Sustainable Earth Trends

Extraction and analysis of environmental insecurity indicators in Ahvaz city

Mostafa Mohammadi Dehcheshmeh[a]*

[a] Department of Geography & Urban Planning, Shahid Chamran University of Ahvaz, Ahvaz, Iran

A B S T R A C T

Today, environmental hazards and consequently environmental insecurity are the most common global challenges in cities. In Iran, cities are involved with environmental challenges such as air pollution, micro dust storms, water stress, land subsidence, soil pollution, and most importantly the challenge of environmental mismanagement. According to the studies, Ahvaz, a strategic metropolis in Iran, is one of such cities that faces the intense challenge of environmental insecurity. The aim of this research is to extract the effective indicators of environmental insecurity by thematic evaluation of these factors and indicators in the city of Ahvaz. In this study, 41 effective indicators have been extracted by analysing the records and opinions of 30 experts (academics and urban-regional managers). The selected indicators were modelled based on the opinions of 20 experts in the Best & Worst technique. Finally, the most important factors and indicators affecting environmental insecurity in Ahvaz were identified, categorized, and prioritized. According to B&W, among the 41 investigated indicators, the indices of hazardous hospital waste (I21) with value of .077, dust storm (I1) with value of .076, and Oil flares (I4) with value of .076 had the highest impact on the insecurity of the urban ecosystem of Ahvaz. Also, the results of this study have shown that among the five mega factors of air, water and soil pollution, environmental behavior, and environmental management, the indicators of air pollution have the highest effect on the environmental insecurity of Ahvaz city.

A R T I C L E   I N F O

1. Introduction

The present time can be called the era of vulnerability (Mohammadi, 2018), the world is facing a new range of threats and hazards and environmental challenges became the most pervasive type of global risks. Cities, with 80 percent of the world's population (UNDP, 2020) and nearly 3 percent of the earth's landmass, have put the highest pressure on natural ecosystems (UN-Habitat, 2020). Cities are the main hub for energy and materials consumption, greenhouse gas production, waste production, and the emission of pollutants in water, soil and air. The environmental impacts of modern cities go beyond their surrounding regions (UNDP, 2020).

In addition to experiencing the effects of climate-related hazards such as water stress and air pollution (Khairulliza and Lechjan, 2016), cities are known as generators of environmental health risks with air, noise and soil pollution (World Health Organization, 2019). They have also introduced the two challenges of solid and hazardous municipal waste management (Shanbehpour, 2018) and limited access to green spaces (Khairulliza and Lechjan, 2016). The emergence of these concerns and their intensification on an international scale have led to a conceptual link between security and the environment. The feeling of security is one of the basic standards in any society and is a

prerequisite for human life (Mohammadi, 2018). Today, this concept does not only refer to military threats (Buzan and Ole, 2009) but also it requires to expanding the traditional concepts of security and civil threats (Rob, 2010). In recent years, the strengthening of the challenges mentioned in the urban areas has made the environment the most widely-used and the most challenging aspect in security studies. The combination of these two terms, i.e. environment and security also mean to mitigate or resolve insecurity (Kornec, 2020). Radoslaw (2020) asserts urban environmental security is a concept of development security designed to establish favorable urban ecosystem conditions (Ekaterina and Larisa, 2018).

Nevertheless, the presence of a responsible local government working to effectively protect cities regarding the sustainability of the urban ecosystems is inevitable (Mohammadi et al., 2021). In order to achieve an urban environmental security vision, it is also necessary for local governments to control the various types of urban pollutions (Larry, 2018), encourage environmental investment (Velayatzadeh, 2020) and strengthen the environmental behaviors of citizens and policymakers (Maria et al., 2018). However, the lack of attention to environmental security drivers in many countries, especially in the developing world, has made the environment a serious threat (Maria, 2008). This neglect has given rise to the concept of environmental insecurity.

