Asia Pacific Academy of Science Pte. Ltd.

Journal of Environmental Law and Policy 2026, 6(1), 3616.
https://doi.org/10. 54517/jelp3616

Article

Dynamic evaluation of air pollution in Ahvaz: Source apportionment, SWOT-AHP analysis, and innovative control strategies

Faezeh Jahedi[1,2,3], Neamatollah Jaafarzadeh Haghighi Fard[3,*], Ahmadreza Lahijanzadeh[4], Elham Khaksar[4], Bamshad Shenavar[5], Helena Kaabi[4], Soqra Rostami[4], Sirous Karimi[5], Mohammad Javad Ashrafi[4]

[1] Department of Environmental Health Engineering, School of Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz 6135715794, Iran
[2] Student Research Committee, Ahvaz Jundishapur University of Medical Sciences, Ahvaz 6135715794, Iran
[3] Environmental Technologies Research Center, Medical Basic Sciences Research Institute, Ahvaz Jundishapur University of Medical Sciences, Ahvaz 6135715794, Iran
[4] Khuzestan Environmental Protection Office, Ahvaz 6135715794, Iran
[5] Air Pollution, and Climate Change Office, Khuzestan Department of Environment, Ahvaz 6135715794, Iran
*** Corresponding author:** Neamatollah Jaafarzadeh Haghighi Fard, Jaafarzadeh-n@ajums.ac.ir

CITATION

Jahedi F, Jaafarzadeh Haghighi Fard N, Lahijanzadeh A, et al. Dynamic evaluation of air pollution in Ahvaz: Source apportionment, SWOT-AHP analysis, and innovative control strategies. Journal of Environmental Law and Policy. 2026; 6(1): 3616. https://doi.org/10.54517/jelp3616

ARTICLE INFO

Received: 16 April 2025
Revised: 17 December 2025
Accepted: 24 December 2025
Available online: 28 January 2026

Abstract: Background: Air pollution significantly impacts global health, contributing to approximately 3.7 million premature deaths annually. Ahvaz, as one of the most polluted cities in the world, experiences severe air pollution due to urbanization, industrial expansion, and transportation. This study aims to identify pollution sources, evaluate their impact through a hybrid SWOT-AHP analysis, and propose innovative air quality management strategies based on global best practices. **Methods:** A combination of emission inventory analysis, geographic information system (GIS) mapping, and a multi-criteria decision-making (MCDM) approach was applied to assess key pollution sources. SWOT analysis was integrated with the Analytical Hierarchy Process (AHP) to prioritize effective interventions for air quality improvement. Comparative analysis was conducted with cities such as Beijing, New Delhi, and Los Angeles to benchmark pollution control measures. **Results:** Nitrogen oxides (NOx) were identified as the most emitted pollutants in central Ahvaz, reaching 392 tons annually. Other major pollutants included carbon monoxide (CO) (89 tons/year), suspended particles (87 tons/year), and hydrocarbons (34 tons/year). The Ramin Power Plant accounted for 54% of SO2 emissions, while oil industries contributed to 82% of total pollutants. The hybrid SWOT-AHP analysis ranked "Implementing an advanced air pollution monitoring system and smart traffic management" as the most effective strategy. Benchmarking with other global cities revealed that implementing low-emission zones and transitioning to cleaner fuels significantly reduced air pollution levels. The AHP analysis prioritized strategies as Smart Monitoring System (46.7%)—The most effective approach, emphasizing real-time pollution tracking and traffic optimization. Next Clean Fuel Transition (27.7%)—Reducing emissions by shifting industries and vehicles to low-emission fuels. Low-Emission Zones (16.0%)—Establishing restricted zones to control vehicular pollution. And Urban Green Infrastructure (9.5%)—Expanding green spaces to enhance air quality. **Conclusion:** Strategic investments in pollution control technologies, combined with policy interventions such as emissions-based congestion pricing and green infrastructure expansion, are crucial for mitigating pollution in Ahvaz. The SWOT-AHP framework provided a structured approach to prioritizing actionable environmental management strategies based on feasibility and effectiveness.

Keywords: air pollution; air quality management; SWOT-AHP; Ahvaz; source apportionment; smart environmental strategies

1. Introduction

1.1. Background and significance

Global warming is changing the planet's weather patterns, leading to more frequent, intense and longer extreme weather events and natural disasters, which also affect air quality [1,2]. According to the World Health Organization (WHO), 99% of the world's population breathes air that exceeds the WHO pollution threshold, indicating that no level of air pollution is safe for humans [3,4]. Air pollution poses multisystemic health risks, affecting not only the cardiovascular and respiratory systems, but also detectable effects even at low doses [5–7]. Air pollution-related health problems include stroke, heart disease, lung cancer, and acute and chronic respiratory diseases, costing trillions of dollars and affecting well-being [8,9]. Air pollution causes approximately 3.7 million premature deaths globally each year [10].

1.2. Air pollution in Iran and the case of Ahvaz

Air pollution is one of the main problems in major cities of Iran, caused by outdated industrial units, old vehicles, and high energy consumption in residential and commercial sectors [11]. Ahvaz, the capital of Khuzestan Province, is one of the most polluted cities in the world due to its concentration of heavy industries, vehicular emissions, and unfavorable meteorological conditions [12]. Rapid urban expansion, an increase in the number of private vehicles, aging cars, and the use of heavy fossil fuels in public transportation are the main factors contributing to air pollution [13].

1.3. Research gap and objective

Although previous studies have assessed pollution levels in Ahvaz, few have proposed structured and locally adaptable mitigation frameworks. To address this gap, the current study integrates SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis with the Analytical Hierarchy Process (AHP) to develop a comprehensive and prioritized air pollution management strategy.

1.4. Methodological innovation

SWOT analysis is a widely used strategic planning tool for identifying internal and external factors, while AHP adds quantitative rigor by ranking intervention priorities based on expert judgment and decision-making criteria [14,15]. The combination of these two approaches offers a robust decision-support system, particularly suitable for multi-stakeholder urban environmental planning. Additionally, international case studies from cities such as Beijing, Los Angeles, and New Delhi have been reviewed. These examples provide a comparative assessment of mitigation techniques that can be adapted to Ahvaz's unique environmental conditions.

1.5. Research objectives

This research seeks to:

1) Identify and quantify major sources of air pollution in Ahvaz.
2) Evaluate the effectiveness of pollution mitigation strategies using a structured

SWOT-AHP approach.

3) Compare global best practices to propose a comprehensive air quality management plan.

2. Literature review

2.1. Air pollution challenges in Iranian cities

Urban centers in Iran, notably Tehran, Isfahan, and Ahvaz, grapple with severe air pollution due to factors such as outdated industrial operations, aging vehicle fleets, and high energy consumption in residential and commercial sectors. For instance, Tehran has experienced multiple closures of governmental offices, schools, and universities due to hazardous air quality levels, primarily attributed to vehicular emissions and industrial activities. Similarly, Isfahan faces significant air quality issues, exacerbated by industrial emissions and urban development pressures [16,17].

2.2. Application of SWOT and AHP in environmental management

The integration of SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis with the Analytic Hierarchy Process (AHP) has been employed in various Iranian studies to develop strategic plans for environmental management. In Tehran's District 2, researchers utilized the SWOT model to identify internal and external factors affecting air quality management. The study culminated in 21 strategic options, with the top priority being the implementation of a comprehensive energy management plan for vehicles and industries. Another study applied AHP to prioritize control measures for gaseous pollutants emitted from power plants, identifying nitrogen oxides (NOx) as the primary pollutant requiring immediate attention [17,18].

2.3. Strategic environmental planning in Isfahan

In Isfahan, SWOT analysis has been applied to assess urban planning strategies with an environmental focus. The study aimed to identify internal and external factors influencing the city's ecological situation and to develop strategies for sustainable development. The findings highlighted the need for integrated planning approaches that consider environmental capacities and constraints [16].

