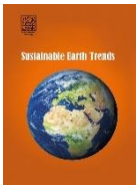
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Analyzing the capacities of Ahvaz city in order to become a biophilic city

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ABSTRACT

Architects and planners' concern is to decrease the impact of urbanization on the natural environment and increase human-nature relationships. A biophilic city is a city full of nature, a place where, in the normal course of work and life, residents feel, see, and experience rich nature. The present study aims to analyze the capabilities of Ahvaz city to determine how far this city is from becoming a biophilic city. The current research is descriptive-analytical and applied regarding content and methodology. The statistical population of the research consists of geography and urban planning experts. The result of their viewpoint was the basis of the research analysis. The Entropy and WASPAS methods were used for data analysis. Eventually, the IDW interpolation method has been utilized to display the biophilic city index conditions in the Ahvaz region. The research results found that region 2 has the best quality of biophilic indicators compared to other regions. Region 3 of Ahvaz ranked next with an extremely negligible difference. The region that has given the lowest rank is region 7. The results of the research showed that the majority of the regions of Ahvaz city have a significant weakness in the biophilic city indicators due to climate conditions. Nevertheless, Ahvaz can become a biophilic city due to its river "Karoun", plus the appealing and diverse plant species. However, it requires related groundwork to diminish the impact of the city's climatic features as much as feasible.

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1. Introduction

Urbanization presents sustainability challenges for the natural environment, resources, and ecological systems, whilst high levels of pollution and disconnect from the natural environment can adversely impact the health and well-being of urban residents (O'Sullivan et al., 2023). Architects and planners concern is to decrease the produced impact of urbanization on the environment and increase human-nature relationships (Radha, 2022). Human beings need contact with nature and the natural environment. Nature is not optional, but an essential quality of modern urban life. Conserving and restoring the considerable nature that already exists in cities and finding or creating new ways to grow and insert new forms of nature are paramount challenges of the twenty-first century (Beatley, 2016). A biophilic city is a city full of nature, a place where in the normal course of work and play and life residents feel, see, and experience rich nature (Beatley, 2011). They are cities that strive to foster deep connections and daily contact with the natural world (Nkubiyaho, 2020). It is important to recognize that biophilic cities are not simply green cities. The presence of abundant nature is a necessary, but not sufficient condition, and the philic is as important as the bio. In biophilic cities, residents are directly and actively engaged in learning about, enjoying, and caring for the nature around them (Beatley and Newman, 2013). In the last ten years, 'nature' and biophilic design have received widespread attention in architecture, especially in response to growing environmental challenges (Zhong et al., 2022). The Biophilic Cities Network (include 26 cities in North and

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Central America, Europe, India, Singapore, Australia, and New Zealand) was launched in 2012 to create a global alliance of partner cities, organizations, and individuals working collectively in pursuit of the vision of a 'natureful' city (Milliken et al., 2023). While retrospectively, Iranian cities have had a profound bond with nature, and it was an inseparable sector of urban design and especially house architecture design, after the emergence of modernism approach in the urban planning system of Iran, urban skeleton issues were in priority, and nature lost the previous consideration the urban planning to a large extent (Tabibian et al., 2015; Hajhassan and Ghorbaninia, 2016; Ali, 2018; Zolfaghari Tehrani et al., 2024). In recent years, since Iran's cities have encountered various environmental troubles, attention to nature has increased to some extent in urban planning. Assuredly, it is still far away from the past. Considering the bright sides of the biophilic approach in different urban dimensions of development and Implementation of natural elements in the city, the significance of investigating this field becomes clear. Ahvaz city has constantly had a direct association with nature due to the diversity of plants and natural elements within the city (including the Karoun River). However, owing to the obstacles related to air pollution and the lack of proper exploitation of natural resources in the city, nevertheless, it has not been able to attain a sufficient status regarding a biophilic city. The lack of research in this field in Ahvaz demonstrates the necessity of performing it. The present study aims to analyze the capabilities of Ahvaz city to determine how far this city is from becoming a biophilic city.