As the eighth largest city and the most important multi-functional core in southwest of Iran, Ahvaz is involved with severe environmental challenges. With a dominant role in industry and the concentration of heavy metal, agriculture and oil industries, Ahvaz is known as a city with a geo-strategic location and economy in Iran (Mohammadi et al., 2021). These factors have made the environmental ecosystem of the city extremely vulnerable in recent years such that in 2016, according to a report by the World Health Organization, the city of Ahvaz has been nominated as the most polluted city in the world (Velayatzadeh, 2020). Despite the diverse environmental challenges and their consequences for Ahvaz city and its citizens, the studies conducted in this case have been mostly one-dimensional. Gudarzi Studies (2018), Golam (2018); Sajjadi (2018); Mohammadi (2018) and Velayatzadeh (2020)

with emphasis on air pollution, the researches of Ahvaz municipality (2019, 2020, 2022); Mohammadi and others (2015) and IR whether organization (2019) with an emphasis on environmental management and the studies of Hosseini (2017); Kathleen (2018) emphasizing the pollution of the Karun River, are among the most important studies conducted in this regard. Therefore, the main question of the current research is what are the indicators of environmental insecurity in the city of Ahvaz and how effective is each of them? Based on this, the main objectives of this research are the concept examiniating of environmental insecurity in the cities, recognizing, extracting, and categorizing factors and indicators of environmental insecurity in Ahvaz city and finally ranking of the environmental insecurity indicators based on their effectiveness.

Literally, security means freedom from danger, fear or anxiety (Mohammadi, 2018) and when it refers to a territory, it means the state of being safe or protected from harm (Radosław, 2020). The concept of security has been strongly influenced by the viewpoints of the Copenhagen School and is mainly associated with the researches of Buzan (Nkonya, 2016). In the 1980s, experts (Buzan, 1991) emphasized the conceptual development and comprehensive definition of security (Nicole and Michele, 2009). They tried to find a broad definition beyond the traditional concept of security (Baum et al., 2019). In the post-Cold War period, the Copenhagen school has been the starting point for the conceptual evolution of the term "security"(Radoslaw, 2020). After that, the concept of human security has gone beyond physical security and now it includes economic security, food security, health security and environmental security (Rob, 2018; Rajput and Kavita, 2021).

The dependency of "security conceptual evolution" with global environmental challenges such as local ecology, resource scarcity (water, land and food), global warming, ozone layer (Rajput and Arora, 2021), ecological suitability and deforestation has led to the emergence of "environmental security" as a key word. The conceptual evolution of this term influenced by global environmental currents can be examined in three stages.

- Environmental security initially (the 1980s to the 1990s) emphasized ecological challenges at the national and regional levels. During this

time, the concept tended to link environmental degradation and associated scarcity of resources with human conflict at individual, group and state levels (Hosseini et al., 2017). Environmental security in the second phase of the conceptual transformation (the 2000s) focused on the crisis of climate change and global warming (Tschakert, 2007; Floyd, 2008).

- With the intensification of environmental changes in recent years, environmental security has become one of the most important concerns for managers and politicians at regional, urban and rural levels (Hamzeh et al., 2021; Velayatzadeh, 2021). Nevertheless, in all these stages, environmental security is defined as the state of protecting the vital interests of the individual society, protecting natural environment from the threats resulting from anthropogenic and avoiding natural impacts on the environment (Buzan, 2009). Accordingly, environmental insecurity is what endangers the security and sustainability of the environment and human beings. Given the high role of cities in environmental challenges, the new concept of security is readily used by urban environmental planners. The main focus of urban environmental security studies is on anthropogenic change and pollution, ecosystem protection (Coker, 2018), land management (Golam and Sharma, 2015), environmental crime and eco-global criminology (Ekaterina and Gorina, 2018), urban environmental security and climate change (Kathleen and Derek, 2018) access to healthy water, energy, and food, public health, nutrition, quality of life and waste management (Rajput and Arora, 2021), and environmental behavior (Mohammadi and Ghaedi, 2020). Today, however, the most active part of research on environmental security in cities focuses on climate change and global warming and its consequences on settlements (Floyd, 2008).