2.4. International case studies on air pollution mitigation

Globally, cities like Beijing [19,20], Los Angeles [21], and New Delhi [22] have implemented various strategies to combat air pollution. Beijing's coal-to-gas transition underscores the importance of addressing industrial emissions, while Los Angeles' stringent vehicle emission standards highlight the role of regulatory measures in controlling transportation-related pollution. New Delhi's odd-even vehicle rationing policy demonstrates that while such measures can offer temporary improvements, they may not suffice in isolation to tackle the multifaceted nature of urban air pollution [23,24].

3. Materials and methods

3.1. Study area

Ahvaz has a warm and semi-humid climate, with an average temperature increase of about 1.5 °C [12]. The highest average temperature is in August (38 °C) and the lowest in January (12 °C). Humidity is a key parameter in assessing climatic comfort. In Ahvaz, the highest average relative humidity is in January (70.40%) and the lowest in June (24.11%) [25]. Rainfall in Ahvaz follows a winter regime, with very little precipitation during the five warm months of the year. The maximum rainfall is recorded in November with 182 mm. the lowest evaporation occurs in January and the highest in June (549 mm) [26]. The winds in the Khuzestan region include regular seasonal and local winds, with the predominant direction in Ahvaz being westward. Important winds include the Shamal, Qaws, Suhail, Nashini, Samum, and Chaab winds, each with its characteristics. In the cold season (January), Ahvaz is exposed to predominant north and northwest winds as the primary winds, and south and southeast winds as secondary winds. In the warm season, northwest and west winds are predominant, and generally, the frequency of winds decreases gradually during the summer months. Temperature inversion in Ahvaz occurs less frequently than in elevated and valley areas due to its geographical location and specific weather conditions. In summer, the likelihood of inversion increases in the early hours of the day, causing pollutants to remain near the ground and their concentration to rise. Ahvaz is located in the Khuzestan plain and has a semi-tropical climate [27]. The region's climate is influenced by various air masses and is classified as a severe semi-desert climate. Wind erosion is a major problem in dry and semi-dry areas. In Khuzestan, 4.6 million hectares of land are threatened by wind erosion. The study area in Ahvaz includes active and semi-active erosion and deposition zones, with dunes in the west of Ahvaz being affected by local dust storms. The study area in this report is considered in three sections:

1) In the environmental, economic, and social status section, the study area is considered to be the old Ahvaz County (including Bavi, Karun, Ahvaz, and Hamidiyeh counties).
2) In the pollution sources section, based on the latest changes (drawn by the consultant and unofficially), pollution sources are examined separately for each county.
3) Given the importance of Ahvaz city, environmental, economic, and social assessments, and identification and examination of pollution sources within the Ahvaz municipality (Ahvaz city areas) are also determined **(Figure 1)**.

In the first stage of investigation, research, behavior measurement, recognition of the cause, and determination of appropriate methods of air pollution control were considered in the study area. Urban resources are divided into two parts: heating and transportation resources, and industrial resources, in which air-polluting sources are divided into non-metallic mineral, metal, foundry, chemical, oil, drilling, electricity, and food industries groups. Regarding agricultural resources, the amount of fuel consumed by agricultural machinery (the number of combines) has been studied, taking into account the operating hours per year and finally calculating the emitted pollutants. In these surveys, to find the concentration of pollutants in different parts and regions of Ahvaz city, this city has been divided into three parts: Bavi, Central, and Hamidiyeh. All the activities resulting in the release of air pollutants in the mentioned urban areas and points have been studied and the air pollutants released as a result of the activities of these sources have been calculated.

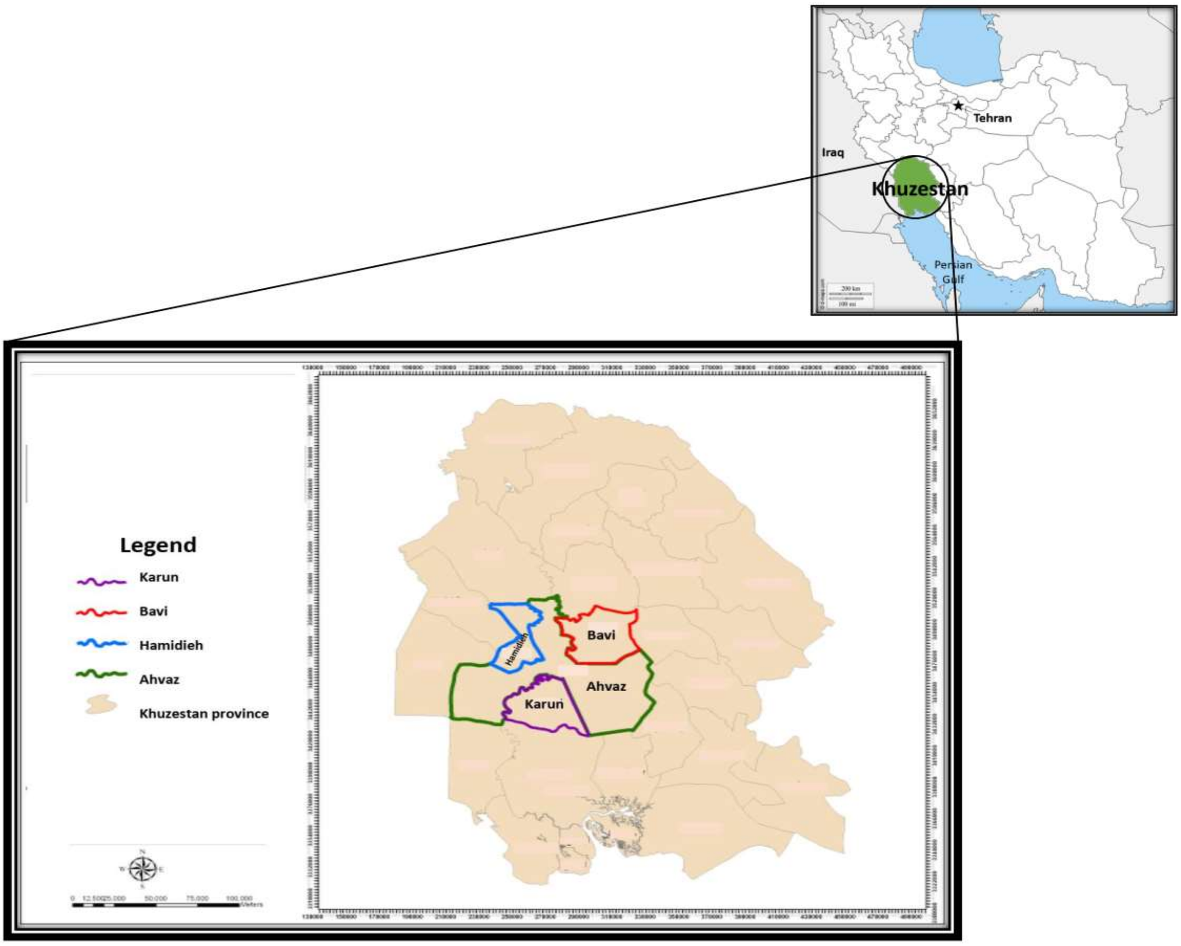

Figure 1. Location of the study area relative to Khuzestan Province.

3.2. Pollutant emission calculation model

To estimate the volume of air pollutants released in different regions of Ahvaz, we applied a bottom-up emission inventory approach. This method is based on the activity data of each pollution source combined with corresponding emission factors (EFs). The general formula used is:

$$E = A \times \text{EF} \times (1 - \text{ER})$$

where:

E = Emission of a specific pollutant (in tons/year)

A = Activity rate (e.g., fuel consumed in liters or tons, vehicle kilometers traveled, or production volume)

EF = Emission factor (e.g., grams of pollutant per unit of activity)

ER = Pollution control efficiency (if applicable)

For each source category (industrial, transportation, agricultural, and residential), we used specific datasets and emission factors:

Industrial emissions were calculated based on the type and quantity of fuel used, production volume, and technology type, using EFs from Iran's Environmental Protection Organization (EPO) and IPCC Guidelines (2006).

