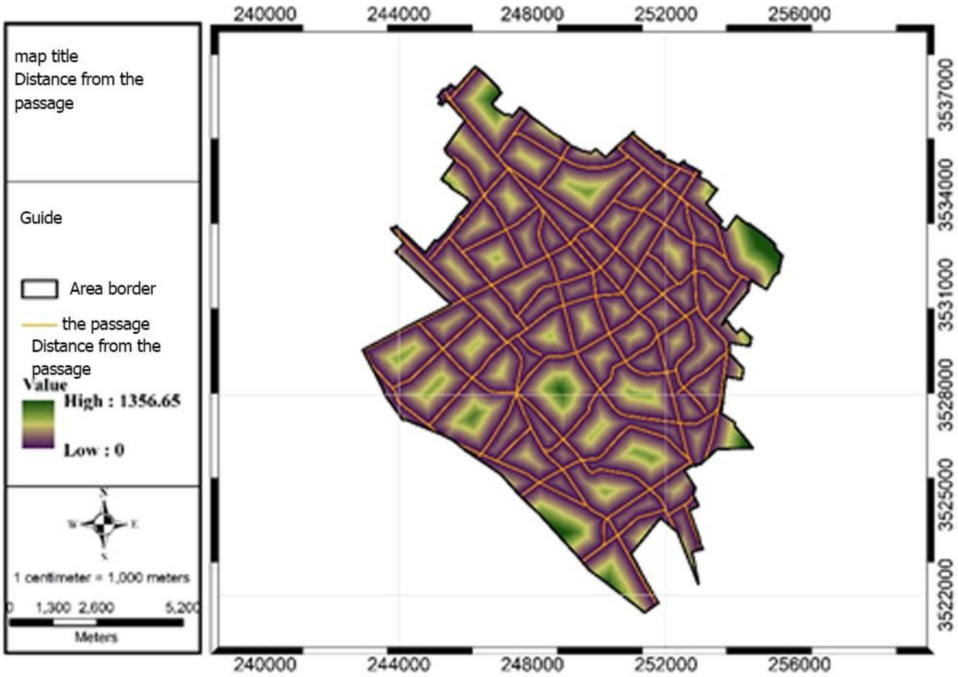


Figure 20: Distance map of passages.

Distance from green space

The proximity of urban forests to urban green spaces such as gardens overlaps functions. Therefore, proper distribution of green space in the city should be considered. And urban forests should be built away from green space. Figure 21 shows a distance map of existing green spaces.

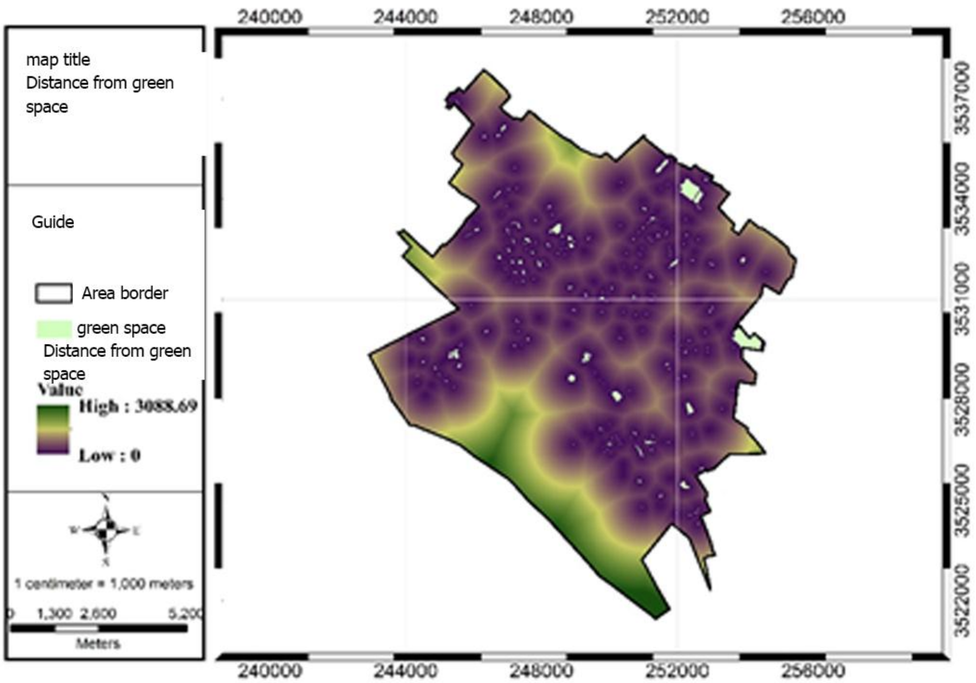


Figure 21: Distance map of green space.

Distance from arable land

The neighborhood of urban forest with agricultural use may cause degradation and disturbance for agriculture. Therefore, it is better for urban forests to be away from agricultural use. Since there are agricultural lands within the city limits, the distance from arable land was also considered as a criterion, which is shown in Figure 22.

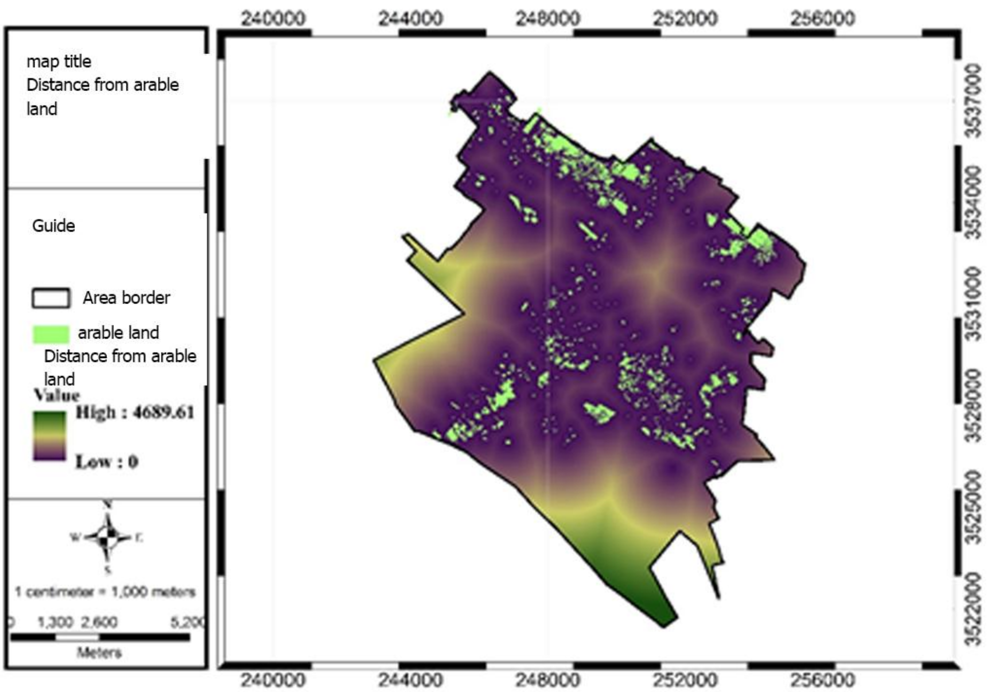


Figure 22: Distance map from arable land.