2. Material and Methods

2.1. The study area

Ahvaz, the capital of Khuzestan province, is located in the southwest of Iran (Fig. 1). This city with, a population equal to 1300,000 (SCI, 2018) is the seventh largest city in Iran and in terms of size, with an area of 185 km, is the fourth largest city in Iran. Until the 80s, this

city was considered one of Iran's immigrant-friendly cities (Mohammadi et al., 2021). After that, due to population saturation, environmental challenges, and the onset of dust storms, Ahvaz became the first reverse migration metropolis (Mohammadi and Ghaedi, 2020). The most important result of this growth has been the formation of 10 suburban residential quarters with at least 400,000 people (34% of the total city population) in an area of 1417 hectares (Ahvaz Municipality, 2019).
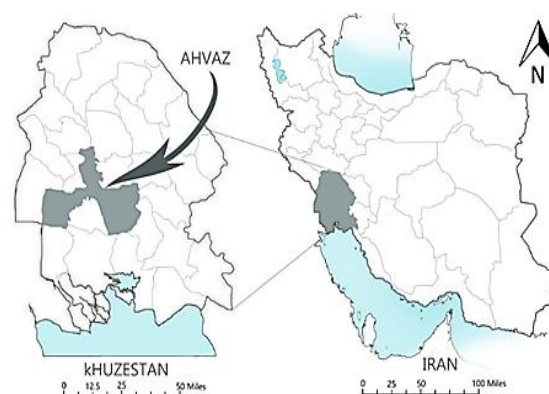

Fig. 1. The area of research

In terms of natural ecology, Ahvaz city has a unique geography. This city is located in the plains of Khuzestan, at a height of 12 meters above sea level (Ahvaz Municipality, 2022). This characteristic and the lack of attention to the proper principles of urban planning have caused severe challenges in the field of surface water and urban sewage management, especially in autumn and winter. The studies of the Ahvaz Municipal Water and Sewerage Company have shown that, due to the severe deterioration of the urban sewage network, Ahvaz has 130 critical points for surface water management and the interaction of surfacewater with sewage (Ahvaz Municipality, 2019).

Also, according to de martonne climate classification, which is based on two variables of rainfall and temperature average, the city of Ahvaz is in the hot and arid climate group. During the long summers, the average temperature of the hottest months of the year (May, June, July, August and September) is 48°C (GMDKP, 2020). It is noteworthy that, Karun, which is the largest and wateriest river in Iran, passes through the middle of Ahvaz and divides the city into two halves, the western and the eastern. According to the surveys

conducted, in addition to upstream pollution, this river receives industrial, hospital and commercial effluents in more than 50 places in the Ahvaz urban area (Shanbehpour, 2018), and especially in the summer season, it has become an environmental source of pllution when the flow of the river decreases. Functionally, Ahvaz is a strategic city in the transnational dimension for Iran's economy. The concentration of oil and metal industries has made this city a strategic population center in Iran. (Mohammadi et al., 2021).

2.2. The mega factors of environmental insecurity in Ahvaz City

The special ecological structure, has finally made Ahvaz as one of the most polluted populated centers in Iran and, perhaps, in the world. In order to extract the research indicators, the analysis of the main environmental challenges in Ahvaz has been done based on the main available studies. In order to recognize the environmental structure of Ahvaz city, the results of the studies are mentioned in 6 dimensions.

1-Industrial air pollution: The main source of typical air pollution in Ahvaz is the consumption of fuel energy, oil and petrochemical industries as well as the activities of heavy metal industries, carbon and oil companies, and dust caused by iron ore and limestone (Sajjadi et al., 2018; Velayatzadeh, 2020). Burning 15 million cubic feet of sour gas per day by 15 torches (flare) in the city and 29 torches in the near fringes of Ahvaz (Goudarzi et al., 2018) have caused 9 million tons of carbon dioxide (CO_2) and three million tons of hydrogen sulfide (H_2S) in Ahvaz.