Transportation sector data included the number of vehicles by type, mileage, and fuel consumption per vehicle. Emission factors were derived from local traffic studies, the National Emissions Inventory, and Tier 1 EMEP/EEA (European Environment Agency) methodologies.

Agricultural sources (e.g., burning of crop residues, fuel used in machinery) were estimated using cultivated area, equipment hours, and regional agricultural data.

Urban heating and residential emissions were estimated based on average fuel consumption in residential and commercial buildings, with emission coefficients from national energy balance reports.

Activity data were collected through:

Field surveys and structured questionnaires

Interviews with local authorities and industrial facility managers

Reports from the Khuzestan Department of Environmental Protection

Satellite-based land-use data (for industrial and agricultural zoning)

Previous research and local environmental impact assessments

All emission calculations were aggregated and spatially distributed across districts using GIS tools, allowing pollutant loads to be mapped and analyzed by region.

After preparing the detailed service description approved by the Environmental Protection Organization, explanatory sessions—including public and private meetings with representatives of relevant organizations—were held to collect their perspectives on the plan. The project's implementation stages were also discussed and reviewed with them during these sessions

In the next step, the records of studies conducted in the field of air pollution in Ahvaz city were examined. The required data by determining the deficiencies in the studies, determining the current status of the polluting sources and updating the background information, by preparing specialized questionnaires for different polluting sources, interviews, holding face-to-face meetings, visiting the polluting sources, and reviewing the files of each source were provided. After analyzing and classifying the data, the obtained results were shown on the base maps of Ahvaz and the city, and in this way, the zoning of resources and their density according to the grouping of resources into urban, industrial, service, and agricultural were determined. Also, the statistical data on the air quality of Ahvaz City in the last 5 years were studied. Using the emission coefficients of fossil fuels and industrial production processes, the pollution load of polluting sources was calculated and estimated, and used to determine the share of polluting sources. By using specialized questionnaires, interviews, face-to-face meetings, a collection of expert theories, the proposed plans of different organizations were divided into three groups: direct, indirect and support. In the following, by determining the priority of the implementation of each of the projects and the amount of resources and financial credit required, the effectiveness of the implementation of each project in reducing the air pollution of Ahvaz using SWOT matrix was determined. By presenting the structure of formations for the implementation of plans and evaluating and monitoring the implementation of all the proposed plans, the necessary solutions in the field of control and supervision and optimization of the implementation of each of the plans were determined.

4. Results and discussion

4.1. Identification of industrial air pollution sources

This section presents a comprehensive analysis of pollutant emissions across industrial, transportation, and agricultural sectors in Ahvaz. The results are based on emission inventory data, spatial analysis, and classification of sources by region and activity type. These findings provide a foundation for evaluating the impact of different sectors and formulating targeted mitigation strategies.

In this study, air-polluting industries have been identified by industrial groups and their locations. In the Ahvaz district, 4 non-metallic mineral industries, 7 metal industries, 1 chemical industry, 1 power industry, and 3 food industries have been studied. Additionally, in the Bavi district, 1 power industry, and in the Karun district, 7 non-metallic mineral industries and 3 food units have been examined.

The industries studied include brick factories, Farsit Ahvaz Company, Khuzestan Steel Company, National Iranian Steel Group, Sepanta Industrial Company, Ahvaz Rolling and Pipe Company, Kavian Steel Company, Iran Carbon Company, oil and drilling units, Ramin Power Plant, Zargan Power Plant, Khuzestan Flour Factory, Jonoob, industrial towns, and sugarcane development. Finally, the information has been divided by the urban area of Ahvaz and the entire Ahvaz district, and the amount of pollutants emitted by these industries has been estimated.

4.2. Spatial distribution of industrial land use

In Ahvaz, Region 8 has the highest concentration of heavy industries, followed by Regions 4 and 6. The lowest per capita industrial activities belong to Regions 1, 3, and 5. Regions 8 and 4 have the highest weight of heavy industrial land use, while Region 1 has the lowest share of light industrial land use (**Figure 2**).

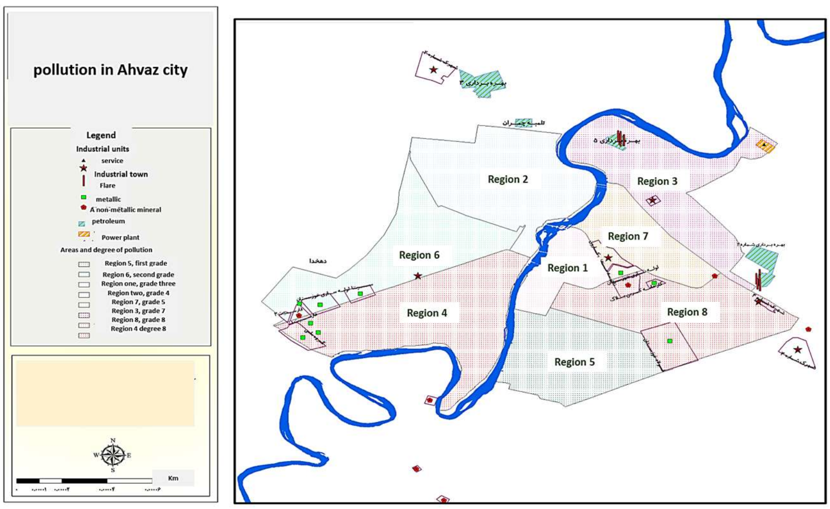

Figure 2. The state of pollution in the areas of Ahvaz city.

4.3. Emission load from industrial activities

Studies conducted to determine the pollution load from industrial activities in Ahvaz County show that this county, with the emission of 300,047.63 tons of pollutants per year, accounts for about 75.13% of the total industrial pollutants in Khuzestan Province. Following Ahvaz, Karun County with 20,897 tons (5.23%) and Bavi County with 78,451 tons (19.64%) rank next.

The main pollutants include carbon monoxide (CO) with 97% and sulfur dioxide (SO_2) with 91.8%, having the highest share in air pollution. The highest pollution load from SO_2 belongs to the Ramin Power Plant (54%) and oil units (44%). In total, the Ramin Power Plant and oil units produce 98% of the total SO_2 emissions. The highest share of NOx emissions belongs to the Zargan Power Plant, which uses natural gas as fuel. Additionally, oil units, by burning large amounts of gas and oil liquids, produce over 98% of the emitted CO.

Metal industries contribute the most to dust particle emissions, accounting for 61%, followed by non-metallic mineral industries with 18.5%. In terms of total pollutant emissions, oil industries represent the largest share at 78.8%, followed by power industries (9.5%), metal industries (6.46%), non-metallic mineral industries (3.58%), chemical industries (1.34%), and food industries (0.1%).

4.4. District-level emission assessment

The assessment of pollutant emissions in the eight districts of Ahvaz City shows that District 3 has the highest number of flares and is most affected by pollutants from the oil industry, while District 6 has the highest number of air-polluting industrial units overall. Out of a total of 15 industrial units (excluding oil units), metal industries with 7 units have the highest number, and power, non-metallic mineral, and chemical industries each have 1 unit, the lowest number.

The share of districts in industrial pollutant emissions shows that region 4 with 55.28% and region 6 with 36.35% have the highest shares in industrial sector emissions.

4.5. Transportation sector emissions

In the urban transportation sector of Ahvaz, the pollution load from transportation activities, including urban and intercity transport, has been assessed. This assessment considers travel frequency, travel percentage, the number of vehicles by type, fuel consumption, and mileage. The traffic routes in Ahvaz are divided into main and secondary categories, and traffic is calculated based on the type and number of vehicles in the eight districts.