Distance from residential areas

Residential areas, because they contain the population of the city, are one of the important criteria in locating the city. Easy access and proper distribution of green space in the city will increase the efficiency and use of the urban population. The proximity of urban forests to residential areas is important and necessary. Figure 23 shows the distance map of residential areas.

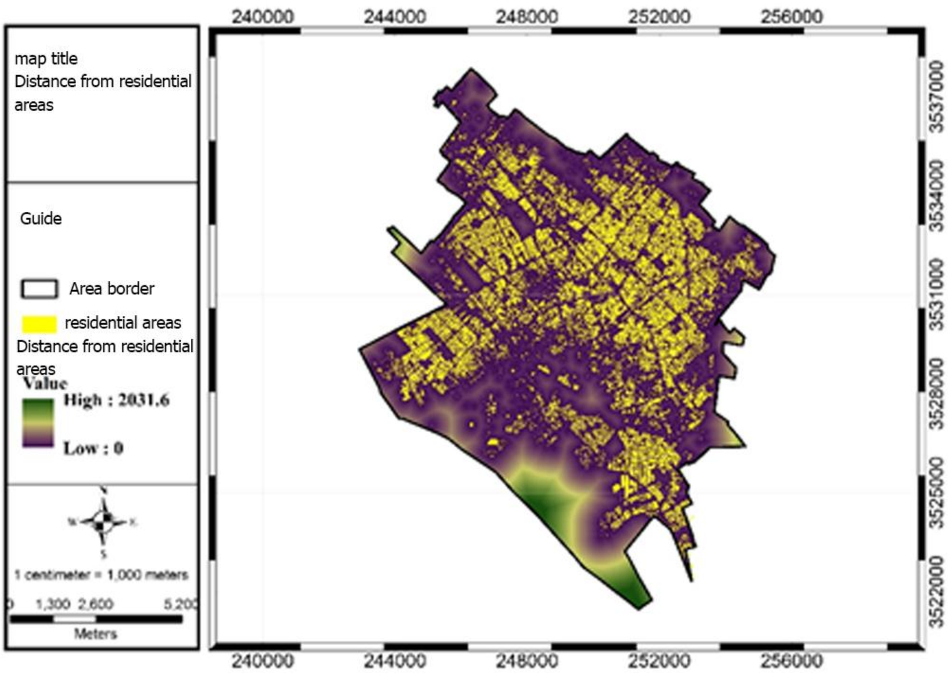


Figure 23: Distance map of residential areas.

Normalize maps

The units of each of the prepared maps are different. The same unit and scale are needed to model and overlap them. In this research, a fuzzy model was used to equalize the measurement scale of the layers. In this method, the value of all layers is placed between 0 and 1. The number 1 means the maximum proportion of pixels in the relevant map relative to the target, and the number 0 indicates the disproportion of pixels. Other pixels in the map have a value between 0 and 1, and the closer this number is to 1, the higher the proportionality. In the case of urban service criteria, distance and proximity, socio-economic and ecological criteria are the minimum and maximum values. Therefore, in this study, a decreasing and increasing linear model was used to normalize the layers. In the incremental linear function, the higher the numerical value of a map, the higher the proportion to the objective (in this study, the location of the urban forest planting site) and in the output map, its value tends to 1. Conversely, the smaller the numerical value of the map pixels, the less fit it is to the target, and in the resulting map, its value tends to 0. Table 4-3 shows the function used in each criterion.

Table 3: Function used in each criterion.

Criterion	Sub-Criteria	Function used	Description
Socio-economic	population density	Incremental linear	More density, more need
	Literacy ratio	Decreasing line	Low literacy, more social need
Ecology	carboniferous	Incremental linear	More carbon storage, high fit
	Biodiversity	Incremental linear	High variety, more fit
	Surface temperature	Incremental linear	High temperature, need to reduce the temperature further
	Shading	Decreasing line	Low shading, need more shading
	Storm adjustment	Decreasing line	Low storm adjustment, need more shade
	Dust absorption	Decreasing line	Less dust absorption, higher requirement
Socio-economic	Distance from educational centers	Decreasing line	Less distance, more fit
	Distance from office centers	Decreasing line	Less distance, more fit
	Distance from accommodation	Decreasing line	Less distance, more fit
	Distance from the garden	Incremental linear	More distance, more fit
	Distance from barren land	Decreasing line	Less distance, more fit
	Distance from urban facilities	Decreasing line	Less distance, more fit
	Distance from production centers	Incremental linear	More distance, more fit
	Distance from the passage	Decreasing line	Less distance, more fit
	Distance from green space	Incremental linear	More distance, more fit
	Distance from arable land	Incremental linear	More distance, more fit
	Distance from residential areas	Decreasing line	Less distance, more fit

The following is the normalized map of the criteria used. These maps show high-fit areas with a value of 1 or close to 1 in purple, and areas of lower value with a value of 0 or close to 0 are shown in brown.

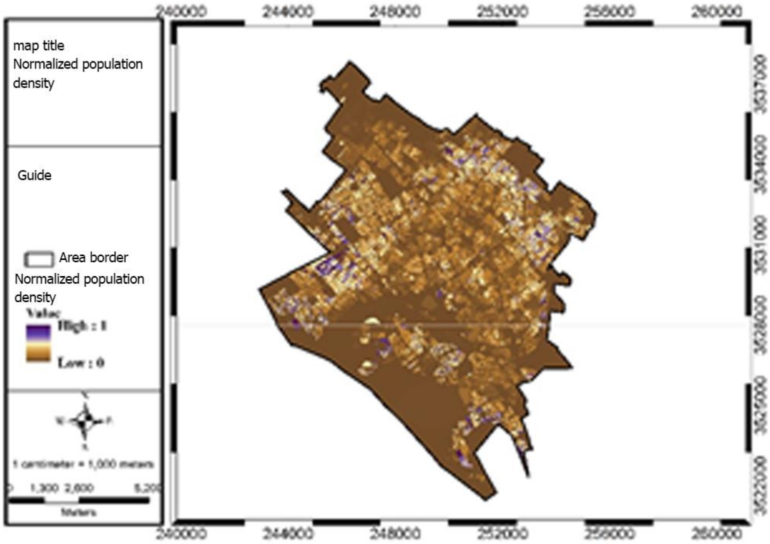


Figure 24: Normalized population density map.

