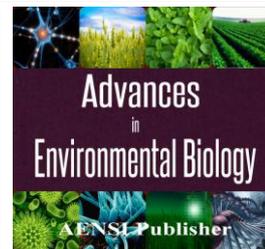




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Inappropriate Location Selection and Its Effects on Environmental Pollutions: A Case Study in Arak City, Iran

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ABSTRACT

Abstract: The aim of this study was to show natural environmental conditions, the ground's inequalities system, the air's immovability in most of the year's months, inversion conditions, extensive growth of industries in Arak industrial zone, lack of equipment for controlling pollution in industries, and other factors influencing environmental pollution in Arak city, Iran. The research design was practical regarding the purpose of the study and descriptive-analytical in nature. The results of this study showed that the features of geographical areas in Arak are likely to create the occurrence of inversion phenomenon and exacerbate pollution. Moreover, industrial units and companies have the most important role in the air pollution in Arak. Location selection in Arak city in the up-streams of the basin of Mighan desert and the farming lands in the north of Arak have made this closed ecologic zone sensitive and vulnerable ecologically.

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INTRODUCTION

Since the industrial revolution in the middle of eighteenth century, pollution has been mainly concerned about air pollution and the production of waste materials. In recent decades, special attention has been given to the issue of controlling pollutions caused by industrial units and companies at the national, regional and universal level [26]. Along with industrial development and technological changes in today's societies, environmental issues and problems have been exacerbated. Nowadays, the air, soil, food, and potable water are exposed to different kinds of pollutions in societies [24]. Seventy percent of people in the world are living in urban habitations. The highest amount of different kinds of pollution is caused by diverse urban activities [4]. Urban areas as population and economical activities centers have encountered high centralization of environmental contaminant units/companies. The citizen's health has been threatened seriously by these contaminants and pollutant. Some of those threats are cancerous diseases, respiratory diseases, and skin and optical allergies [3]. It's obvious that these air pollutants in urban areas increase the affliction to respiratory diseases remarkably.

Urban pollutants have affected ecology locally, regionally, nationally, and universally which range from urban pollution to acid rain and climatic changes all over the world [15]. Some of the chemicals produced by productive, industrial, and service workshops are odorless and invisible. The circulation of these materials in urban environments has enormous potential threats and dangers. Therefore, the application of these materials in workplaces requires the observance of environmental laws and sanitary and hygienic issues [12]. Stable urban development is a continuous process from diversity towards adaptability and compatibility which, on one hand, is concerned about the development/spread, extension of economical and social welfare of the present and future generations and on the other hand, the protection of environmental and human resources [7]. Increasing the knowledge and raising the awareness of urban planners and managers about different dimensions of development and administrative actions which lead to social ecological balance are the prelude to stable urban development [27].

Evaluating the city environment is the predicting process of assessing the effects of activities on the environment the results of which are used as managerial decision-making tools in managing public affairs [1]. Environment and economic development are closely related to each other. The goal of city environmental policy is improving environmental conditions through preventing damages to the environment. Although technology

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solves many problems, it brings up new problems itself. Solving these new problems requires complicated specialties and more expensive technology. As a result, much of human resources (money, resources, creativity, and energy) are spent for solving problems [11], while the goal of stability of city environment is that resources or city resources are preserved in some ways or at least remain the same [21]. Nowadays, the destruction of the environment influences the world's economic processes directly [17]. Each city's public affairs' managerial system requires investigating environmental effects of human activities [1].

Nowadays, urban organization seems inevitable and essential for combatting the abnormal process of urban development [16]. It will be possible to prevent environmental issues and problems only through appropriate location selection for land uses, regulating coordinated and adaptable land uses in space and separating opposite land uses from each other [19]. A lot of factors have an important role in air pollution in urban environments. The most important ones are pollution caused by transportation, industrial activities, and garbage burning. The deleterious effects of urban environmental pollution depend on the degree of toxicity and poisonousness of different pollutants and the number of people exposed to them [25]. Controlling the environment of humans requires taking appropriate actions and measurements about controlling air pollution, appropriate water quality, wastes management, and reducing acoustic pollution [23].

It needs to be mentioned that controlling and preventive pollution policies come into effect when factories and companies address these policies strictly in their plans and programs. In response to the exacerbation of air quality and urban environment, urban managers in developed and developing countries have started taking new actions regarding location selection of factories, the way of establishing industrial activities in urban areas, transportation, and so on [6].

The geographical status of Arak city studied in this research, the heights, the position of the city in a low amplitude area, having slow air in most seasons, the conditions of a high pressure center resulting from Siberia high pressure and its stretches over central parts in Iran, and the accumulation of industrial pollutants in the surface air of the region, inversion phenomenon, and the stability of air are all the most important factors in the pollution in Arak city.