Daily traffic statistics of public vehicles from the entry and exit points of Ahvaz have also been examined, and the percentage of passage and the total traffic volume have been calculated. The results show that the highest pollution load is related to carbon monoxide (CO) with over 16,199 tons per year and nitrogen oxides (NOx) with over 8158 tons per year. Hydrocarbons (HC) follow with 6864 tons per year.

4.6. Agricultural sector and biomass burning

Studies indicate that the agricultural sector has a negligible share in air pollutant emissions. Pollutant sources in this sector include fuel consumption in agricultural machinery and burning fields in specific seasons. These pollutants, due to their transient nature, low concentration, and high dispersion, mainly occur outside urban areas and are of lesser importance in terms of air pollution. Burning fields in the warm seasons can temporarily increase air pollution, with climatic conditions such as wind speed and direction affecting its dispersion and intensity.

4.7. Emission source comparison by sector

To determine the amount of pollutants emitted from burning agricultural fields and sugarcane lands, two approaches were examined. The first method included experimental and pilot studies, which were excluded due to the extensive nature of the studies. The second method was based on cultivation area, production, crop type, and emission factors. In this study, the amount of pollutants emitted from burning wheat, barley, and sugarcane fields was calculated based on this approach.

Determining the Share of Pollution in Urban Areas

The assessment of pollutant emissions from various sources (industrial, transportation, and residential-commercial) in the eight districts of Ahvaz City shows the following (**Figure 3**).

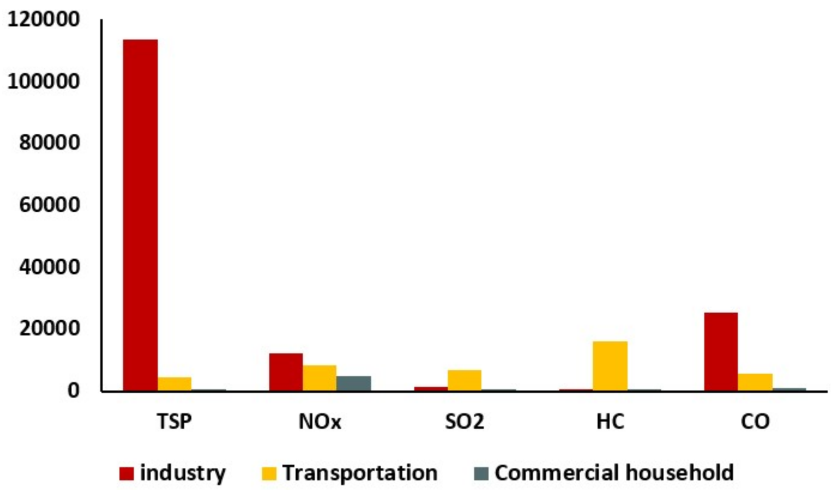

Figure 3. The emission rate of pollutants from different sources in the eight regions of Ahvaz metropolis (tons/year).

Industrial Sector: Total suspended particles have the highest emission level at 113,488 tons per year, while hydrocarbons (HC) have the lowest emission level at 122.5 tons per year.

Transportation Sector: Hydrocarbons (HC) have the highest emission level at 16,199 tons per year, while suspended particles have the lowest emission level at 4361.73 tons per year.

Residential-Commercial Sector: Nitrogen oxides (NOx) have the highest emission level at 5016 tons per year, while sulfur dioxide (SO_2) has the lowest emission level at 84 tons per year.

The overall assessment of pollutant emissions from different sources shows that the industrial sector ranks first with 152,409.20 tons per year, accounting for 75.90% of total emissions (**Figure 4**). The transportation sector ranks second with 41,327.33

tons per year, accounting for 20.60% of total emissions. The residential-commercial sector ranks third with 6987.05 tons per year, accounting for approximately 3.5% of total emissions. **Figure 3** shows the amount of pollutants emitted from various sources in the eight districts of Ahvaz (tons/year).

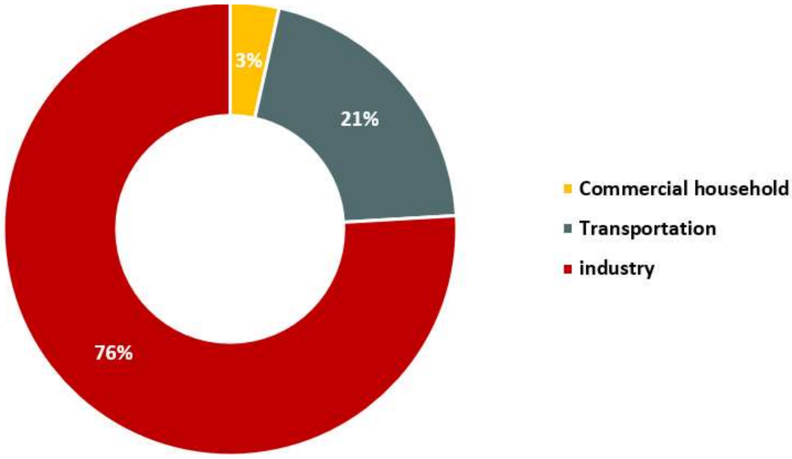

Figure 4. The contribution of different sources in the emission of pollutants in the areas of Ahvaz city.

4.8. SWOT-AHP strategic analysis

After reviewing the current situation and based on the information collected in the previous stage, the environmental status of air pollution in Ahvaz was analyzed using the SWOT (Strengths, Weaknesses, Opportunities, and Threats) method (**Tables 1** and **2**). This analysis will identify the strengths, weaknesses, opportunities, and threats in various environmental areas. Initially, the concepts of "strengths, weaknesses, opportunities, and threats" will be defined to ensure a consistent understanding of categorization. These definitions are presented conventionally, independent of theoretical discussions.

After identifying environmental factors, it is necessary to integrate and summarize the strengths, weaknesses, opportunities, and threats to examine the major environmental challenges facing air pollution in Ahvaz County.

The SWOT approach is a decision-making method designed to determine long-term or short-term strategies and create significant and key decisions on various issues. This model can be designed for an organization, a company, a specific geographical area, or an issue that we are dealing with. Its main function is to determine strategies to improve efficiency or status. This model first examines the potential and capacity of a subject or place, and the internal and external factors affecting it, and then uses these results to determine various strategies for making decisions, predictions, and solutions to improve that place or subject.

For any subject or place, various factors affect its performance quality. These factors generally fall into two categories:

Internal Factors: These are factors that exist within the system or area and influence its status. In the SWOT model, internal factors include the strengths and weaknesses of a system, organization, or area. Identifying strengths reveals ways to enhance the system while identifying weaknesses allows for leveraging them to benefit the strengths.

External Factors: These are factors beyond the control of the area and affect the system from the outside. They are related to processes occurring outside the region. External factors include opportunities and threats. Opportunities are external factors that can contribute to the advancement of an area, while threats are external factors that pose risks and should be avoided or turned into opportunities.

The SWOT model works by calculating and determining these strengths, weaknesses, opportunities, and threats, and then using these factors to determine various strategies in four sections. Ultimately, it determines the direction of strategies and identifies the most important and effective strategy.

Table 1. Internal Factor Evaluation (IFE) matrix.