2-Air pollution caused by dust storms: The results of other studies (Goudarzi et al., 2018; Velayatzadeh, 2020) showed that dust storms are the main source of pollution in Ahvaz with regard to air particles. Dust storms have been seen in Ahvaz since 2003. Climate change and precipitation irregularities, drying up of Iran-Iraq border wetlands (Mohammadi et al., 2015) and mismanagement of water resources at the national level (Goudarzi et al., 2018) are the most important reasons for the intensification

of dust storms in recent years in Khuzestan province and in Ahvaz. A timely study of dust storm has shown that Ahvaz has experienced the largest number of unhealthy days (pm10>300)[1] with the unallowable limit of airborne particles in 2008 and 2009 with more than 80 days per year (Goudarzi et al., 2018). On average, this index has been 22 days in the five years leading up to 2021[2].

3-Mismanagement of surface water and wastewater: Ahvaz does not have a separate surface water disposal system and directing surface water to the worn-out sewerage network has caused wastewater to rise in more than 300 critical points of the city (Ahvaz Municipality, 2018). Environmental pollution and the exacerbation of infectious and parasitic diseases (IR whether organization, 2019) are among the uunavoidable consequences of surface water and wastewater mismanagement.

4-Severe pollution of the Karun River: The Karun River is passing through the city center and is the main source of drinkable water for Ahvaz. Remarkable decreasing of river discharge in recent years and the absorption of agricultural (Hosseini et al., 2017), industrial and hospital sewage in the urban area of Ahvaz (Kathleen et al., 2018) have turned this river into an environmental threat.

5-Environmental pollution from waste: Mismanagement in waste system, along with the poor tendency of residents to participate in urban management (Hosseini et al., 2017) has created environmental health challenges, especially in suburban quarters.

6-Poor environmental behavior and culture (citizens and managers): Cultural diversity, attraction of rural immigrants, lack of social trust, low social capital (Mohammadi et al., 2021), lack of proper policy in city management, and poor empowering plans have resulted in an unfavorable level of environmental behavior (Shanbehpour, 2018).

2.3. Method

This research is an applied based on the type of aims and descriptive-analytical based on the methodology. The main steps of the research are mentioned below.

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1 - When Particular Matter (pm10) is more than 300, the air quality is in a dangerous level(Environmental Protection Organization 2017).

2 - Today (Fri Mar 4th, 2022), coinciding with the final editing of this paper, a huge sand and dust storm swept through the city. The estimated pm10 by Khuzestan Meteorological Organization for today in Ahvaz was 3778! Though this index is between 51 to 100 for healthy air quality.

1. First, the affecting factors on the environmental insecurity in Ahvaz were extracted by examining the study records, considering the environmental challenges of the research area and interviews with 50 city managers and academics. In this method, after explaining the objectives of the research to the focus group, an open questionnaire was sent to this group and they listed the most important factors affecting environmental security in the city of Ahvaz in the first step. In the second step, after the integration of the results, the author sent the final list of factors to the target group with the aim of categorizing them. The results of this category were merged and finalized in 5 factor groups.

2. These factors were listed in five gropes as follows: 1. Air insecurity 2. Water and sewage insecurity 3. Soil insecurity 4. Urban environmental mismanagement 5. Environmental behavior (citizens and managers).

3. In this step, regarding to the finalized factors extracted in previous step, related indicators to each factor were extracted. At this step, 41 final indicators were extracted.

4. In the third step the priority of effective factors and indicators on environmental insecurity of Ahvaz is determined by using Best-Worst Method (BWM) model. Best-Worst Method (BWM) is a multi-criteria decision-making (MCDM) method for finding the importance of the criteria and evaluating the alternatives with respect to the criteria (Rezaei, 2016; Rezaei, 2020). In this method, the main steps of BWM are listed below.

Step 1. Determine a set of decision criteria. The BW identifies a set of decision-making criteria, $C = C^1, C^2, \dots C^n$)which contributes to the goal of the decision-making problem (Zhong and others, 2020).