A biophilic city is full of varied sights, sounds, smells, and textures, many but not all of which are natural. It is a city of rich and deep sensory experiences. The sources of these biophilic sensory experiences are many, from the textures, shapes, and colors of buildings, to the trees and flora and other green elements in urban environments, to the many sounds of life all around (Beatley, 2011). Biophilic cities cherish what already exists (and there is much, as we have already seen) but also work hard to restore and repair what has been lost or degraded and to integrate new forms of nature into the design of every new structure or built project. We need contact with nature, and nature can also take the form of shapes and images integrated into building designs, as we will see (Beatley, 2011). Biophilic urbanism is a subset of the broader theory of green urbanism. Beatley states that "biophilic urban design and biophilic urban planning represent one particular, albeit critical, element of green urbanism – the connection with and designing-in of nature in cities". Therefore, biophilic urbanism overlaps with green urbanism in many ways and can achieve similar results; however, the focus of biophilic urbanism is concentrated on designing cities to emulate nature and encourage human connections to it (Kurtz, 2016). One of the shortcomings in the cities is an attitude towards green space and an understanding that green space can be used as a natural resource for the benefit of residents by providing a green structure in the city, for more extensive sustainability. Biophilic urban design, with a concentration on nature, in addition to emphasizing beautification, could look to obtain capital by taking advantage of the direct and indirect benefits of using nature as a practical and conceptual indicator. Urban structure plans should be city-wide and local special plans must be defined for it in such a way that, with the rapid variation in social and environmental statuses in the city, a consistent approach to planning, design, management and investment is provided, since this green structure of the city, as an existing potential, will assist enhancing environmental sustainability (Pourahmed and Kachoei, 2020). Empirical studies underline the potential of biophilic design to mitigate the adverse effects of urban living. For instance, research has shown that access to green spaces and exposure to natural light can significantly reduce stress, improve cognitive functioning, and increase workplace productivity (Ma and Sb, 2025). One notion of a biophilic city is mimicking, and is modeled after natural systems in its functioning. Cities might also be viewed as more biophilic if their buildings and built environments reflect the shapes and forms of nature (Radha, 2022). The concept of the biophilic city was introduced by Beatley, who suggested that cities 'can be designed and planned to be profoundly more "natureful" and organic, providing opportunities for extensive and deep contact between urban residents and nature (Milliken et al., 2023). A 'biophilic city' is a green city, a city with abundant nature and natural systems that are visible and accessible to urbanites. It is not only about physical

conditions and urban design (parks, green features, urban wildlife, and walkable environments), but also about the spirit of a place, its emotional commitment and concern about nature and other forms of life, its interest in, and curiosity about nature, which can be expressed in the budget priorities of a local government as well as in the lifestyles and life patterns of its citizens. On the other hand, a 'biophilic city' is at its heart a biodiversity city, a city with abundant nature, a place where, in the normal course of work, play and life, residents feel, see, and experience rich nature (plants, trees, and animals) (Ebrahimpour et al., 2017). A project of Biophilic cities has been introduced by Timothy Beatley in 2011 where he advocates for incorporation of natural aspects in the cities in order to restore the relation to nature, of both the population and the urban space. a biophilic city is a combination of biophilic design and biophilic governance. This approach is a step further in social-ecological construction of cities, as it acknowledges the qualitative social aspect of urban population and urban areas (Novosadova, 2018). Studies have shown that exposure to nature can have a range of positive effects on our physical and mental health, including:

- Reduced stress and anxiety
- Improved mood and well-being
- Enhanced creativity and problem-solving
- Boosted immune function
- Faster recovery from illness
- Increased focus and concentration (Desouky and Mohamed, 2024).

One of the most obvious potential benefits of a biophilic city is the protection of the ecosystem (such as forests, lakes, rivers, or wetlands) in and around the city. There can be no doubt that these biological systems are essential for people's well-being and activities, providing food, recreational facilities and even minimizing the damages caused by natural disasters (Yarantseva, 2019). Therefore, a biophilic design could be a cost-effective strategy to reverse building occupants limited nature interactions and enhance their health and well-being (Sadick et al., 2023). It can be concluded that the conditions of a biophilic city will go a long way in helping to foster social and landscapes, in the face of climate change, natural disasters, economic uncertainty, and various other shocks that cities will face in the future (Radha, 2022).

The Biophilic City Index is structured as a three-aspect hierarchy. On the fundamental aspect exist the basic natural services we need from nature: air to breathe, water to drink, and productive land to feed the populace. The second aspect is the ecological aspect, supporting a healthy ecological system with fauna and flora. The top aspect is the biophilic aspect that facilitates interaction between humans and nature. This structural model also demonstrates the hierarchy of priorities. A healthy physical environment is the foundation of any ecosystem. A healthy ecological system needs to support the prosperity of vegetation and wildlife species so that urban residents can enjoy (Huang, 2017).

The incorporation of nature into the human environment can be found in the earliest man-made structures, and cultures around the world have found ways to bring nature into homes and public spaces. It has been poetically expressed for millennia and scientifically explored for decades. As such, biophilic design is not a new phenomenon; rather, it is the codification of human intuition for what makes a space a good place for humans. Good biophilic design draws from nature in a manner that is equally inspirational and restorative without disturbing the functionality of the space to which it is integral. How that balance is achieved may differ for particular user groups, building types, or geographical regions, but the science that informs the quality or condition of a healthy space remains relatively universal human response (Ryan et al., 2014). Biophilic design principles have been applied in various contexts, including interior spaces, buildings, and urban areas, to promote the integration of natural elements and improve the quality of life for inhabitants (Gadhi et al., 2024). The successful application of biophilic design necessitates consistently adhering to certain basic principles. These principles represent fundamental conditions for the effective practice of biophilic design. They include:

1. Biophilic design requires repeated and sustained engagement with nature
2. Biophilic design focuses on human adaptations to the natural world that over, evolutionary time, have advanced people's health, fitness, and well-being.
3. Biophilic design encourages an emotional attachment to particular settings and places.

4. Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural communities.
5. Biophilic design encourages mutually reinforcing, interconnected, and integrated architectural solutions (Kellert and Calabrese, 2015).

Biophilic urbanism has emerged as a way to bring nature more purposefully into cities, not just between buildings and infrastructure, but into and onto them in ways that increase the connectivity between people and nature and derive benefits from natural services and functions. Although the application of biophilic urbanism to streets has been present in the literature for some years and has informed the work of biophilic designers, it has not been formally developed into a design framework demonstrating how it can be delivered and what its multiple benefits are (Cabanek, 2020). Kellert and Calabrese (2015) have identified two main dimensions of biophilic design: the organic or naturalistic dimensions (the forms of the built environment that refer directly, indirectly or symbolically to nature) and a place-based or vernacular dimension (when the built environment or landscape refers to the culture of a given territory). According to Kellert and Calabrese (2015), the two dimensions are linked to six biophilic design elements (environmental features, natural shape and forms, natural patterns and processes, light and space, place-based relationships, evolved human-nature relationships) which are in turn found in more than 70 biophilic design attributes (Totaforti, 2018).

The indicators are presented into three main categories; Biophilic infrastructure, Biophilic spaces and places (buildings, blocks, streets, neighborhoods, and regions), in addition to community and people activity. The different categories cover both physical and non-physical aspects so it was essential to select indicators that can be measured and applied in the proposed framework (Tarek and Ouf, 2021). biophilic architecture emphasizes the implementation of eco-friendly technologies, the promotion of green infrastructure and fostering of a harmonious balance between human development and environmental conservation as essential strategies for creating resilient and sustainable built environments (Agboola et al., 2024). Adopting biophilic elements in architecture design and urbanism is believed to have a direct impact on people's health, like; reducing stress, emotional well-being, boosting creativity, healing effects, increasing productivity. Thus, such elements will make cities more resilient on the ecological, economic, and social levels (Tarek and Ouf, 2021).

2. Material and methods

The current research is descriptive-analytical and applied regarding content and methodology. The required data and information for the study were collected through a documentary field survey method. In the next stage, the indicators of a biophilic city have been extracted by reviewing theoretical literature. There is incomplete information and lack of information regarding the indicators moreover data related to the status of the city in line with research indicators were different in various documents, making it tough for the authors to identify the reliable and correct data, afterwards it has tried to benefit the opinions of the experts who are aware of these data and the research history of the research. They have conducted research in regard of Ahvaz, in order to extract real data. The statistical population of the research consists of geography and urban planning experts. The sample size was 30 experts, who were questioned, and the results of their viewpoints were the basis of the research analysis, and the final research indicators selected can be seen in the table below. In this questionnaire, experts were asked to evaluate the regions of Ahvaz according to selected indicators so that the average of these evaluations would be the basis for weighting. The Entropy and WASPAS methods were used for data analysis. To weigh the indicators the multi-indicator weighting method "Entropy "was applied. Besides that, the "WASPAS" model has been used to classify Ahvaz city regions based on the degree of their proximity to biophilic city indicators (Fig. 1).

Eventually, the IDW interpolation method has been utilized to display the biophilic city indexe conditions in the Ahvaz regions. Taxonomy of biophilic elements is shown in Table 1. Also, research biophilic city indicators are shown in Table 2.

Table 1. Taxonomy of biophilic elements, Adapted from (Andreucci, 2021)

Scale of Biophilic Design	Forms of Biophilic Elements	Taxonomy of Biophilic Elements
Building scale	Green roofs, green walls, shade trees, vegetation, and natural elements inside and around the building	Green roofs, green walls, shade trees, vegetation, and natural elements inside and around the building
District and neighborhood scales	Street trees, pocket parks, orchards and community gardens, business parks	Many installations, small-medium in size, restoration possible, high technical and technological requirements, public and private properties
City scale	City parks, urban forests, urban agriculture, waterfronts	Few installations, large in size, restoration possible, high technical and technological requirements, public land