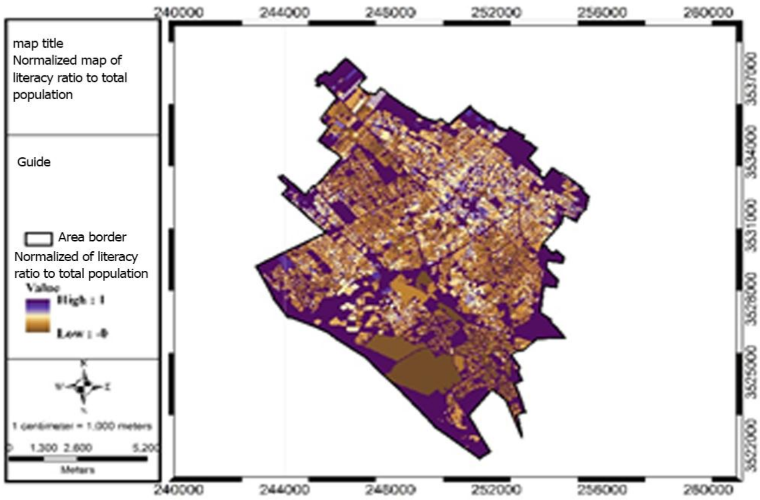


Figure 25: Normalized map of literacy ratio to total population.

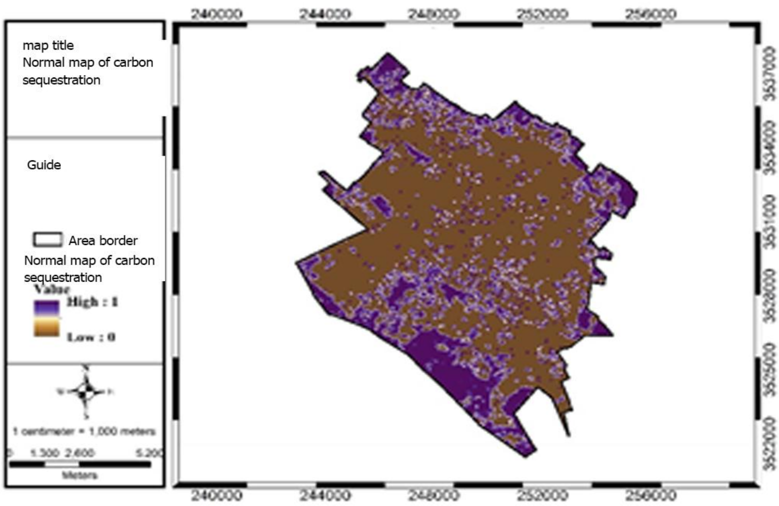


Figure 26: Normal map of carbon sequestration.

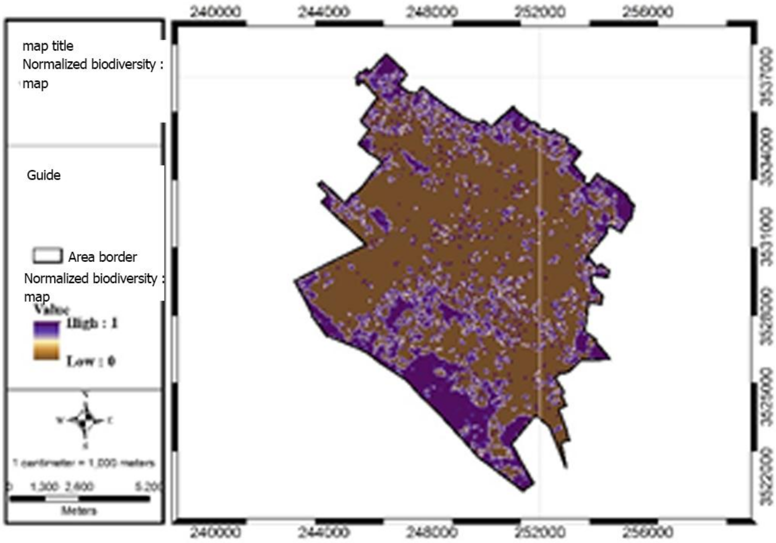


Figure 27: Normalized biodiversity map.

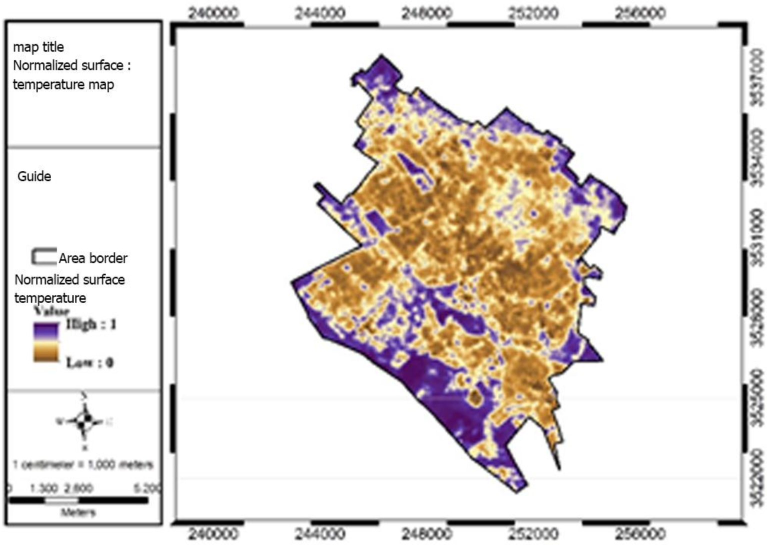


Figure 28: Normalized surface temperature map.