Step 2. The DM then identifies the best (B) (e.g., most important, most desirable, most contributing) and the worst (W) (e.g., least important, least desirable, least contributing) decision-making criteria.

Step 3. Determine the preference of the best criterion over all the other criteria using a number between 1 and 9. The resulting Best-to-Others vector would be: $AB = (a_{B1,}a_{B2\dots}a_{Bn})$.

Step 4. Determine the preference of all the criteria over the worst criterion using a number between 1 and 9. The resulting Others-to Worst vector would be $A_W = (a_{1w,}a_{2w,\dots}a_{nw})^T$.

Step 5. Find the optimal weights $(w_1^*, w_2^*, \dots w_n^*)$. The BW expresses his/her preferences regarding the best over the other criteria as aBj and of all the criteria over the worst asa_{jw}, using a number from 1 to 9. 1 means criterion i is equally important to criterion j, while 9 means criterion i is extremely more important than criterion j. (Rezaei, 2020). In order to obtain the most consistent weights with the pairwise comparisons, the maximum distance between the pairwise comparisons and their corresponding weight ratios should be minimized, or equivalently as (Eq. 1):

$$\min \min_j \max \left\{ \left| \frac{w_B}{w_J} - a_{Bj} \right|, \left| \frac{w_j}{w_W} - a_{jw} \right| \right\},$$

$$\text{s.t.}$$

$$\sum_{j=1}^{n} w_j = 1, \qquad w_j \geq 0 \quad \forall j \quad \text{For all j}$$
$$\text{(1)}$$

3. Results and discussion

After identifying the most important dimensions of environmental insecurity in the city of Ahvaz, the second step is to use the opinions of experts and extract the effective indicators of environmental insecurity for this city. In order to measure environmental insecurity in Ahvaz, the following factors and their indicators were extracted: air insecurity factor with 10 indicators, water insecurity factor with 8 indicators, soil insecurity factor with 7 indicators, environmental management insecurity with 9 indicators and environmental behavior factor with 7 indicators were identified and categorized (Table 1). After identifying and classifying the factors and selecting the final indicators (Step 1, Table 1), weighting was done based on the best-worst model. The second step in this model was to select the most effective and the least effective indicators selected according to the experts. In this step, and among 41 selected indicators, the experts selected dust storm (I1) as the most effective factor and the lack of environmental tax on soil polluting companies (I24) as the least effective indicator in the environmental insecurity of Ahvaz using a simple weighting method. In the third step, the preference of the best indicator over all the other indicators was determined using a number between 1 and 9. The values in Table 3 are the averages obtained

from the pairwise comparison of Indicator I1 (the most effective indicator) with other selected indicators in terms of the impact on environmental insecurity in Ahvaz. Table 3 which presents the preference of the best (the most important) indicator over all other indicators of environmental insecurity in Ahvaz shows a significant preference of the city's climate insecurity factor and its indicators over others. The calculated average obtained by the pairwise comparison of the insecurity index from dust storms (I1) with other indicators in the BWM model shows a very high preference of this index over other indicators of environmental behavior. The average obtained between these indicators is 7.02, which shows

a very high preference. Also, the insecurity indicator related to water and sewage condition in Ahvaz, with an average weight of 5.36, is found as one of the indicators with a high impact on environmental insecurity. Other items are listed in Table 2. The pairwise examining of the preference of the least effective selected indicators of environmental insecurity (I33 and I34) compared to other indicators revealed that the lowest weight average (1.86) of this index was relative to the indicators of climate insecurity and the highest value (4.76) was with the indicators of environmental behavior. Other items are listed in Table 4.

Table 1. Selected factors and indicators.