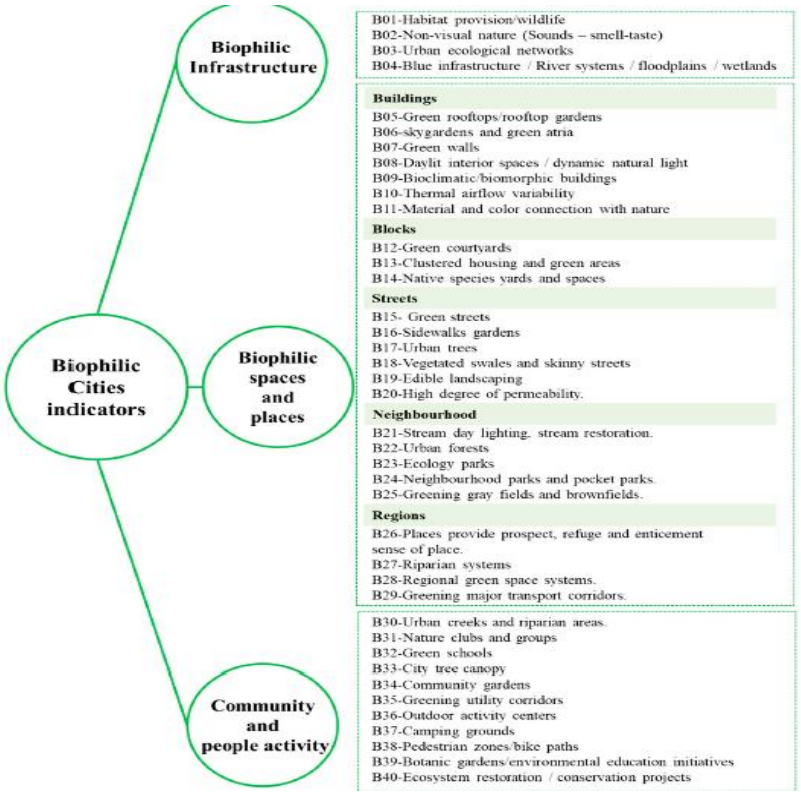


Fig. 1. Biophilic city indicators, Adopted from (Tarek and Ouf, 2021).

Table 2. Research biophilic city indicators.

i1	i2	i3	i4
Park	Green facades	Outdoor leisure centers	walking paths
i5	**i6**	**i7**	**i8**
Public gardens	Relying on public transportation	Voluntary participation of people in improving the state of nature	Animal and vegetal nature knowledge by local people
i9	**i10**	**i11**	**i12**
Local nature-friendly organizations	Suitable lighting in natural environment and green space	Building design according to geographical and natural conditions	Proximity to water

WASPAS is a weighted aggregate product evaluation sum method for parametric optimization. A method can indicate one or more optimization responses. It combines the Weighted Sum Model (WSM) and the Weighted Product Model (WPM). The WASPAS algorithm is developed in several stages (Zalas, 2023). In the WASPAS method, the problem to be solved is designed in a dimensional matrix form in which columns express criteria and rows express decision alternatives. In the decision matrix which is defined as the initial matrix states alternatives and states criteria (Miç and Anymen, 2021).

Stage 1: The Decision matrix is constituted. In this first stage, the decision matrix, which

demonstrates the performance of alternatives with respect to criteria, is generated. This matrix is the same as the aforementioned Eq. 1. In the decision matrix, represents the performance of the alternative as to criteria.

Stage 2: The Decision matrix is normalized. The decision matrix is normalized, taking into consideration the benefit or cost directions of the criteria. Linear normalization is utilized for the normalization process. In cases where criteria are cost-oriented, Eq. 1 is utilized, and in cases where criteria are benefit-oriented, Eq. 2 is applied.

$$\bar{x}_{ij} = \frac{x_{ij}}{max_i\, x_{ij}} \quad (1)$$

$$\bar{x}_{ij} = \frac{min_i\, x_{ij}}{x_{ij}} \quad (2)$$

Stage 3: Relative performances of alternatives are calculated according to the WSM method. This is determined by adding the weighted alternative values of each criterion. This is formulized with Eq. 3 below. This Equation, demonstrates criteria weights.

$$P_i^{(1)} = \sum_{j=1}^{n} w_j x_{ij} \quad (3)$$

Stage 4: Relative performances of alternatives are calculated according to the WPM method. This is obtained by multiplying the alternative value of each criterion by the same indexed criteria weight's power. This is formulized with Eq. 4 below.

$$P_i^{(2)} = \prod_{j=1}^{n} (\bar{x}_{ij})^{w_j} \quad (4)$$

Stage 5: Final performance of alternatives is calculated. The final performance of alternatives, which demonstrates the positions of alternatives in a general ranking, is calculated by adding the relative performances obtained by Eqs 3 and 4. This is presented with Eq. 5:

$$P_i = 0.5P_i^{(1)} + 0.5P_i^{(2)} = 0.5\sum_{j=1}^{n} w_j x_{ij} + 0.5\prod_{j=1}^{n} (\bar{x}_{ij})^{w_j} \quad (5)$$

Eq. 6 in the following can be utilized to increase the ranking efficiency and accuracy of the decision-making process. α is a parameter that can take values between 0 and 1.

$$P_i = \alpha P_i^{(1)} + (1-\alpha)P_i^{(2)} = \alpha\sum_{j=1}^{n} w_j x_{ij} + (1+\alpha)\prod_{j=1}^{n} (\bar{x}_{ij})^{w_j} \quad (6)$$
$$(\alpha = 0, 0.1, \ldots\ldots, 1)$$

When α = 1, the WASPAS method turns into the WSM method, and when α = 0, it turns into the WPM method. α value can be determined freely by the user.