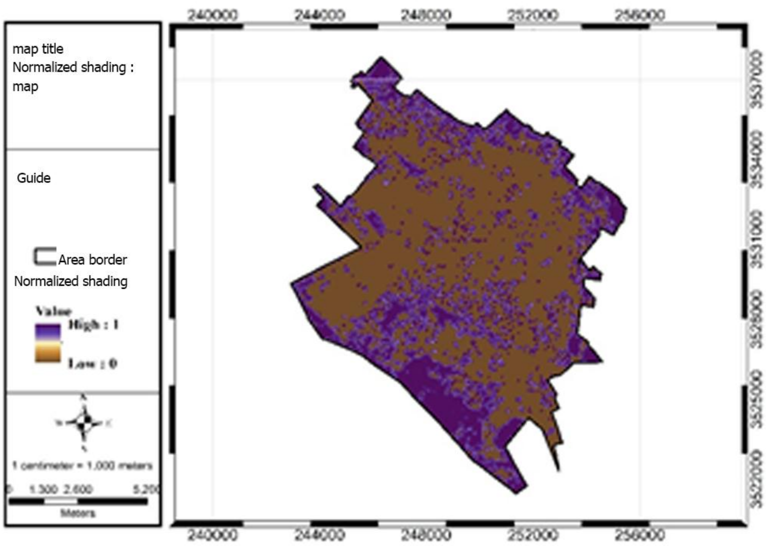


Figure 29: Normalized shading map.

Figure 30: Normalized storm adjustment map.

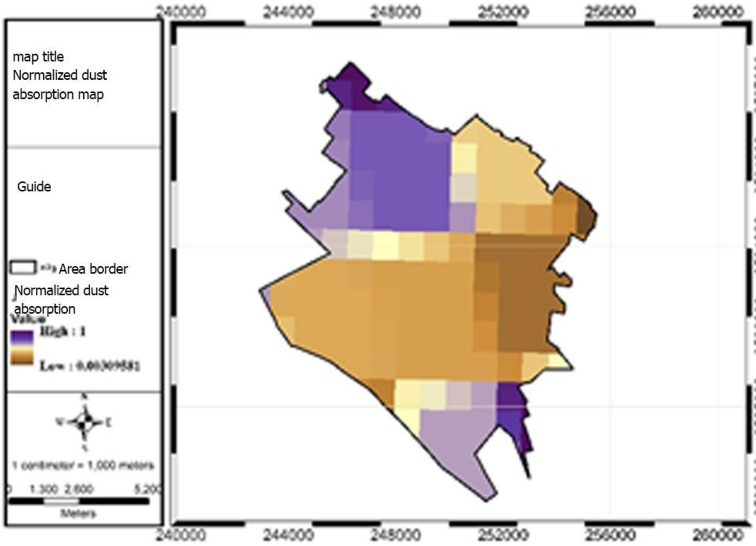


Figure 31: Normalized dust absorption map.

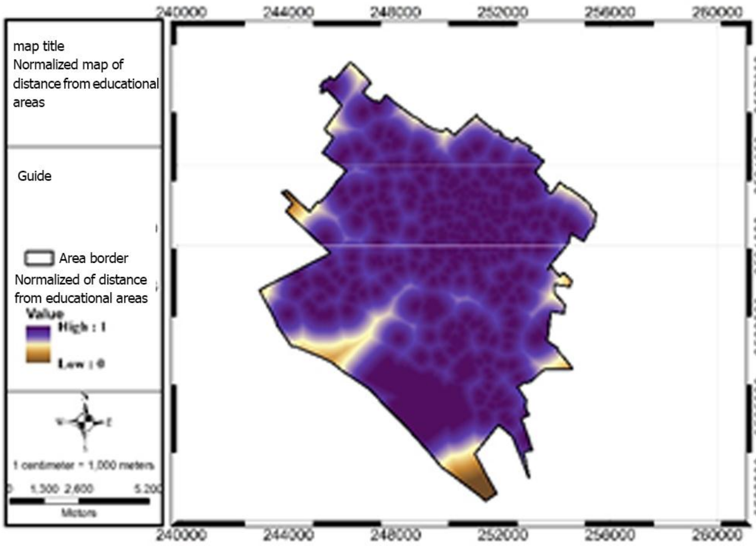


Figure 32: Normalized map of distance from educational areas.

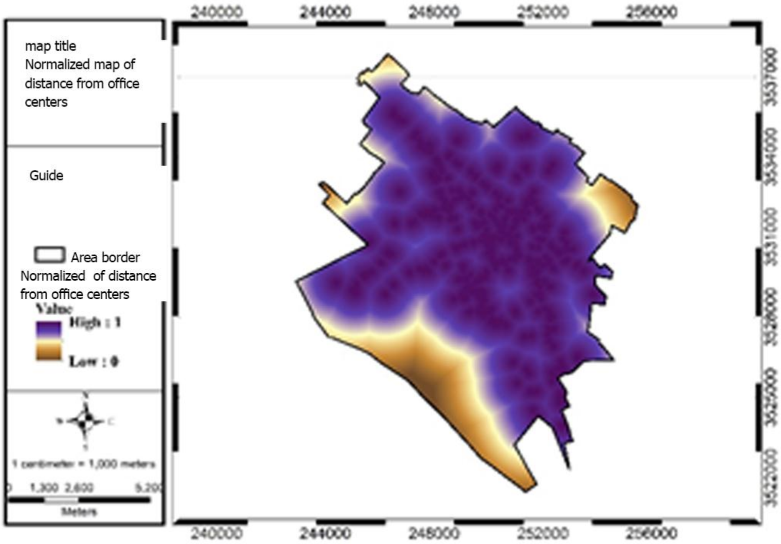


Figure 33: Normalized map of distance from office centers.

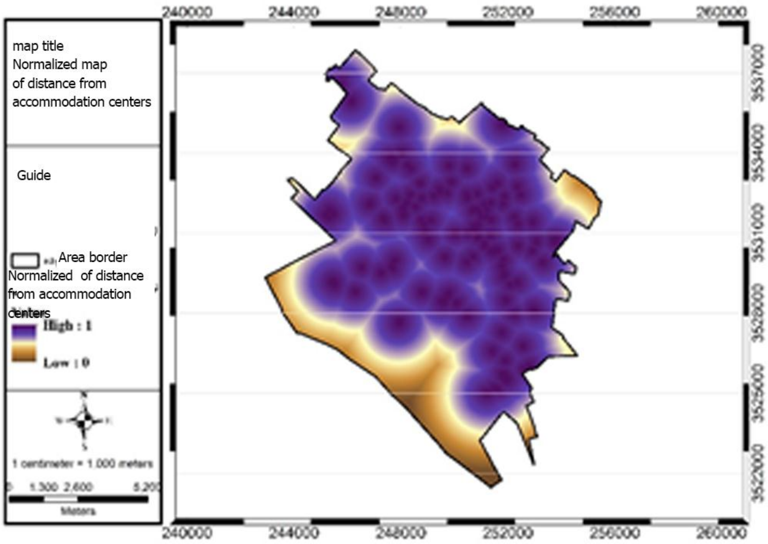


Figure 34: Normalized map of distance from accommodation centers.