Factors	Indicators
Air Insecurity	Dust storm(I1), Burning sugarcane fields (I2), Industrial dust (I3), Oil flare (I4), Transport pollution (I5), Incineration of municipal wastes, (I6), Lack of tax on air pollutants (I7), Use of fossil fuels (I8), Lack of encouragements to use clean energy (I9), Lack of environmental assessments for industries (I10)
Water Insecurity	Quality of drinking water (I11), Per capita drinking water consumption (I12), Decrease of drinking water sources (I13), Lack of environmental tax on water resources pollutants (I14), Water stress (drinking and surface) (I15), Pollutants of the Karun River in urban areas (I16), Lack of incentives for optimal water consumption (I17), Poor municipal wastewater management (I18)
Soil Insecurity	oil industry pollutants (I19), metal industry pollutants (I20), hospital waste pollutants (I21), municipal wastewater Pollutants (I22), agricultural Pollutants (I23), Municipal waste pollutants (I24) Lack of Tax on soil polluting companies (I25)
Insecurity in Environmental Management	Light pollutants (I26), Weak equipment for waste management (I27), Limited green space per capita (I28), Dirty passages (I29), Low cleaning of public places (I30), Lack of noise comfort (I31), Visual pollution (I32), Magnetic pollutants (I33), Weakness in surface water management (I34)
Insecurity in Environmental Behavior	Citizens' irresponsibility towards the environment (I35), Managers' irresponsibility towards the environment (I36), Lack of citizens' participation in environmental issues (I37), Lack of citizens 'environmental knowledge (I38), Lack of Managers' environmental knowledge (I39), Lack of training on environmental issues (I40), Disorganization for environmental participation incentives (I41)

Table 2. The preference of the best indicator.

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	Average		
	0	5.9	5.9	6.9	5.4	6	5.8	6.9	7.4	5.4	**5.06**	High preference	**Air Insecurity indicators**
	I11	**I12**	**I13**	**I14**	**I15**	**I16**	**I17**	**I18**			Average		
	6.4	5.5	2.2	6.1	5.9	5.9	5.1	5.9			**5.36**	High preference	**Water Insecurity indicators**
	I19	**I20**	**I21**	**I22**	**I23**	**I24**	**I25**				Average		
I1	7.1	7.4	7.5	6.5	6.5	6.2	7.9				**6.08**	High preference	**Soil Insecurity indicators**
	I26	**I27**	**I28**	**I29**	**I30**	**I31**	**I32**	**I33**			Average		
	8	6.5	5.9	7.4	6.5	6.9	5.9	8.8			**6.98**	High preference	**Environmental Management indicators**
	I34	**I35**	**I36**	**I37**	**I38**	**I39**	**I40**	**I41**			Average		
	7.9	6.9	6.2	6.5	5.9	7.9	7.4	7.5			**7.02**	Very high preference	**Environmental Behavior indicators**

In the final step, the optimal amount of environmental insecurity indicators $(w_1^*, w_2^*, \ldots w_n^*)$ in the city of Ahvaz were extracted from Tables 3 and 4 and calculated in the BWM model.

Table 3. The preference of criteria's over the worst indicator.

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	Average		
	1	2	2	1	2	3.2	1	3	2.4	1	**1.86**	Low preference	**Air Insecurity indicators**
	I11	I12	I13	I14	I15	I16	I17	I18			Average		
	2.4	2.1	1.8	1.1	2.9	1.9	2.1	5.3			**2.45**	Low preference	**Water Insecurity indicators**
I33 and I34	I19	I20	I21	I22	I23	I24	I25				Average		
	3.1	2.4	2.6	2.3	2.1	3.8	2.1				**2.67**	Low preference	**Soil Insecurity indicators**
	I26	I27	I28	I29	I30	I31	I32	I33			Average		
	1	1	**2.4**	2.3	4.1	3.2	4.1	**1**			**2.38**	Low preference	**Environmental Management indicators**
	I34	I35	I36	I37	I38	I39	I40	I41			Average		
	1	5.3	7.8	5.3	3.2	5.9	4.1	4.1			**4.76**	Moderate preference	**Environmental Behavior indicators**

Table 4. Final weights of environmental insecurity indicators.