Stage 6: Alternatives are ranked. Values are ranked from highest to lowest to determine the final rankings of alternatives. In this ranking, the first alternative is best, whereas the last alternative is worst.

All interpolation methods are based on the assumption that close points have greater correlation and similarity than distant points. In the inverse distance weighting method, the fundamental assumption is that the degree of correlation and similarity between neighbors is proportional to the distance between them, which can be defined as a function of the inverse power of the distance of each point from neighboring points. It is important to note that the definition of the neighborhood radius and the power of the inverse distance function are significant issues in this method. In inverse distance weighting method, the weight factor value is calculated using the following method (Eq. 7) (Khosravi and Abasi, 2016).

$$\lambda_i = \frac{D_i^{-a}}{\sum_{i=1}^{n} D_i^{-a}} \quad (7)$$

In this equation $'D_i'$ is the distance between the estimated point and the observed value at the point 'a', 'i' is equation power, and 'n' is the number of observed points.

The core principle of IDW is straightforward; it assigns weights to sampled points based on the horizontal Euclidean distance between them, allocating greater influence to nearer samples. This method ensures that the interpolated values are most strongly influenced by the closest data points, reflecting the assumption that spatial proximity correlates with geochemical similarity. The IDW interpolation method remains a highly effective tool for 2D modeling and mapping, even as its application in 3D modeling has become more limited (Sadeghi et al., 2024).

2.1. Research study area

Ahvaz is the center of Khuzestan province, located in the southwest of Iran (Ahmadi et al., 2013). The geographical location of Ahvaz is 31°20′N, 48°40′E, and 18 m above sea level. The presence of large industrial plants has turned Ahvaz into one of the most important industrial centers of Iran, attracting many immigrants to Ahvaz. The city has a total population of more than 1 million and a total

surface area of 220 km (Alavi et al., 2015). In terms of population rank size, Ahvaz is the fifth city, and in terms of area, it ranks the second city in Iran. Ahvaz is divided into two western and eastern parts. Urbanization growth in this city has been high (Fig. 2) (Lotfi, 2004).

In surveys conducted regarding Ahvaz city and its physical space, diversity and accessibility were the most crucial traces of capabilities in Ahvaz; moreover, the lack of generality in the city, weakness in hierarchy and heterogeneity, inefficiency of signs and monuments, and environmental agents were the most serious physical obstacles of this city. The examination of the physical space of the city also indicates that wherever construction is consciously and with the previous design, the urban texture has become more beautiful and efficient, while spontaneous or spiral construction, as well as the incorporation of non -urban textures, has increase the difficulties of the city (Pourahmad et al., 2016). Economically, 51 % of the oil of oil-rich areas in southern Iran is produced in Ahvaz. Some of the country's largest and main factories are located in this city. The presence of large industrial factories, administrative and industrial facilities of the National Iranian South Oilfields Company, and the National Iranian Drilling Company has made Ahvaz one of the most important industrial centers in Iran (Ranjbar and Jorfei, 2011). From the perspective of social characteristics, it should be expressed that Ahvaz is one of the cities where the residence of disparate ethnicities is. This linguistic diversity caused the identity disorder of Ahvaz habitants (Amiri Fard and Shir Mardi, 2017).