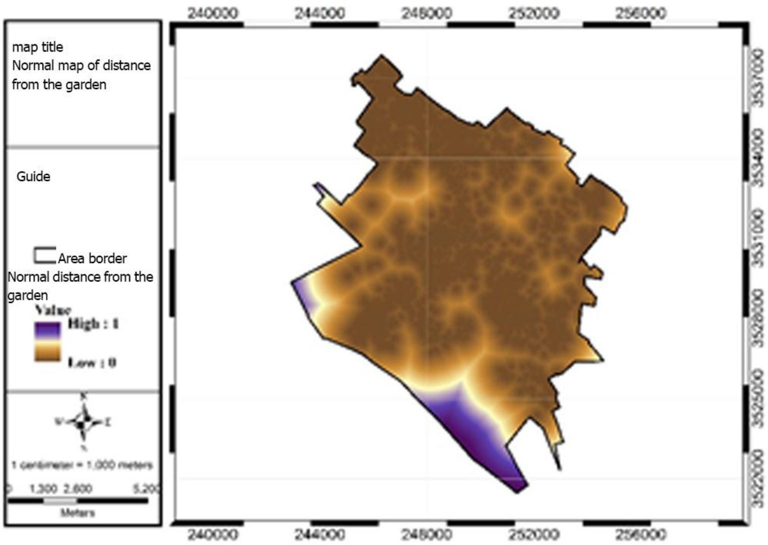


Figure 35: Normal map of distance from the garden.

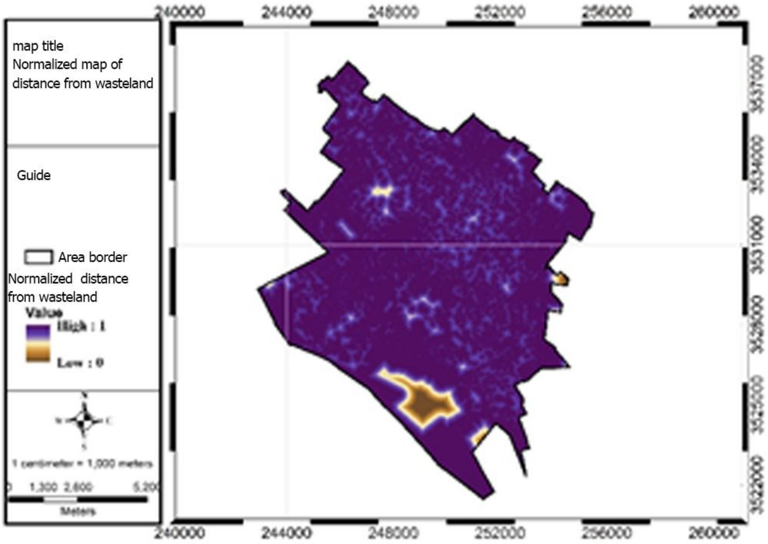


Figure 36: Normalized map of distance from wasteland.

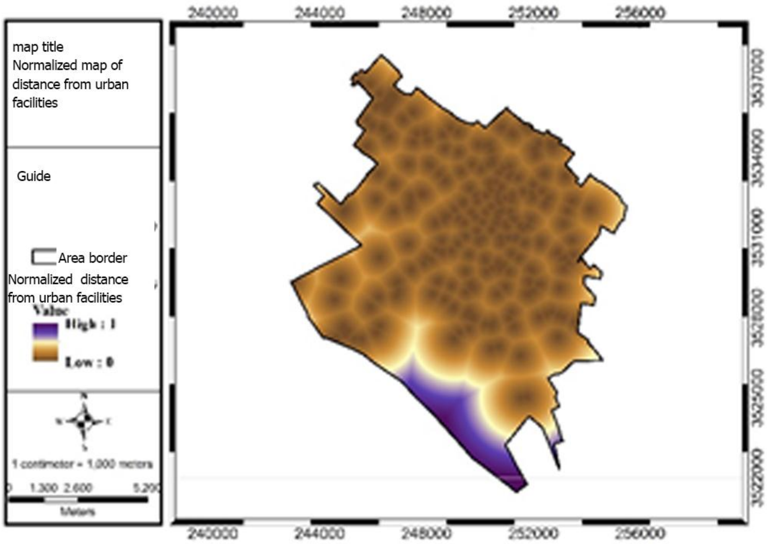


Figure 37: Normalized map of distance from urban facilities.

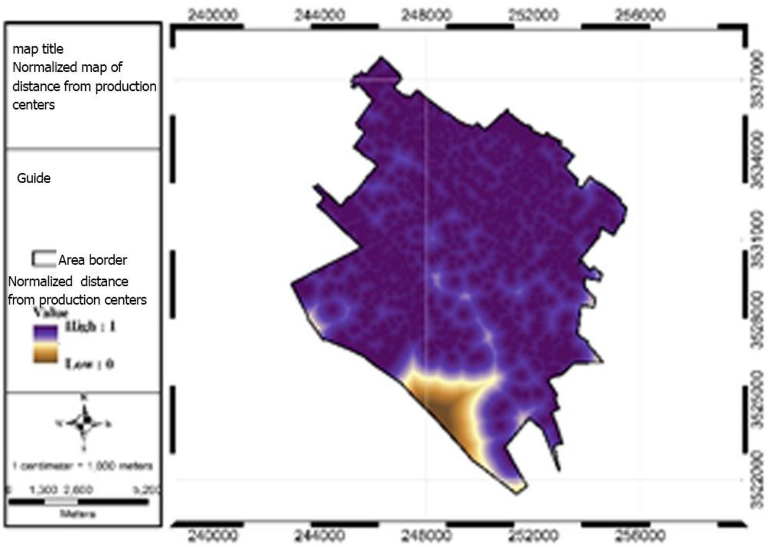


Figure 38: Normalized map of distance from production centers.