Internal strategic factors					
No	**Strengths (S)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
1	The existence of the results of previous studies related to the control and reduction of air pollution in Ahvaz city	4	0.06	1	0.06
2	The existence of programs to improve the transportation management system and pollution control	5	0.08	2	0.16
3	Existence of fixed air pollution measuring stations (5 stations)	3	0.04	2	0.08
4	The existence of an air pollution reduction committee and the holding of related meetings	5	0.08	2	0.16
5	Construction of subway lines and BRT lines project	4	0.06	1	0.06
6	Expanding the use of natural gas and replacing gas fuel with gasoline and diesel fuels in service centers, businesses and cars, and industrial units around the city (industrial town, brick kilns)	4	0.06	4	0.24
7	Establishment of 14 single-purpose fuel stations (gas) and 14 dual-purpose fuel stations in Ahvaz city	2	0.03	2	0.06
8	Increasing green space, Shahrvand Forest Park and the amount of green space per capita is 12 m2	4	0.06	4	0.24
9	Government support for financial aid in the form of loans to expand metro lines	4	0.06	1	0.06
10	Effective and useful efforts and support of the Ministry of Petroleum to promote and supply standard fuel	5	0.08	2	0.16
11	Construction of mechanized technical examination centers without paying the government's allocated budget by the municipality	4	0.06	1	0.06
12	The sensitivity of the police force to traffic control and extensive efforts in its direction	4	0.06	1	0.06
13	The support of the Ministry of Interior and the Yaha Mayor's Organization for the withdrawal of worn-out taxis	4	0.06	1	0.06
14	The effective pressures of the Environmental Protection Organization and the pursuit of standards updates	3	0.04	1	0.04
15	Entry of the private sector into the field of public transportation	3	0.04	2	0.08
16	Supporting car manufacturers to make gas-powered buses and produce gas-powered buses	3	0.04	2	0.08
17	Efforts and effective information of the Environmental Protection Organization in promoting the culture of dealing with air pollution	4	0.06	1	0.06

Table 1. (*Continued*).

Internal strategic factors					
No	**Strengths (S)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
18	All-round support of the police force for technical inspection of cars and dealing with violators	2	0.03	1	0.03
No	**Weaknesses (W)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
1	The absence of an integrated and capable management system with a suitable structure to control air pollution and the lack of establishment of an environmental management system	5	0.053	2	0.112
2	Lack of a comprehensive plan and long-term and medium-term strategic goals	5	0.053	1	0.056
3	Not giving priority and lack of serious determination at management levels to improve the conditions and implement laws and proper communication (dealing) with the illegal activities of air polluting units.	5	0.053	2	0.112
4	Lack of local regulations and standards needed to improve the situation	4	0.043	2	0.09
5	Limitations in infrastructure and facilities necessary to determine air pollution and display weather conditions	3	0.032	1	0.034
6	Inadequate financial resources in order to reduce air pollution and allocate the necessary funds for this sector	5	0.053	2	0.106
7	The lack of necessary supervision in assessing the environmental effects of projects and the lack of the role of environmental management in changing the use and performance of cities	5	0.053	2	0.106
8	Lack of communication with research and academic centers and lack of attention to the results of the studies	4	0.043	2	0.09
9	Lack of correct and documented statistics related to air pollution and lack of understanding regarding the importance of the issue	4	0.043	2	0.09
10	Lack of facilities and educational and cultural programs related to air pollution through public participation	4	0.043	2	0.09
11	Failure to provide financial resources for personnel and other resources	5	0.053	2	0.112
12	Lack of centralization of political institutions and decision-making	5	0.053	2	0.112
13	Absence of air pollution control center in Ahvaz city	3	0.032	2	0.068
14	Lack of public parking spaces in Ahvaz city	3	0.032	2	0.068
15	Failure to fulfill some legal obligations and lack of coordination between departments in relevant organizations and bodies	3	0.032	2	0.068
16	The disproportion and balance between the excessive increase in the number of vehicles in cities with the expansion of the urban road network	3	0.032	2	0.068
17	Lack of benefit from new technologies in improving scientific and technical knowledge and management of transportation sub-sectors	4	0.043	2	0.09
18	The high useful life of the intra-city transport fleet and its wear and tear	3	0.032	1	0.034
19	Inappropriate location of Ahvaz airport and railway near residential area	3	0.032	2	0.068

Table 1. (*Continued*).

Internal strategic factors					
No	**Weaknesses (W)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
20	The slowness of movement and the level of undesirable and critical service in a part of the arterial roads of Ahvaz city, especially in the central core of the city	4	0.043	2	0.09
21	Low share of public transportation (bus) in urban transportation	5	0.053	2	0.112
22	Saturation of the network of main and arterial roads of Ahvaz city, especially in the central core during peak traffic hours	4	0.043	2	0.09
The sum of the matrix of internal factors		1.80			

Table 2. External Factor Evaluation (EFE) matrix.

External strategic factors					
No	**Opportunities (O)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
1	The possibility of supplying gas to production units along with providing financial facilities	4	0.055556	2	0.111111
2	The existence of a vehicle technical inspection center through the private sector to provide a technical inspection label	2	0.027778	1	0.027778
3	Taking advantage of government support, bank facilities and national budgets in green belt projects, metro, replacement of worn out cars and air pollution control programs.	5	0.069444	1	0.069444
4	Telecommunication systems and internet facilities and using ATMs in banks	4	0.055556	4	0.222222
5	The presence of environmental experts in the country	4	0.055556	4	0.222222
6	The development of environmental sciences in the world and the region and the possibility of exchanging knowledge with developed countries	5	0.069444	4	0.277778
7	Conventions and protocols related to air pollution, climate change and ozone layer	4	0.055556	4	0.222222
8	Laws and regulations related to air pollution control in the country	5	0.069444	4	0.277778
9	Using the capacity of oil units in the city of Ahvaz in the development of green space	4	0.055556	2	0.111111
10	The presence of government counter offices	3	0.041667	1	0.041667
11	Establishment of various environmental education and research centers in the province	4	0.055556	4	0.222222
12	Using the capacity of Ahvaz city's environment project for education	4	0.055556	2	0.111111
13	Allocation of financial resources to reduce dust and international cooperation in this regard	5	0.069444	1	0.069444
14	The presence of HSE units in large industries and related organizations	4	0.055556	2	0.111111
15	Force to remove polluting industries from Ahvaz city	4	0.055556	1	0.055556
16	Existence of air pollution measurement and monitoring equipment	3	0.041667	4	0.166667
17	There are graduates of environmental engineering-air pollution	3	0.041667	4	0.166667

Table 2. (*Continued*).

External strategic factors					
No	**Opportunities (O)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
18	Compilation of regulations for reducing pollution in eight cities and determining the wear life of cars	5	0.069444	4	0.277778
No	**Threats (T)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
1	Lack of integrated urban management, lack of meritocracy and lack of use of specialists in urban management positions and lack of information exchange and communication in order to implement joint projects in order to reduce air pollution.	5	0.064103	4	0.25641
2	Influence (influence) and the existence of multiple centers of power in decision-making by higher institutions and changing the goals of projects and the lack of knowledge necessary to solve the problem of air pollution and the lack of approval and implementation of projects related to air pollution	5	0.064103	4	0.25641
3	The financial dependence of the implementation of projects and environmental management improvement activities on the national budget and the lack of prioritization of funding for air pollution control projects	5	0.064103	4	0.25641
4	Non-compliance and implementation of environmental laws in the regulations of other organizations and organizations and non-coordination of organizations with the Environmental Protection Organization in issuing permits for the establishment of air-polluting industrial units	3	0.038462	4	0.153846
5	Lack of consulting engineers with regional experience in air pollution management and lack of private executive institutions	2	0.025641	1	0.025641
6	Weakness of public awareness among different groups, lack of educational programs on radio and television, and educational and cultural programs of organizations regarding air pollution issues.	5	0.064103	4	0.25641
7	Lack of active non-governmental organizations (NGOs) related to air pollution	3	0.038462	3	0.115385
8	Destruction of green space to change land use and widespread issuance of construction permits and density sales	4	0.051282	4	0.205128
9	Taking suitable lands by urban capitalists and influencing legal authorities to change land use and create air polluting centers	3	0.038462	3	0.115385
10	Non-allocation of necessary gas for Ramin power plant in the cold season and some industrial units	5	0.064103	4	0.25641
11	The problems of air pollution and the limitations of the transportation sector, especially the public transportation system, and the absence of an intelligent traffic control system	4	0.051282	3	0.153846
12	Existence of air polluting industries in Ahvaz city	5	0.064103	4	0.25641
13	Existence of sanctions and lack of sufficient currency to use air pollution control resources in the industrial sector	3	0.038462	3	0.115385
14	Reducing the amount of standard fuel production	4	0.051282	4	0.205128
15	Increase in dust (fine dust) in Ahvaz city	5	0.064103	4	0.25641

Table 2. (*Continued*).