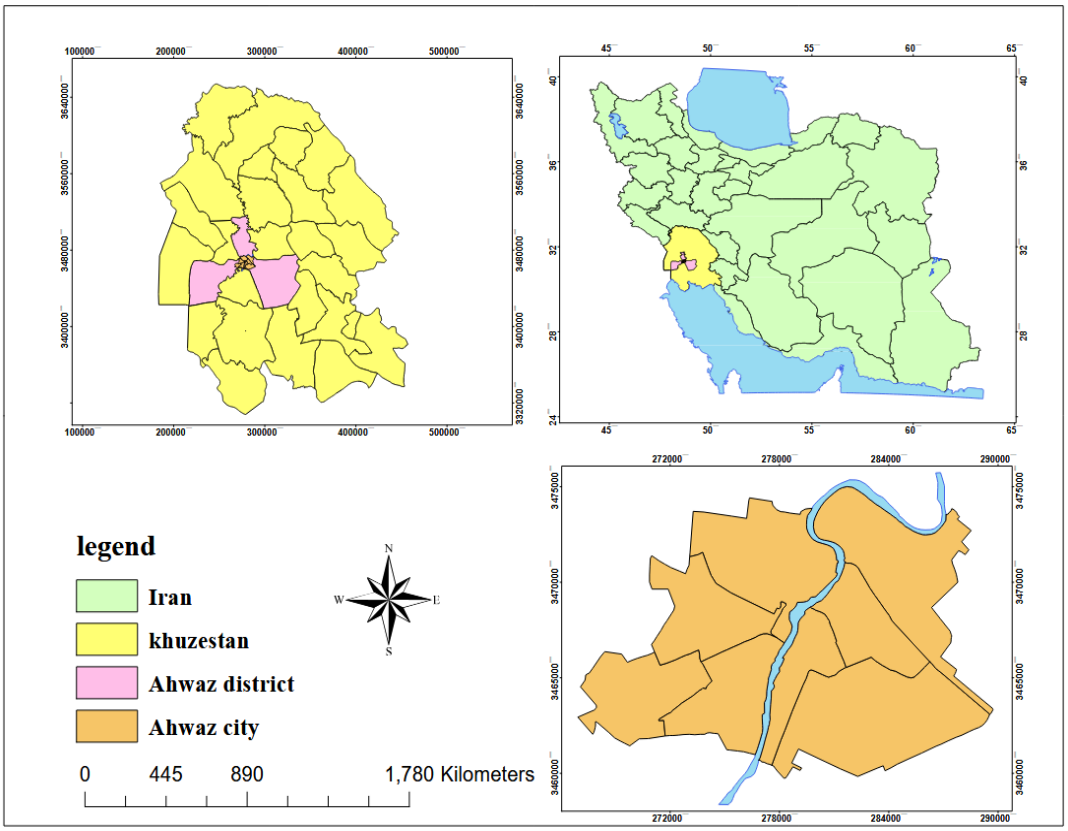


Fig. 2. Study area location.

3. Results and discussion

As previously stated, Ahvaz has substantial capacities regarding a biophilic city. Including the Karoun River which runs through the city for more than 950 kilometers. The Karoun River has significant biodiversity. In terms of fish diversity, it contains approximately 81 percent of the country's freshwater species, which are classified into 32 species. So far, 7 species of water birds, 13 species of shorebirds, and 43 species of land birds have been identified in and around the Karoun River. Since Ahvaz is located in a fertile plain, the city is surrounded by rice fields and palm groves, especially in the south. Trees such as Ziziphus, Prosopis, and eucalyptus, and various plants such as Salsola, Alhagi, Capparis spinosa, and

Avena sativa can be seen in the city. In general, 3696.79 hectares of the city are covered with vegetation, which plays a key role in softening the air. Indicators were examined. In this respect, a questionnaire was provided to the experts. In which they expressed their notion about the quality of biophilic city indicators in the city based on city zoning. Then the average of their opinions was extracted. Shannon's entropy model was used to determine the indicators' weight. The results of the model indicated the indicators' weight to enter the next stage, which can be seen in the Table 3.

Table 3. indexes' weights.

w1	w2	w3	w4	w5	w6
0.0834838	0.08302	0.083323	0.083769	0.082311	0.084026
w7	**w8**	**w9**	**w10**	**w11**	**w12**
0.083771	0.083994	0.083729	0.083885	0.083829	0.080859

Then the results of the experts' questionnaire, plus the weights of the indicators obtained in the previous step, were entered into the Excel software to determine the ranking of the regions in accordance with the quality of the biophilic city indicators operating the Waspas model. Eventually, a numerical value was obtained, and the rank of each region was determined, which can be seen in the Tables 4 and 5.

Table 4. The final matrix of the WASPAS model.

	i1	i2	i3	i4	i5	i6	i7	i8	i9	i10	i11	i12
R1	0.979	0.952	0.952	0.990	0.989	1.000	0.976	1.000	0.987	0.989	0.979	0.991
R2	1.000	0.990	1.000	0.990	1.000	0.989	0.989	0.989	1.000	1.000	1.000	1.000
R3	1.000	1.000	1.000	0.990	0.977	0.989	1.000	0.989	1.000	1.000	1.000	0.980
R4	0.990	1.000	0.990	1.000	0.989	0.989	0.989	0.989	1.000	0.989	1.000	0.991
R5	0.979	0.952	0.967	0.979	0.922	0.989	0.976	0.976	0.972	0.976	0.979	0.885
R6	0.935	0.935	0.952	0.967	0.922	1.000	0.989	1.000	0.972	0.976	0.967	0.885
R7	0.952	0.935	0.935	0.952	0.892	0.976	0.944	0.989	0.954	0.961	0.967	0.885
R8	0.990	0.952	0.967	0.967	0.977	0.989	0.976	0.976	0.972	0.989	0.979	0.937

Table 5. Regions' ranking based on biophilic city indicators.