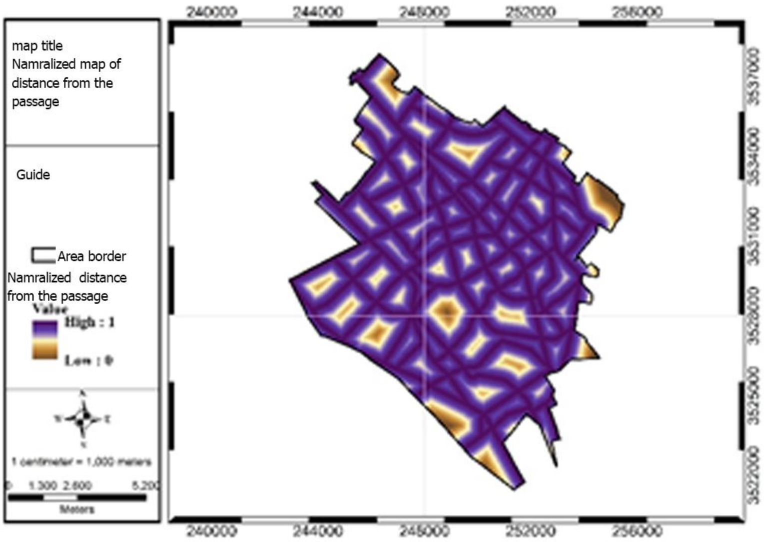


Figure 39: Namralized map of distance from the passage.

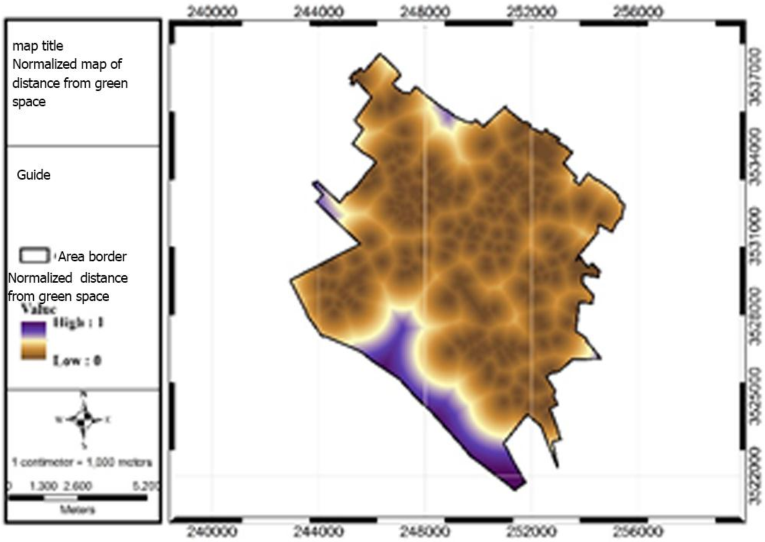


Figure 40: Normalized map of distance from green space.

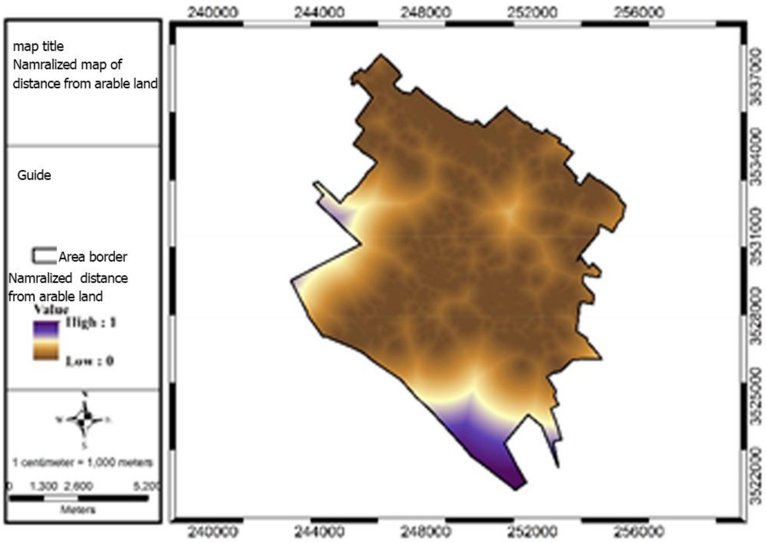


Figure 41: Namralized map of distance from arable land.

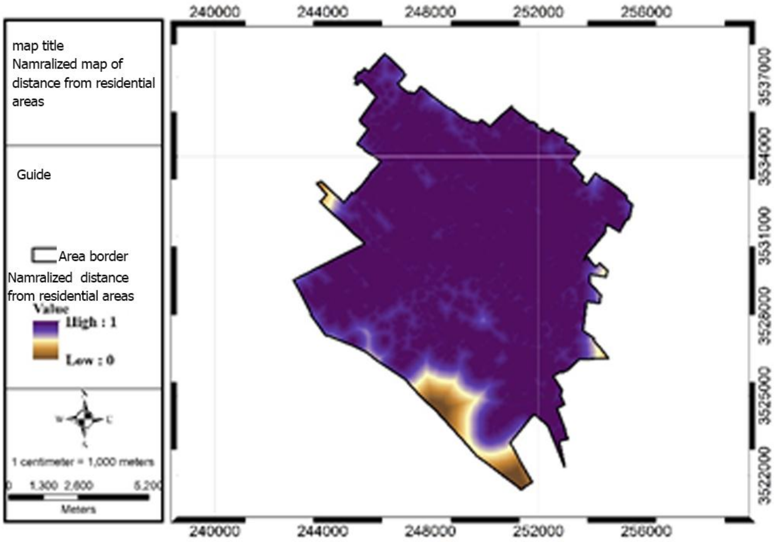


Figure 42: Namralized map of distance from residential areas.

Preparation of normalized weighted layer
At this stage, the weight obtained from the ANP model is applied to the normalized maps of each criterion. The output of this step is obtained by multiplying the weight of each layer in each of the numerical values of its pixels by a normalized and weighted map.

Criteria overlap
In the last step, all the weighted criteria are overlapped and combined. In this study, the Weighted Linear Combination (WLC) method was used. This method is one of the most common methods in multi-criteria decision making. The steps of this method are described below.