wj	Indicators	wj	Indicators
0.01477447	I22	0.07821703	I1
0.01066509	I23	0.04794968	I2
0.01244423	I24	0.04794968	I3
0.00246251	I25	0.07721703	I4
0.00277751	I26	0.04794968	I5
0.03066509	I27	0.04794968	I6
0.00244423	I28	0.00477447	I7
0.04794968	I29	0.00287359	I8
0.00287359	I30	0.00277751	I9
0.00277447	I31	0.00082211	I10
0.04794968	I32	0.00246251	I11
0.00082211	I33	0.00287352	I12
0.04390453	I34	.04794968	I13
0.00477447	I35	0.00246251	I14
0.02444423	I36	0.03066509	I15
0.03066509	I37	0.06151052	I16
0.04777516	I38	0.00295276	I17
0.00246251	I39	0.06194968	I18
0.00287359	I40	0.00246251	I19
0.00295276	I41	0.01295276	I20
		0.07672926	I21

The evaluation and determination of priority among 41 effective indicators of environmental insecurity for the city of Ahvaz showed the followings:

I. Dust storm, which has been going on for more than a decade in Ahvaz, is the first most effective indicator of environmental insecurity in this city with a value of .078 due to the widespread consequences for health (increased lung and respiratory diseases, poisoning, eye allergies, etc.), infrastructure (widespread dysfunction of electricity, water and

telecommunications networks, airports, etc.), social and economic consequences (expansion of forced climatic migration, widespread disruption of economic activities, capital flight, etc.).

II. The second indicator that has wide and profound effects on environmental insecurity in the metropolis of Ahvaz is air pollution caused by the scattered and irregular activities of oil companies. Based on this, the activity of oil flares is known as the second indicator with a high effect on the environmental insecurity of Ahvaz city. It seems that other destructive effects of the activities of large oil companies have not been unaffected by the high score of this index.

III. Insecurity due to hospital waste with a value of .076 known as the third effective index in the environmental insecurity of Ahvaz city. Extraction of hospital effluents in the Karun River and the deep-rooted challenge of hazardous waste management in the large hospitals of Ahvaz are evident in the high value of this index. Also, the high value of this index has been due to the unprincipled process of aggregation and moving of this kind of waste and its improper location.

IV. Pollutants of the Karun River in urban areas and poor municipal wastewater management are figured out as the fourth most important indicator affecting environmental insecurity. Climate change and reduced discharge of the river have decreased its self-purifying power. Nevertheless, in the upstream (before the river enters the urban area), agricultural effluents, fisheries and small workshops cause severe pollution. In the urban area, the sewage spills of the hospitals, shopping malls and restaurants illegally built near the river have made this river an intense source of pollution. Also, severe frazzle of sewage infrastructure and the challenge of surface water management, especially in autumn and winter, are known as a seasonal environmental threat in Ahvaz.

V. Table 5 shows the five-level spectrum of indicators affecting environmental insecurity in the city of Ahvaz. In this table, the indicators are classified into five levels of *very high, high, medium, low* and *very low* according to the amount of the values acquired in BWM.

VI. The final analysis in the BWM model has shown that the most important factor in environmental insecurity, in view of the experts and specialists, is the driving force of air pollution and its sub-indices. The final averages

of the weights obtained in the study shows that the air insecurity factor with an average weight of .035 and then the environmental insecurity factor caused by urban water and sewage with the average weight of .024 were identified as factors having the highest impacts on environmental insecurity of Ahvaz.

Table 5. The effect ranks of environmental insecurity indicators in Ahvaz city.

Level effect	Indicators
Very high	1,21,4,16
High	34,38,32,29,18,13,12,2,3,5,6,7
Medium	36,37,27,15
Low	35,17,23,24,20,22
Very low	33,10,28,39,25,19,14,11,31,26,9,12,40,30,8,41

The study also shows that among the selected factors and indicators, environmental behavior and its sub-indices have played a lesser impact on causing environmental insecurity. Other items are listed in Table 6.

Table 6. The average coefficient of affecting factors on environmental insecurity in Ahvaz.