Region	Q2	rank
r 1	0.8038	**4**
r2	0.9481	**1**
r3	0.9265	**2**
r4	0.9185	**3**
r5	0.6314	**6**
r6	0.5958	**7**
r7	0.5053	**8**
r8	0.7149	**5**

In order to present a transparent illustration of the current situation, the outcomes of the previous steps were entered into the GIS software. Using the IDW interpolation model, the general outline of biophilic city indicators quality was depicted (Fig. 3).

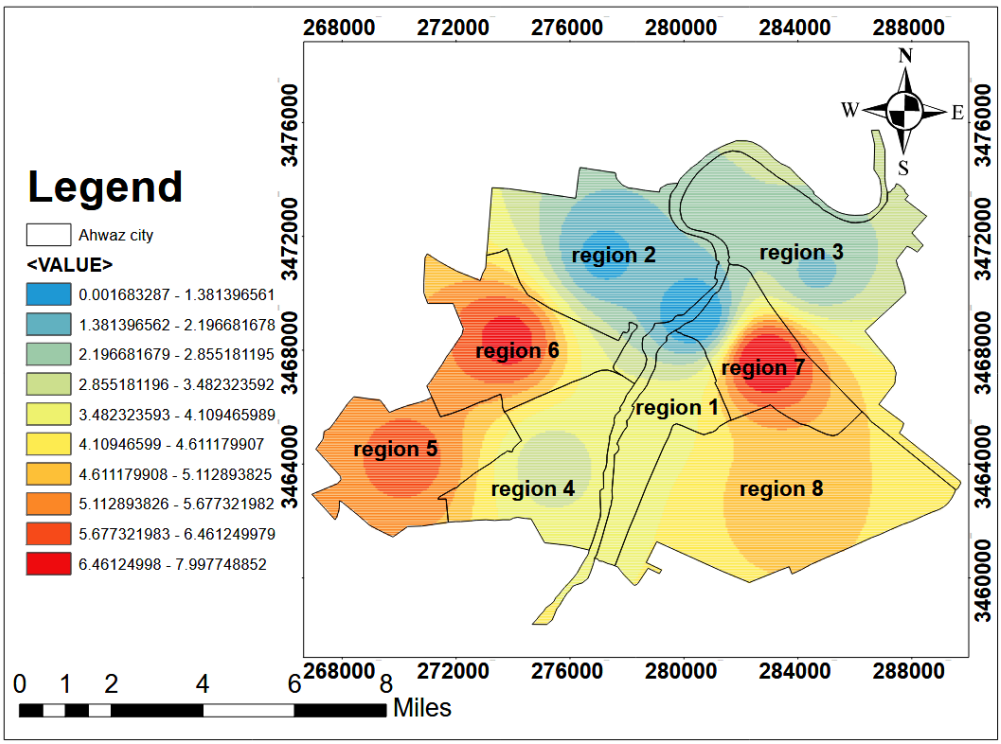


Fig. 3. Biophilic IDW.

By scrutinizing the results of Waspas and IDW models, it was found that region two has the best quality of biophilic indicators compared to other regions. In terms of parks, Outdoor leisure centers, public gardens, Local nature-friendly organizations, Suitable lighting in the natural environment and green spaces, building design according to geographical and natural conditions, and Proximity to water, this region has a superior status to other regions. Furthermore, Green facades and walking paths in this region are at an acceptable level. All these factors allow people in this region to be in contact with nature for a longer period and in more places. The outcomes of the Waspas model displayed that region three of Ahvaz ranked next with an extremely negligible difference. Indeed, region three has a preferable condition than region two in some indicators. These indicators contain the green facades and Voluntary participation of people in improving the state of nature, which is considerably disparate in this region from other regions of the city. In addition, this region is at the same level as region two concerning indicators such as parks, Outdoor leisure centers, Local nature-friendly organizations, Suitable lighting in natural environment and green space and Building design according to geographical and natural conditions. The weakness of this region can be seen in the public gardens index, and that's perhaps because of the privacy of those places, because they often belong to specific organizations that restrict the entry of other people to these places.

The next rank belongs to region 4. This region is in a competent circumstance regarding indicators namely green facades, walking paths, Local nature-friendly, organizations and Building design according to geographical and natural conditions, which has recently received more attention from the architects in the region. This area should implement more plans in terms of the indicators of Suitable lighting in the natural environment and green space, public gardens, relying on public transportation, Voluntary participation of people in improving the state of nature, Animal and vegetal nature knowledge by local people, so that it can reach an optimal situation. As well as in the context of other research indicators, it has been placed in an average situation.

In the next rank, region 1 is. The indicators of the biophilic city in this region are only indicators of Animal and vegetal nature knowledge by local people, and relying on public transportation is in a pleasant status. Among the indicators that require to be improved in this region are the green facades and Outdoor leisure centers. This region has outdoor recreational spaces only in the parts, that are close to the river, and in other parts

there are weaknesses in this field, maybe the reason is because these neighborhoods have commercial and administrative centers in the city, so the concentration is mostly on these dimensions. The next rank is related to region 8, the biophilic city indicators of this region are in optimal circumstances, merely with respect to Park and Building design according to geographical and natural conditions. It is worth mentioning that the city's only amusement park is located in this region. In terms of other indicators, they have an unacceptable situation. The points that should be noted are the indicators of Proximity to water and green facades, which are rare. This region is completely far from the river and is not located near it in any neighborhood.