This method uses normal weighted layers. The weight of each layer determines its order. In this method, it is possible to determine limited areas for the model. This means that areas that can not be used in modeling are removed from the study area and applied to the overlapped map. Equation 1-4 shows how this model works.

Equation (4-1)
$S = \Sigma Wi\ Xi\ \Pi cj$
S: Desirability
W_i: Weight factor
X_i: Fuzzy value of the invoice
c_j: Restriction criterion score
Π: multiplier

The final constraints are also obtained using Equation 4-2
Relationship (4-2)
$C = \Pi cj$
C: Final limit
C_j: Restriction criterion score j
Π: multiplier

Figure 43 shows the final map resulting from the overlap of the layers.

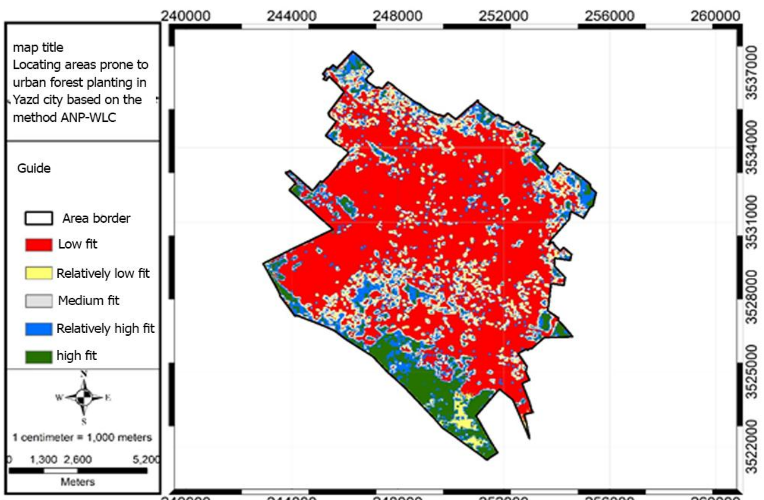


Figure 43: The final location map of suitable areas for urban forest planting.

The map above shows the appropriate areas in green and the unsuitable areas in red.

Table 4 shows the area and percentage of area of each floor.

Table 4: Area and percentage of area of different parts of the location map.

Class	Area (hectares)	Percentage of area
Low fit	6395.67	**59.96**
Relatively low fit	803.7	**7.53**
Medium fit	1349.1	**12.64**
Relatively high fit	1311.66	**12.29**
High fit	805.05	**7.54**

Map 44 The location of high-fit areas is shown on Google Earth images.

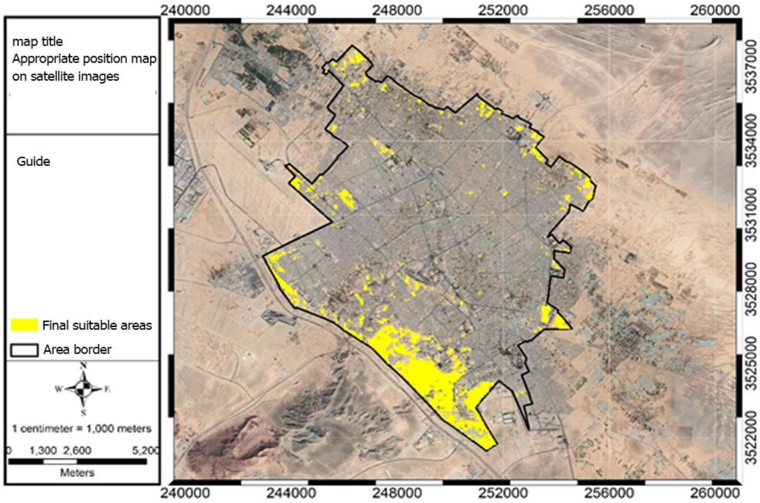


Figure 44: Appropriate position map on satellite images.

Select suggested areas

In this study, after preparing a location map of suitable areas for the construction of urban forest, 8 areas of the appropriate class were selected. To prioritize forest construction in these areas, 7 criteria were selected: area, urban green belt, urban view, population density, proximity to existing green space, access to urban services and the need for urban area to increase green space per capita. The relevant criteria were then compared and prioritized based on the AHP method, which are shown in Figure 4-48. Based on the results, the region needs to increase per capita with a weight of 0.393, the most important criteria and an area with a weight of 0.037 were selected as the least important criteria.

Then, the TOPSIS model was used for prioritization. And 8 regions introduced in this study were prioritized. The weight of each option is given in Table 4-6. Based on the results, option 6 is in the first priority and option 2 is in the last priority.

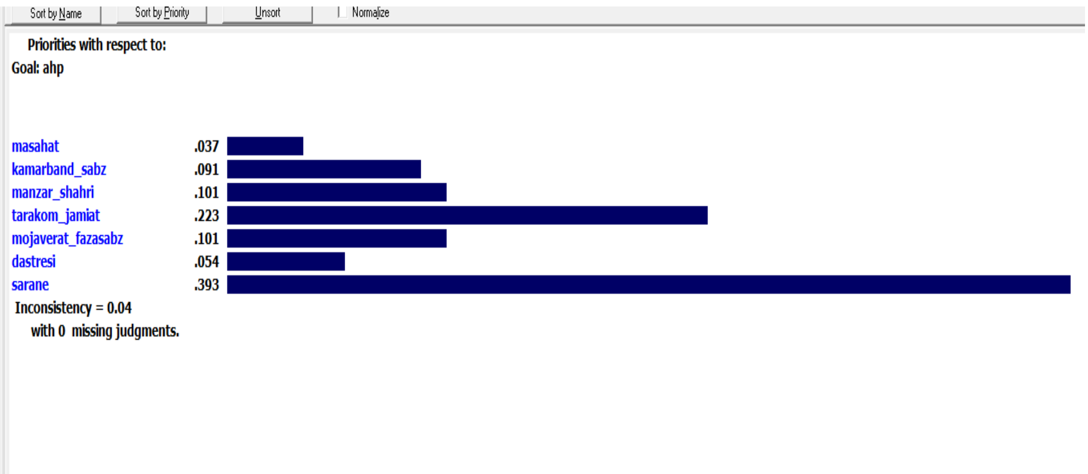


Figure 45: Weight of selection criteria for paired scale.

Table 5: Weights obtained from the TOPSIS model for each option.

Priority	Topsis weight
Option 2	0.172591
Option 1	0.218409
Option 7	0.496448
Option 8	0.510601
Option 5	0.75911
Option 3	0.844258
Option 4	0.86758
Option 6	0.882401

In the map, 46 proposed areas were proposed and prioritized based on the mapped map.