External strategic factors					
No	**Threats (T)**	**Weight**	**Normalized weight**	**Availablescores**	**Weightedscores**
16	Old and middle-aged technology of some cars (increasing fuel consumption, increasing healthcare costs)	4	0.051282	3	0.153846
17	Increasing the number of motorcycles and its traffic in the central cores of the city	3	0.038462	2	0.076923
18	Lack of reliable laboratories related to air pollution in Ahvaz city	2	0.025641	1	0.025641
19	Limited education and internet infrastructure in the country	3	0.038462	3	0.115385
The sum of the matrix of external factors		3			

The analysis of the External Factors Strategic Matrix shows that the opportunities outweigh the threats, while the analysis of internal factors indicates that weaknesses are more prevalent than strengths. Additionally, the analysis of internal and external factors revealed that the air pollution situation in Ahvaz falls within the (WO) quadrant, which involves strategies derived from combining opportunities and weaknesses. This means that strategies are designed to leverage opportunities to mitigate or eliminate weaknesses. This strategy is known as the Maximum-Minimum (WO) strategy, which implies utilizing the advantages of opportunities to compensate for weaknesses. Therefore, if we are to determine a strategy based on the combination of weaknesses and opportunities (Maximum-Minimum strategy), we should identify a strategy that highlights an aspect of opportunities that can be used to eliminate one of the identified weaknesses. **Figure 5** illustrates the strategic position of the air pollution situation in the metropolis of Ahvaz. Overall, the air pollution situation in Ahvaz falls within the conservative strategies quadrant. Accordingly, the desired strategies were formulated, and ultimately, effective programs for achieving each strategy were developed.

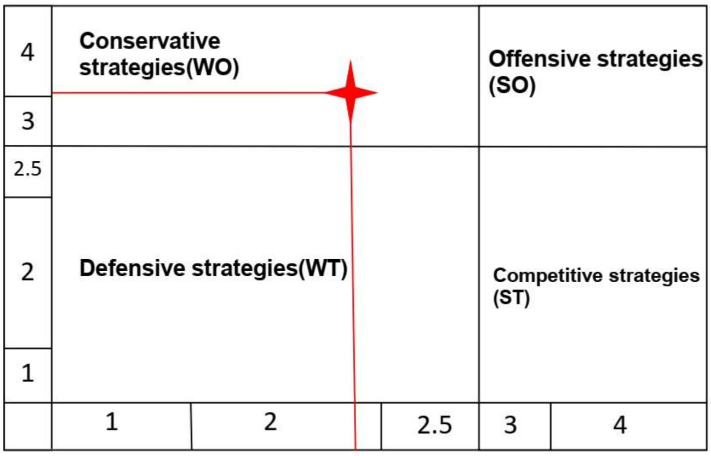

Figure 5. Determining the strategic situation of air pollution in Ahvaz metropolis.

According to the obtained results, several strategies are suggested .I) Allocate financial resources for air pollution control and dust reduction to cover personnel and technical costs and implement resolutions (green belt, desertification). II) Establish

HSE units and environmental management in all industries and related organizations according to legal requirements to interact with the environment. III) Relocate polluting industries and disruptive urban services (airport, railway) from residential areas of Ahvaz to industrial parks and suitable locations. IV) Effectively utilize existing air pollution monitoring and measurement equipment and develop monitoring systems to establish an air pollution control center or air monitoring center in Ahvaz. V) Follow up and implement the resolutions of the air pollution reduction regulations for major cities and prioritize programs to enforce laws and resolutions using the capacity of the air pollution reduction task force. VI) Utilize the capacity of the "Mohit Yar" project and the educational programs of non-governmental organizations to educate and raise awareness about air pollution among Ahvaz citizens. VII) Use legal capacities to secure financial resources and loans to implement and monitor related projects and provide hardware facilities for air pollution reduction (pollutants, emission sources, dust, fuel). VIII)Leverage government support, bank facilities, and national budgets to improve the quality and quantity of urban transportation to reduce pollution from vehicles in public transportation, fuel, and facilities sub-sectors. IX) Establish connections with domestic and international research and academic centers to utilize the technical potential of environmental specialists.

The AHP analysis prioritized strategies as follows:

Smart Monitoring System (46.7%)—The most effective approach, emphasizing real-time pollution tracking and traffic optimization.

Clean Fuel Transition (27.7%)—Reducing emissions by shifting industries and vehicles to low-emission fuels.

Low-Emission Zones (16.0%)—Establishing restricted zones to control vehicular pollution.

Urban Green Infrastructure (9.5%)—Expanding green spaces to enhance air quality (**Figure 6**).

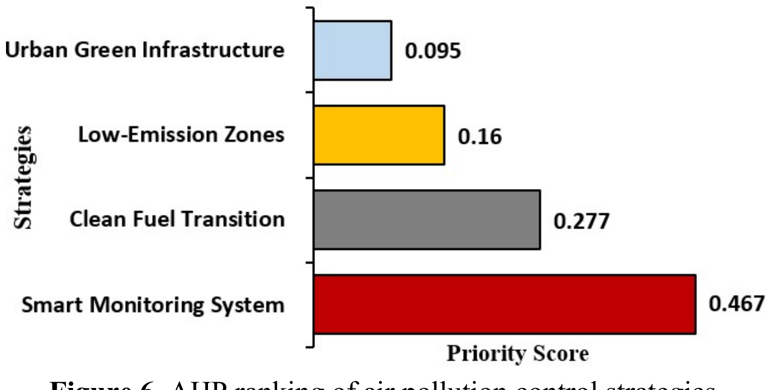

Figure 6. AHP ranking of air pollution control strategies.

R. Ramezanian Bozorg Ghasem Abadi et al. in Tehran, Iran, used a Quantitative Strategic Planning Matrix (QSPM) to prioritize the W/O strategies from the SWOT analysis [28]. They identified the best solutions for managing air pollution caused by traffic in Tehran's 12th district. These solutions include increasing the budget for environmental control, fostering cooperation between the private and public sectors, upgrading public transportation with low-energy and green vehicles, launching extensive public awareness campaigns, and relocating polluting industries to suburban areas.

In a similar study, Mozhgan Zaeimdar and his team proposed practical solutions to mitigate air pollution in Tehran's 2nd district, based on the SWOT model and the area's current conditions and resources. Among the six strategies evaluated, the most appealing was the "Implementation of a comprehensive energy management plan for vehicles and industries, along with a clean energy use plan," which received a total attractiveness score of 10.36 for the area [29].

In a study conducted in Indonesia aimed at identifying the causes of urban air pollution, the SWOT analysis was utilized. The highest score, 5.7, was achieved by the Strength-Opportunities strategy, placing it in Quadrant 1. This indicates that the government, as the responsible authority, has both the opportunity and the strength to implement strategies that support policies promoting aggressive growth by leveraging various existing opportunities and internal strengths [30].

Mohammad-Beigi et al. [31] utilized the SWOT matrix to assess the sustainability of Tehran's BRT system and identified key factors to develop strategies for enhancing the public transportation system and its role in reducing air pollution (**Table 3**). They concluded that the SWOT matrix is effective in formulating management strategies, which aligns with the findings of the present study on using the SWOT matrix to develop operational strategies for reducing air pollution in Tehran [31].

Table 3. Comparison with global pollution control initiatives.