The next is region 5. The Relying on public transportation indicator in this region is the only index that has an acceptable situation, and the reason is that the residents are far from the city center and mostly earn a moderate income to reach their destination, they prefer to use public transportation due to the cost and convenience. The biophilic city indicators in this region are in a fragile state in terms of green facades and public gardens. About other indicators, this region is at a moderate or low level. In the next rank region 6 is placed. The biophilic city indicators in this region are of low quality, further relying on public transportation and Animal and vegetal nature knowledge by local people, in this region, unlike other indicators, are in an extremely desirable condition. The reason is that initially, the people of this region are among the oldest residents of the city, so they have the highest level of knowledge in association with local animal and vegetal nature. Moreover, the residents of this region rely on public transportation, owing to their distance from the city center and their belonging to the low-income class of society. Relating to other indicators, region 6 is in a low state. The region that has given the lowest rank is region 7. The biophilic city indicators in this region are only acceptable with Animal and vegetal nature knowledge by local people. In line with other biophilic indicators, this region has the weakest situation compared to other regions of the city. It should be mentioned that this region includes a significant number of slum neighborhoods in the city. Overall, according to the findings of the research, it can be seen that the majority of the regions of Ahvaz city have a significant weakness in relation to the biophilic city indicators. Indeed, the climate conditions of the city have made people pay less attention to the green space and nature, and tend to stay at home more. Furthermore, even when they prefer to spend time outside the house and in nature, they may refuse to go outside owing to the dust phenomenon that often occurs in this city or due to the heat. Nevertheless, Ahvaz can become a biophilic city due to its river, "Karoun", plus the appealing and diverse plant species. However, it requires related groundwork to diminish the impact of the city's climatic features as much as feasible.

4. Conclusion

High levels of pollution and a disconnect from the natural environment can adversely impact the health and well-being of urban residents. Architects' and planners' concern is to decrease the impact of urbanization on the environment and increase human-nature relationships. Human beings need contact with nature and the natural environment. They need it to be healthy, happy, and productive, and to lead meaningful lives. A biophilic city cares about, seeks to protect, restore, and grow this nature, and strives to foster deep connections and daily contact with the natural world. It is important to recognize that biophilic cities are not simply green cities. In biophilic cities, residents are directly and actively engaged in learning about, enjoying, and caring for the nature around them and have developed important emotional connections with this nature. The present study aims to analyze the capabilities of Ahvaz city to determine how far this city is from becoming a biophilic city. The statistical population of the research consists of 30 geography and urban planning experts, and the results of their viewpoint were the basis of the research analysis, and the final research indicators were selected, which can be seen in the table below. To weigh the indicators, the multi-indicator weighting method "Entropy" was applied. Besides that, the “WASPAS” model has been used to classify Ahvaz city regions based on the degree of their proximity to biophilic city indicators. Eventually, IDW interpolation method has been utilized to display the biophilic city index conditions in Ahvaz regions. From the outcomes of Waspas and IDW models, it was found that region two has the best quality of biophilic indicators

compared to other regions. Region three of Ahvaz ranked next with an extremely negligible difference. Indeed, region three has a preferable condition than region two in some indicators. The next ranks by order are region 4, region 1, region 8, and region 5. The regions that have given the lowest rank are regions 6 and 7. The research results show that the majority of the regions of Ahvaz city have a significant weakness in relation to the biophilic city indicators. Indeed, the climate conditions of the city have made people pay less attention to the green space and nature, and they tend to stay at home more. Nevertheless, Ahvaz has the ability to become a biophilic city due to its river, "Karoun", plus the appealing and diverse plant species. However, it requires related groundwork to diminish the impact of the city's climatic features as much as feasible. Here are some recommended appropriate and practical strategies for biophilic urban design in Ahvaz:

1- Restore natural riverside along the Karoun River to improve city aesthetics.
2- Increasing green space by using native plants that are resistant to heat and consume less water and trees that provide shade to reduce urban heat island effect .This is in particular applicable in the downtown of Ahvaz city.
3- Promoting green walls and roof gardens .Especially in neighborhoods that have less green space or face space limitations for planting vegetation.
4- Incorporate fountains and waterfalls in urban designing. In particular in areas far from Karoun.
5- Using appropriate local materials in construction to promote a sense of connection with nature, this has been almost completely neglected in Ahvaz in recent years.
6- Developing green corridors which distributed throughout the city which make traveling around the city on foot and by bicycle more comfortable and enjoyable. These routes can also be used as recreational routes.

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