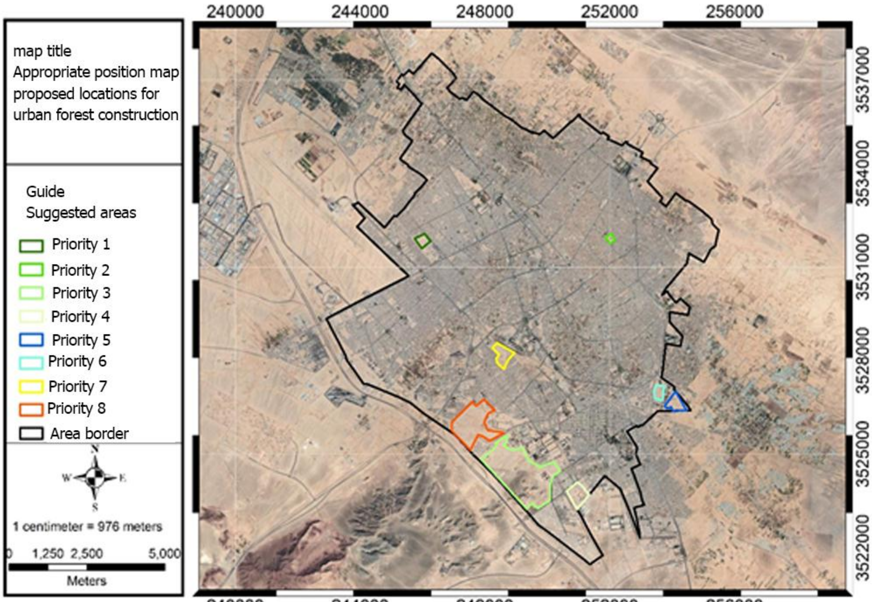


Figure 45: Map of proposed locations for urban forest construction.

Relevant options were evaluated and prioritized based on selected criteria. As can be seen in Table 5, there are 4 options in the 2nd urban area, which have the lowest per capita. Figure 46 shows the position of the proposed areas after prioritization.

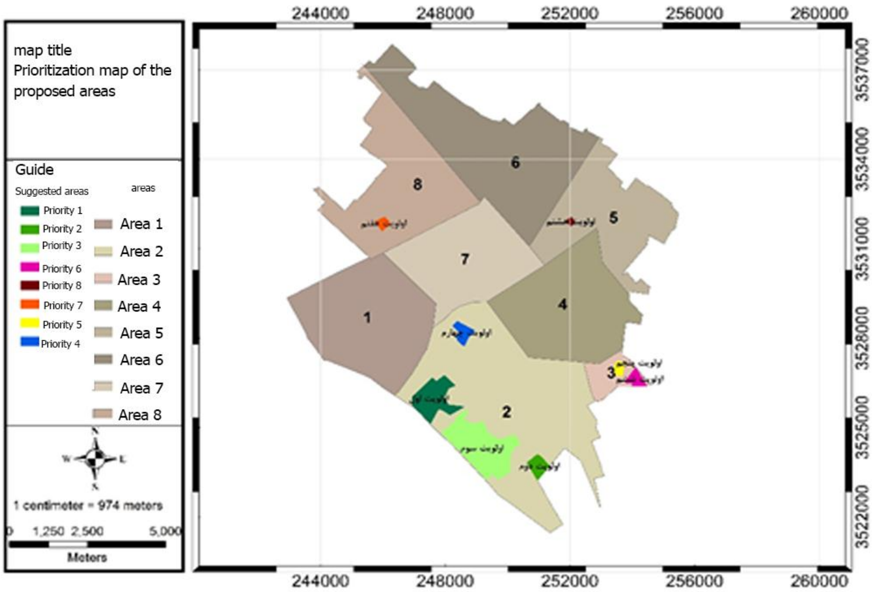


Figure 46: Prioritization map of the proposed areas.

The figure above shows that Region 2 is in the first priority of urban forest construction and Region 3 is in the second priority.

5- DISCUSSION AND CONCLUSION

Using GIS to find the right place to build a forest park will help you make the right decision in managing resource use. Therefore, choosing the right and practical criteria is another important point that should be considered. In addition, the method of aggregation and overlap of the criteria and conditions considered has a great impact on the results. According to the results of this study, increasing the factors or criteria considered may increase the correlation between the criteria and the weight obtained may show the value of more important criteria less. According to the results of this study, the population density criterion with a value of 0.201933 has more than 20% of the total weights. While the criterion of proximity to barren lands with a value of 0.008621 has less than 1% of the total weight. However, population density is one of the most important factors in spatial decisions based on social justice and distribution of resources. But we should not ignore user changes either. Therefore, the selection of criteria with the lowest correlation is very important due to the appropriate weight distribution.

The results obtained from the location map show that most of the suitable areas are located mainly in the southern part of the city. One of the main reasons is the lack of proximity to agriculture, green space and gardens as well as barren lands in this area. It can also be seen that the accumulation and concentration of green spaces and even some agricultural lands in the central areas of the city has caused the appropriate areas in the outskirts of the city and away from these uses according to the laws in question.

Since remote sensing science is able to detect urban green space. It is easy to determine and evaluate the location, amount and distribution of green spaces. Of course, paying attention to the right type and time in choosing the image is important.

There is a significant difference between different areas of Yazd in terms of urban forestry development. Inadequate distribution of green space, especially gardens in the city, causes a difference in the area of green space, followed by a per capita difference in green space. This difference is such that in some areas with the maximum population they have the lowest per capita green space.

By providing a suitable model of urban forestry, the problem of disproportion and proper balance of green space in Yazd can be solved. Using GIS and spatial models and selecting appropriate criteria, the map of suitable areas for forest construction can be found correctly.

Suggestions

After conducting this research and presenting the results, suggestions for better use of future research in this field will be provided.

1- The degree of correlation between the criteria should be examined. Because the alignment of the criteria, in addition to reducing the weight of other criteria, will not have much effect on the results.

2- Areas should be selected as constraints in modeling, to be removed from the study area. For example, existing green spaces should be considered as a constraint, so that the desired map can be prepared without considering these conditions.

3- If you do not have access to images with high resolution, to extract vegetation, use Sentenil and Google Earth images as a time series. To do this, Google Earth image segmentation can be used with object-oriented classification and combination with satellite image spectra.

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