City	Key pollution control measures	Effectiveness
Beijing	Coal-to-gas transition	60% PM2.5 reduction
Los Angeles	Vehicle emissions standards	50% NOx reduction
New Delhi	Odd-even vehicle rationing	11% traffic emissions reduction
Ahvaz (Proposed)	Smart monitoring & clean fuel transition	Projected 40% reduction in NOx

Kobariaizadeh used the Delphi method, combined with SWOT, QSPM, and fuzzy network hierarchy analysis (F.ANP), to develop an air pollution management strategy for Isfahan city. The study suggests that reducing the use of private cars and expanding the public transportation network should be prioritized. Additionally, limiting industrial units within the city and implementing pollution fees will improve public roads. The most effective strategy to control air pollution is to focus on reducing private car usage through policy and planning for public transportation expansion [32].

Beijing's transition from coal to gas as a primary energy source has resulted in a 60% reduction in PM2.5 levels. This strategy has proven highly effective in curbing emissions from the industrial and energy sectors, which were the main contributors to the city's air pollution. By moving away from coal, a major source of particulate matter, Beijing has significantly improved air quality, especially during winter months when coal usage was most prevalent. This transition underscores the importance of shifting to cleaner energy sources to achieve substantial reductions in particulate pollution. Los Angeles has been at the forefront of air pollution control, particularly in addressing vehicular emissions. The city implemented strict vehicle emissions standards, which have led to a remarkable 50% reduction in nitrogen oxide (NOx) emissions. NOx is a primary contributor to ground-level ozone formation and smog, and its reduction is crucial for improving air quality in densely populated urban areas. The success of this measure demonstrates the significant impact that regulatory frameworks targeting vehicle emissions can have on reducing urban air pollution, particularly in cities with high vehicle usage like Los Angeles. New Delhi has implemented various strategies to tackle its severe air pollution, with one of the most notable being the odd-even vehicle rationing policy. This policy restricts vehicles from being on the road based on whether their license plates end in an odd or even number, aiming to reduce the number of vehicles on the road and subsequently lower traffic emissions. While the odd-even policy led to a 11% reduction in traffic emissions, its overall effectiveness in significantly improving air quality has been limited. New Delhi continues to face challenges in air quality management due to the city's rapid urbanization, high vehicle numbers, and industrial emissions. This suggests that while traffic-related measures can contribute to pollution control, they may need to be complemented by broader strategies, such as transitioning to cleaner fuels and enhancing public transportation systems. The comparative analysis of these cities reveals that the most effective air pollution control measures are those that target the largest sources of pollution, such as industry and transportation. Beijing's coal-to-gas transition highlights the importance of addressing industrial emissions, while Los Angeles' vehicle emissions standards underscore the role of regulatory measures in controlling pollution from the transportation sector. On the other hand, New Delhi's experience with the odd-even vehicle rationing policy shows that while such measures can offer temporary improvements, they may not be sufficient in isolation to address the complex and multifaceted nature of urban air pollution.

The findings suggest that cities aiming to reduce air pollution must adopt a comprehensive approach that includes transitioning to cleaner energy sources, implementing stringent emissions standards for vehicles, and investing in public transportation infrastructure. Additionally, there is a clear need for long-term strategies that integrate technological innovation (such as real-time pollution monitoring systems), urban planning (such as low-emission zones), and policy interventions (such as congestion pricing and clean fuel transitions). By learning from global best practices, cities like Ahvaz can develop tailored solutions that address their unique environmental challenges and significantly improve air quality.

This study presents a comprehensive framework for identifying air pollution sources in Ahvaz and prioritizing mitigation strategies using an integrated SWOT-AHP approach. The findings indicate that the industrial sector contributes the most to total pollutant emissions (approximately 76%), followed by the transportation and residential-commercial sectors. Among industries, oil and power plants are the major contributors to SO_2 and CO emissions.

Compared to previous studies conducted in Tehran, Isfahan, and other major cities [16,17] the application of a SWOT-AHP hybrid in this study provides a novel decision-support tool that combines qualitative expert input with quantitative prioritization. Unlike traditional single-method approaches, this model offers a more balanced, transparent, and participatory means of selecting optimal strategies.

From a feasibility perspective, several of the proposed solutions—such as smart monitoring systems and public education—are relatively low-cost and high-impact, making them ideal for short-term implementation. On the other hand, more capital-intensive strategies such as relocation of polluting industries or clean fuel transitions require significant financial resources, regulatory backing, and inter-agency coordination.

Key obstacles include:

- Limited budget allocation for environmental initiatives
- Lack of inter-organizational coordination
- Resistance from local industries to operational changes
- Weak enforcement of environmental regulations

The limitations of this study include reliance on available emission factors and activity data, which may not fully capture real-time variations or unreported emissions. Moreover, socio-political dynamics—such as public opposition or lack of institutional capacity—can impact the practical rollout of proposed strategies.

Despite these challenges, the SWOT-AHP approach allows for adaptive planning by aligning technical feasibility with stakeholder priorities and environmental urgency. This model can be updated and expanded as more data becomes available or as new priorities emerge.

Overall, the findings underscore the need for multi-level governance, sustained public investment, and active community engagement to address air quality challenges in Ahvaz effectively.

5. Conclusion

This study developed a comprehensive framework for identifying air pollution sources in Ahvaz and prioritizing mitigation strategies using a hybrid SWOT-AHP approach. The results showed that the industrial sector—particularly oil industries and power plants—contributes the most to overall emissions, followed by transportation and residential-commercial sectors. The integration of spatial emission data with strategic analysis enabled a targeted, evidence-based approach to environmental planning.

By analyzing internal and external factors, nine management strategies were formulated, with the "Allocate financial resources for pollution control and dust reduction" strategy receiving the highest priority. The proposed action areas cover industrial regulation, transportation reform, green space development, environmental education, and fuel improvement.

These findings offer actionable insights for policymakers in Ahvaz and similar cities facing complex urban air pollution challenges. Implementation success, however, depends on political will, cross-sector coordination, sustained funding, and public engagement. Future studies could focus on real-time pollution modeling and socio-economic cost-benefit analysis of proposed strategies.

Author contributions: Conceptualization, NJHF and AL; methodology, FJ; software, FJ; validation, AL, EK, BS, SK and HK; formal analysis, FJ; investigation, SR; writing—original draft preparation, FJ; writing—review and editing, NJHF; visualization, FJ; supervision, NJHF; project administration, NJHF; funding

acquisition, AL. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Khuzestan Department of Environment through a contract with Jundishapur University of Ahvaz, grant number 81I07. The APC was funded by the Khuzestan Department of Environment.

Ethical approval: Not applicable.

Informed consent statement: Not applicable.

Acknowledgments: The authors would like to acknowledge the Khuzestan Environmental Protection Office and the Air Pollution and Climate Change Office for providing data and technical support for this study.

Conflict of interest: The authors declare no conflict of interest.