Reverse heat or inversion shows the stability of the atmosphere in which the circulation or dispersion of pollution hardly occurs. This state usually happens at night in association with the natural reflection of the earth's surface in which the earth's surface is cold but the layers of high surfaces are warmer but the air in that layers cannot come into contact with the earth's surface.

The lack of wind intensifies inversion phenomenon [18] and if the inversion event is elongated by low amplitude and reaches the saturation point along with the increase in the air's relative humidity, the hazardous phenomenon of toxic cloud is likely to happen [14]. The inversion layer creates a stable, durable, and motionless or stationary barrier because of low amplitude and elongated period of time which hinders the integration of this layer with higher levels and air pollution is exacerbated and intensified by the increase in the density of pollutants [9].

Arak city plays an important role in exacerbating pollution by having at least 57% of annual still air current [8] and should be taken into account in the establishment of heavy industries [10].

Arak industrial city was founded 5 kilometers away from Arak city at its eastern side in the middle of 1960, decade (see Figure 1, Golbad city, Arak).

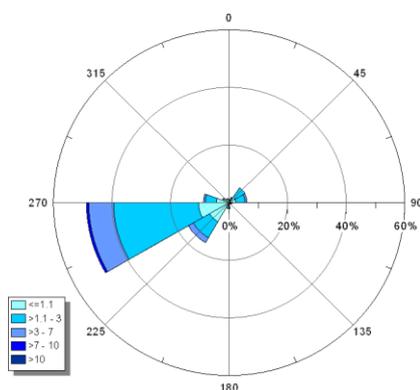


Fig. 1: Golbad 50 years old; Arak Synoptic station.

During the last four decades, these two complexes are merged due to the development of urbanization and industrial units and a lot of problems especially environmental ones have been arisen. Undoubtedly, many factors have been influential in this respect. The main objectives of this study are:

- Identifying the environmental conditions in Arak city and studying factors causing pollution
- Studying the geographical features and aspects influencing the exacerbation of pollution in Arak city

- Studying the industries and their effects on environmental pollutions in Arak city
- To achieve the objectives of the study, the following two substantial questions were raised:
- 1) Have the proper principles of location selection been applied in the Arak industrial city?
 - 2) Has the establishment of Arak industrial city had environmental effects on Arak city?

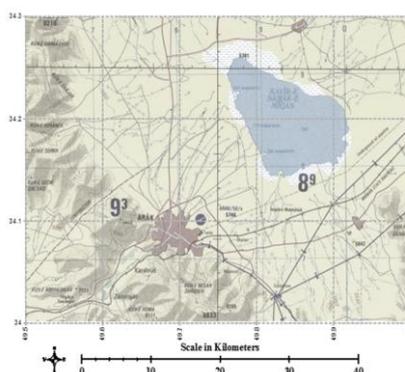
Scope Of The Study:

The central province as the industrial capital of Iran is almost at the center of Iran. Arak metropolis is the biggest city and the center of Central province in Iran. This province is situated in the south of Tehran, Alborz, and Ghazvin provinces and is about 29530 square kilometers. The presence of major industries in Arak and productive factories in Saveh city have made Arak province one of the industrial poles in Iran. The most important industrial factories include machinery, aluminum making, cable making, combine making, tire making, road making machinery, profile making, aluminum irrigation pipes making, agricultural instruments, and paint making factories besides petrochemical refinery and powerhouse. These industrial factories are mainly established in the industrial city near Arak and are not often equipped with instruments for controlling environmental pollution.

Geographical Features And Their Effects On The Environment In Arak City:

The location of Arak industrial city was selected in the middle of 1980s decade. It is located 5 kilometers away from Arak in its eastern side. It has two sections, the residential and productive sections. The residential area was established with 150 hectare space for a population of 15000. The productive area has 10 large industrial units and 10000 employees with 528 hectare space with 4 kilometers long alongside Arak-Ghom road (The extension and renovation organization of industries in Iran, 1974). Now, there are over 400 industrial units of major and minor factories which are developed in a limited area and it spreaded into Arak city. The area's topography have made Arak's foothills morphology.

The elevated areas in Arak city are located in southern parts and the earth's slope decreases from the south to the north uniformly. Southern heights of Arak city are deterrent factors for the air mobility and the area's wind (see Arak city map) so that the percentage of still and slow air is 57% in the spring and 62 to 70 % in other seasons (Map 1 shows the topography in Arak area).



Map 1: Arak city and area; the heights are determined in dark color.

Studies about Arak wind show that the annual current of slow air in Ark area makes 5.64% of the total observations which plays an important part in intensifying and exacerbating air pollution. This should be considered in the establishment of heavy industries. Slow air, as it is expected, happens less in the spring but it surpasses 60% in other seasons and reaches 70% in the winter (see Table 1).