Insecurity factors	Insecurity coefficient	Insecurity rank
Air Insecurity indicators	0.035	1
Water Insecurity indicators	0.024	2
Soil Insecurity indicators	0.018	3
Environmental Management indicators	0.016	4
Environmental Behavior indicators	0.015	5

Finally, the comparative results of this study with the research conducted in similar fields reveals important facts. The findings of this research in terms of the high impact of air pollution on the environmental security of cities are in line with the results studies conducted by Goudarzi and others (2017); Ekaterina and Larisa (2018). Guderzi et al. (2017) considers dust storms and air pollution caused by oil industries to be the most important threats to citizens' health (Guderzi et al., 2017). Also, Ekaterina and Larisa (2018), by examining the effective indicators in the sustainable development of large cities, defined air pollution caused by industries and transportation as the most general factor affecting environmental security in large cities (Ekaterina and Larisa, 2018). The Environment Organization of Khuzestan believes that 55% of

the total industrial air pollution in the city of Ahvaz is due to oil flares. Currently, 29 large flames are continuously burning sour gas and oil and release it in the air of Ahvaz (Environment Organization of Khuzestan, 2020). The weakness of infrastructure as well as the non-compliance of these companies to paying attention to pollution rights (due to high economic power) has exacerbated these conditions in recent years.

The findings of this research also confirm the research results of Mohammadi et al. (2021). Mohammadi and others (2021) have considered the incompatibility of urban land use as a factor in Ahvaz's environmental insecurity, emphasizing the weakness of the city's environmental management. In this regard, the research results of Shanbepour (2018), has confirmed the findings of this research. Emphasizing on climate change and its impact on water stress and environmental challenges, Shanbepour considered water shortage and pollution of water resources as drivers of environmental insecurity.

At the end, the findings of this research have shown that Ahvaz is exposed to environmental insecurity due to the diversity of environmental challenges in many ecological factors. In the air pollution sector, most of the insecurity comes from dust storms. Part of them are the internal dust centers and the major part of them originates from the dust storms centers outside the borders of Iran. In this regard, it is necessary to take the measures to stabilize the internal centers of dust storms. Also, in the field of foreign micro dust centers, the need to use diplomacy to manage this challenge is felt more than ever. Also, requiring oil companies and heavy industries to perform periodic environmental assessments and apply environmental management rules and codes seems necessary. In the field of environmental behavior, the citizens of Ahvaz need training. In this regard, it is necessary for relevant organizations such as the municipality and the environmental organization to implement educational and incentive programs for environmental integration.

Finally, the findings of this research have shown that the main effective factors on the insecure environmental structure of Ahvaz are:
I. The lack of infrastructure management in sewage and surface water.

II. The lack of laws with executive guarantees to control the environmental pollutants from industrial and oil companies.
III. Inefficiency in performing the inherent functions of urban management sections such as cleaning, environmental health, environmental education, incentives.
IV. Multiplicity and incoherence of organizations involved in urban management.
V. Environmental lawlessness.

4. Conclusion

Ahvaz is an important and strategic city for Iran. Regardless of the location, the high potentials of geo-economics, hydro-politics, and geo-culture have made Ahvaz an important demographic-economic pole for Iran. Nevertheless, the diversity and extent of environmental hazards in Ahvaz is undeniable. In response to the main question of this research, it should be said: the results which was completed based on the opinion of experts and reviewing existing written records, showed that currently the dimensions of environmental insecurity in Ahvaz city can be divided into five dimensions of air insecurity, water insecurity, soil insecurity, environmental mismanagement and insecurity caused by citizens' environmental behavior. Also, the factor of air pollution caused by dust storms, pollution caused by oil industries, pollution related to waste management and hazardous hospital effluents, pollution caused by worn-out water and sewage infrastructure and Karun river pollution are the most important drivers of environmental insecurity in the city of Ahvaz. Based on this, it is suggested that future researches should be focused on the mentioned cases:
- Management of stabilization of fine dust with internal and external origin.
- Organizing waste and hospital effluents.
- Organizing the challenge of surface water and urban sewage in Ahvaz.

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