References

1. Kulick ER, Kaufman JD, Sack C. Ambient Air Pollution and Stroke: An Updated Review. Stroke. 2023; 54(3): 882–893. doi: 10.1161/strokeaha.122.035498
2. Montone RA, Rinaldi R, Bonanni A, et al. Impact of air pollution on ischemic heart disease: Evidence, mechanisms, clinical perspectives. Atherosclerosis. 2023; 366: 22–31. doi: 10.1016/j.atherosclerosis.2023.01.013
3. Amiri F, Jamali AA, Gharibvand LK. Tracing air pollution changes (CO, NO2, SO2, and HCHO) using GEE and Sentinel 5P images in Ahvaz, Iran. Environmental Monitoring and Assessment. 2023; 195(10). doi: 10.1007/s10661-023-11885-4
4. Berg CD, Schiller JH, Boffetta P, et al. Air Pollution and Lung Cancer: A Review by International Association for the Study of Lung Cancer Early Detection and Screening Committee. Journal of Thoracic Oncology. 2023; 18(10): 1277–1289. doi: 10.1016/j.jtho.2023.05.024
5. Choobkar N, Saffar AK, Norouzi H, et al. Seasonal and spatial zoning of air quality index and ambient air pollutants in ahvaz oil and gas factories with geographic information system. Environmental Engineering and Management Journal. 2023; 22(5): 957–968. doi: 10.30638/eemj.2023.077
6. Sicard P, Agathokleous E, Anenberg SC, et al. Trends in urban air pollution over the last two decades: A global perspective. Science of The Total Environment. 2023; 858: 160064. doi: 10.1016/j.scitotenv.2022.160064
7. Jahedi F, Jaafarzadeh Haghighi Fard N, Abdullatif Khafaie M, et al. Characterization of airborne microplastics and exposure assessment in the Mahshahr special economic zone, Northern Persian Gulf. Atmospheric Pollution Research. 2025; 16(9): 102585. doi: 10.1016/j.apr.2025.102585
8. Haddad P, Kutlar Joss M, Weuve J, et al. Long-term exposure to traffic-related air pollution and stroke: a systematic review and meta-analysis. International Journal of Hygiene and Environmental Health. 2023; 247: 114079. doi: 10.1016/j.ijheh.2022.114079
9. Olesiejuk K, Chałubiński M. How does particulate air pollution affect barrier functions and inflammatory activity of lung vascular endothelium? Allergy. 2023; 78(3): 629–638. doi: 10.1111/all.15630
10. Lelieveld J, Haineset a, Burnett R, et al. Air pollution deaths attributable to fossil fuels: observational and modelling study. BMJ. 2023: 383. doi: 10.1136/bmj-2023-077784
11. Shojaee Barjoee S, Malverdi E, Kouhkan M, et al. Health assessment of industrial ecosystems of Isfahan (Iran) using phytomonitoring: Chemometric, micromorphology, phytoremediation, air pollution tolerance and anticipated performance indices. Urban Climate. 2023; 48: 101394. doi: 10.1016/j.uclim.2022.101394
12. Sadeghi HA, Sadeghi R. Temporal Analysis of Air Pollution Effects on Cardiovascular Diseases and Mortality in Ahvaz, Iran. International Journal of Population Issues. 2024; 1(2): 71–85. doi: 10.36312/ijpi.v1i2.1828
13. Jahedi F, Dehdari Rad H, Goudarzi G, et al. Polycyclic aromatic hydrocarbons in PM1, PM2.5 and PM10 atmospheric particles: identification, sources, temporal and spatial variations. Journal of Environmental Health Science and Engineering. 2021; 19(1): 851–866. doi: 10.1007/s40201-021-00652-7

14. Puyt RW, Lie FB, Wilderom CP. The origins of SWOT analysis. Long Range Planning. 2023; 56(3): 102304.
15. Shinde PA, Abbas Q, Chodankar NR, et al. Strengths, weaknesses, opportunities, and threats (SWOT) analysis of supercapacitors: A review. Journal of Energy Chemistry. 2023; 79: 611–638. doi: 10.1016/j.jechem.2022.12.030
16. Bozorg Ghasem Abadi RR, Mohammadi A, Moattar F. Development of a strategic plan through SWOT analysis to control traffic-borne air pollutants using CALINE4 model. International Journal of Human Capital in Urban Management. 2019; 4(2). doi: 10.22034/IJHCUM.2019.02.07
17. Moghadam R, Jozi S A, Hejazi R, et al. A strategic management plan for reducing air pollution using the SWOT Model: A case study of district 2 of Tehran Municipality. Anthropogenic Pollution. 2021; 5(2). doi: 10.22034/ap.2021.1928790.1105
18. Tanha F, Rangkooy H, Marzban M, et al. An Approach to the Control Management of Gaseous Pollutants Emissions from Power Plants Using Analytic Hierarchy Process (AHP). International Journal of Occupational Hygiene. 2015; 7(1): 27–31.
19. Zhang J, Wu WW, Wang CY. Air Route Selection for Beijing Capital International Airport Based on an Improved TOPSIS Method. IOP Conference Series: Earth and Environmental Science. 2018; 189(6): 062022. doi: 10.1088/1755-1315/189/6/062022
20. Ahmed AM, Zairi M, Almarri KS. SWOT analysis for Air China performance and its experience with quality. Benchmarking: An International Journal. 2006; 13(1/2): 160–173. doi: 10.1108/14635770610644655
21. Guzman J. The Port of Los Angeles: From Mudflat to World Port (Master’s thesis). World Maritime University, Shanghai, China; 2013.
22. Goswami A, Sen S. Geospatial Appraisal of Vegetation Health and Air Quality of Delhi During Pre-and Post-lockdown Phases Through a Multi-criteria Decision Model, in Temporal and Spatial Environmental Impact of the COVID-19 Pandemic. Springer; 2023. pp. 7–43.
23. Pandya J, Sarkar D, Kaul DS. Application of Fuzzy Factor Comparison Method for Evaluation of Key Performance Indicators Affecting Air Quality in India: A Decision Matrix Approach for Mitigating Anthropogenic Pollution Sources. Journal of The Institution of Engineers (India): Series A. 2024; 106(1): 175–193. doi: 10.1007/s40030-024-00856-8
24. Malik N, Singh V, Kumar K, et al. VOC source apportionment, reactivity, secondary transformations, and their prioritization using fuzzy-AHP method in a coal-mining city in India. Environmental Science and Pollution Research. 2024; 31(17): 25406-25423.
25. Kazemi Z, Kazemi Z, Jafari AJ, et al. Estimating the health impacts of exposure to Air pollutants and the evaluation of changes in their concentration using a linear model in Iran. Toxicology Reports. 2024; 12: 56–64. doi: 10.1016/j.toxrep.2023.12.006
26. Jaafarzadeh N, Nouhjah S, Shahbazian H, et al. The relationship between hot spots of air pollution and the incidence of gestational diabetes based on spatial analysis: A study on one of the most air-polluted metropolis of Iran. Environmental Health Engineering and Management. 2024; 11(1): 83–92. doi: 10.34172/ehem.2024.10
27. Salmabadi H, Saeedi M, Roy A, et al. Quantifying the contribution of Middle Eastern dust sources to PM10 levels in Ahvaz, Southwest Iran. Atmospheric Research. 2023; 295: 106993. doi: 10.1016/j.atmosres.2023.106993
28. Abadi RRBG, Mohammadi A, Moattar F. Development of a strategic plan through SWOT analysis to control traffic-borne air pollutants using CALINE4 model. International Journal of Human Capital in Urban Management. 2019; 4(2): 133–144. doi: 10.22034/IJHCUM.2019.02.07
29. Moghadam R, Jozi S A, Hejazi R, et al. A strategic management plan for reducing air pollution using the SWOT Model: A case study of district 2 of Tehran Municipality. Anthropogenic Pollution. 2021; 5(2):85–92. doi: 10.22034/ap.2021.1928790.1105
30. Prasetyawati ND, Tjiptowibisono S, Pranoto P, et al. Swot analysis of factors causing air pollution and recommended control efforts in the city of Yogyakarta, Indonesia. Environmental Health Engineering and Management. 2024; 11(1): 1–7. doi: 10.34172/ehem.2024.01
31. Mohammad-Beigi H, Nouri J, Liaghati H. Strategic analysis of bus rapid transit system in improvement of public transportation: Case of Tehran, Iran. Modern Applied Science. 2015; 9(9): 169. doi: 10.5539/mas.v9n9p169
32. Kebriaeezadeh S, Ghodduosi J, Alesheikh AA, et al. Presenting a Programme for Estrategical Managment to Control Air Pollution (Case Study: Isfahan). Environmental Researches. 2023; 14(27): 59–76. doi: 10.22034/eiap.2023.179288