Table 1: Annual current of slow air in Ark area.

Season	The dominant wind direction	The percentage of the dominant wind	The percentage of slow air
Spring	Southwest	17/5	57
Summer	northeast	11/5	62
Autumn	southwest	12/5	69
Winter	southwest	12	70

Source: Arak city Meteorology Station 2012

Environmental effects arising from arak city:

Environmental pollution is the result of industries based on the principle of gradual adaptation to the environment since industrial instruments that are bought from industrial countries are always equipped with installations for controlling environmental pollution, while such equipment are rarely used in Iran [20]. From the

late 70s decade (B.C.) to 2011, about 400 major and minor industrial units have been established within Arak industrial city. Most of these industries have the potential to pollute the environment. The pollution caused by these industries is the result of fuel consumption and production process.

Arak industrial zone which is among industrial poles is one of the polluted cities in Iran which is affected by gas, particle, and alight pollutants, and vast industries and the congestion of means of transportation. According to the researches, in general 91% of the pollutants present in the air in Arak are gas and the other 9% are particles such as copper, Zink, and aluminum, but the hazard of this little amount is much more than the hazard of gas.

Based on the researches, the degree of the produced pollution from different sources of pollutants in Arak at the present time is shown in Table 2. Table 2 shows the share of each of the triple groups of air pollutant sources in Arak in percentage.

Table 2: Share of each of the triple groups of air pollutant sources in Arak in percentage.

Pollutant Sources	PB	So2	NOX	H.C	Co	Sp
Means of transportation	100	0.005	0.01	3	2	1/34
Industries	-	99.97	96.84	97.95	96.96	98/59
Sources of household heating	-	0.03	0.05	0.05	0.04	0.07
Total	100	100	100	100	100	100

Source: Studying environmental issues in Central Province, 2011.

According to the report by the information and statistics unit of the national company of the distribution of oil products in Arak, 427471 cubic meters of kerosene, 14001667 cubic meters of nitrogen, 37904474 cubic meters of gas oil, 182814 cubic meters of derivative fuel, 3188324 cubic meters of natural gas are distributed in Arak city (The information and statistics unit of the national company of the distribution of oil products, 2011). Based on the standard tables which show the degree of pollutants from the combustion of 1000 liters gas, gasoline, kerosene, and mazot in kilogram [18], the amount of pollutants in Arak city is estimated as in Table 3.

Table 3: Pollutants from fuel consumption in Arak industries.

Kind of fuel	Amount in cubic meter	Pollutants				
		Particles	H>C	NOX	so	co
Kerosene	427471	0.59	0.14	0.63	1.078	0.24
Mazot	14001667	37.3	5.8	97.3	6.8	42.2
Gasoline	37904474	60.4	162.7	16500	1100	930
Derivative fuel	182814	0.39	0.74	10.5	4.06	5.8
Natural gas	3188324	-	-	9850	-	857
Total		98.68	169.3	26458	1111.9	1835.2

Source: Obtained by the researcher

As it can be seen, the industries in Arak comprise about 91% of air pollution and it is very high based on tonnage of pollution. It has to be mentioned that the amount of annual tonnage of CO₂ is about 400000 ton and this shows that a huge amount of air pollution is centralized in a small city. According to the statistics issued by the municipality of Arak, the amount of pollution from transportation systems is more than the standard level in this city and the amount of CO₂ in industrial areas is much higher than the standard level due to using fossil fuels that contain sulfur. In addition, the rapid growth of population in recent years has intensified pollution in Arak city.

Conclusion:

The geographical situation in Arak, heights in the southern parts of the city is deterrent factors to the movability of the air, and winds of the area. The annual current of still and slow air reaches 57% in the spring and 70% in other seasons. Inversion indicates the stability of the atmosphere and the dispersion of pollution hardly occurs in it. Over 400 major and minor industrial units exist in a small area and most of them lack the equipment and installations for controlling pollution.

The research questions can be answered in the following way:

1) Have the proper principles of location selection been applied in the Arak industrial city?

Regarding the point that the industrial city is 5 kilometers away from Arak city and the aforementioned geographical conditions, and the amount of pollutants from industries in Arak addressed in this study, it is concluded that national goals had priority to local and regional goals and benefits.

2) Has the establishment of Arak industrial city had environmental effects on Arak city?

Regarding the fact that Arak industrial city was established without considering the physical and human capacity and the development of the city, therefore, the location selected for the industrial city has caused

pollution and has exacerbated environmental problems in Arak city. The aluminum making factory has made the highest pollution in the city. In addition, the position of the industrial city in the upstream of Mighan desert has made severe environmental problems in farming lands and the basin of Mighan watercourse so that the basin of Mighan desert and the farming lands in the north of Arak have made this closed ecological basin seriously sensitive and vulnerable ecologically.

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