



## Introducing the causes, origins and effects of dust in Iran

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### ABSTRACT:

This study provides an overview of the cause, source, origin and effects of dust storms. Desertification and climate change are the most important environmental challenges in arid regions of the world, and their effects, including air pollution, affect people all over the world. Although air pollution is a harmful and pathogenic phenomenon for all people and at all ages, a wide range of people, including the elderly, pregnant women, children and the sick, are more vulnerable. Dust is one of the environmental problems that ultimately causes respiratory and skin diseases in humans. Iran is also one of the countries in the arid and semi-arid region, which is surrounded by dust storms. The internal source of dust storms includes southwest, east and central Iran. In general, there are two approaches to environmental change. The first approach is to ignore these changes and continue the current situation, which will only result in more environmental degradation. Another approach is to identify these changes from the past to the present and to develop an environmental management program to control these changes and to plan to improve the environmental situation.

### Review

Today, climate change has become one of the most important challenges on earth. Phenomena such as widespread droughts, devastating floods, fires, as well as large-scale dust are part of the consequences of climate change. Reducing the rate of dispersion and change in precipitation distribution patterns in parallel with over-harvesting of water resources, drying up of wetlands, deforestation, conversion of orchards into residential areas, abandonment of agricultural lands and general extensive land use changes Lands without regard to land potentials have led to many problems in the country, one of which is the phenomenon of dust [1, 2]. According to the World Meteorological Organization, if the wind speed

exceeds 15 m/s at the meteorological station and the horizontal visibility reaches less than 1 km, a dust storm will be reported. Sandstorms are winds that can move particles with a diameter of 0.15 to 0.30 mm to a height of 15 m. While dust storms are made up of tiny particles 0.5 to 0.1 mm in diameter, they move much higher than the earth's surface and cover long distances that can cover a country's cities. Or even countries on a continent [3].

Dust storms, as one of the most common natural disasters of the last century, have many positive and negative effects on ecosystems. These storms increase the fertility and growth of phytoplankton by increasing the amount of soil nutrients in sedimentation areas and oceans, and by reducing the

amount of radiation, affect the growth and yield of vegetation and cause the spread of disease. There are different types of human societies [4, 5]. Dust storms are climatic phenomena that affect other climatic parameters and have several effects. Dust storms always affect different parts of the globe, including Africa, West Asia, China, and Australia. At least four decades ago, several hurricanes were reported each year in Iran and other countries in the region, causing dust and even shifting sands in vulnerable areas. Dust is one of the atmospheric phenomena that has adverse effects on the environment [6, 7]. Dust storms have a detrimental effect on the health and economy of the community and climate change. Understanding the nature, origin, and effects of sandstorms and dust storms plays an important role in determining how to control them. Dust storms are a meteorological phenomenon that usually occurs in arid and semi-arid regions and its various effects and damages are not hidden from anyone [8]. Dust and dust rising from the earth's surface in the air contain a variety of chemicals and chemicals that can have a variety of effects on humans and the environment. In recent years, the occurrence and occurrence of dust storms and the entry of fine dust into the country have seriously endangered the western, southern, southeastern and southwestern provinces, and damaged and damaged various parts of the country has done [9].

In the short term, this phenomenon has been able to have adverse effects on the environment, economy and health of the residents of 17 provinces of the country, especially border cities such as Ahvaz and Kermanshah. Of course, currently 22 provinces of the country with different intensities and weaknesses are affected by the dust and storms caused by it. Iran has also suffered irreparable damage in terms of dust due to regional co-

ordinates, hot and dry climates, as well as being on the world's desert belt. What exacerbates the crisis is the misguided planning of regional governments, including Turkey, Iraq, Saudi Arabia, and even Iran itself, for the unregulated extraction of surface water and the non-compliance with low water rights. Hands and wetlands, as well as unplanned and unprofitable land use change, as well as the destruction of more and more vegetation in the region, lead to positive feedback on the effects of climate change in the region. According to the Environmental Protection Agency, 70 points have so far been identified as crisis points in Iraq, Syria, Jordan and parts of Africa, of which 14 points are considered the main points of crisis. Of course, in the meantime, we should not forget the active sand dunes present in the two great deserts of the Arabian Peninsula, namely Rab Al-Khali and Al-Najd Desert [10-12].

### ***Source and origin***

The most important and most valuable asset of any country is the soil of that country. Unfortunately, in our country, billions of tons of valuable and irreparable soil are eroded every year by harmful storms, and by accumulating in different areas, they become a threat to production areas and investment in potential areas, or are washed away by runoff. They are deposited in the reservoirs of the dams. The soil is moved by the wind, which, depending on the size of the particles, moves in one of three ways: suspension, purchase, and mutation. Suspension is the movement of many particles that often do not exceed 0.1  $\mu\text{m}$  in diameter. After being lifted by the wind, these particles can remain suspended for a long time with the help of turbulence and rotational currents. Dust is a surface process that occurs seasonally in all deserts and deserts of the world, including the deserts of Africa, Saudi Arabia, and

southern Iran, especially during the warmer seasons. Dust is the result of wind erosion and the movement of quicksand, and various factors play a role in creating and exacerbating it. It is necessary to control wind erosion and thus reduce dust storms, which is the basic principle in controlling erosion [6, 10]. The main source of dust is mainly in neighboring countries. These countries include Iraq, Syria and Saudi Arabia, respectively. Drought, land degradation due to regional wars, dams on existing rivers, non-productive cultivation, and declining vegetation in the region have been the main causes of dust in recent years. Solutions such as mulching have been proposed by the governments involved to address this issue, but recent studies have shown that these desertification measures have little effect on reducing this phenomenon, as studies show that the source the fine dust is not sandy but has a sedimentary and wetland origin. Therefore, one of the ways to fight against it is to rehabilitate the dried up wetlands in the neighboring countries of Iran [7, 9]. Drought, destruction of land in regional wars, construction of dams on rivers, non-productive cultivation and reduction of vegetation in the region are the five main reasons for the formation of the dust phenomenon. When a region is exposed to low rainfall over a period of time and is used incorrectly and improperly, and in fact the activities on these lands are carried out without an attitude towards sustainable development, that part of the land is damaged and unstable. Some of these factors can be interpreted as follows. Of course, not only the country and the people of the Islamic Republic of Iran are affected by these unfavorable conditions, but other countries in the region, especially Syria and Iraq, are also affected by these storms in more difficult conditions. In the region, which includes Iran, two or three long-term droughts have occurred in the last 50

years. Also, the Iraqi military invasions of Iran, the war between Iraq and Kuwait, and then the US military invasion of Iraq, have turned the region's lands into a sensitive ecosystem, because with the start of the war, the region will become a hotbed of military equipment. In fact, it is plowed with cannons and tanks, which has disrupted the ecosystem of the prone area.

The construction of a dam along the rivers of the region, such as the dam created on the Tigris and Euphrates rivers, has disrupted the soil texture and subsequently caused dust. After the construction of the dam, the riverbed was out of normal condition, and in fact the water area of the river was reduced, and as a result, the humidity of the environment was reduced. After the dampness of the river decreased due to the construction of the dam, the wet land was turned into a dry land with dust and dirt. Decreased soil moisture and soil erosion due to intense sunlight is another important reason. Iraq is an alluvial region, and the entire Iraqi plain is covered by river sediments, making Mesopotamia the best area for farming, but with declining water and humidity, followed by declining vegetation and the movement of weapons such as tanks. Lands, stable deserts have been plowed. After the desert was damaged in these areas, followed by intense sunlight, low rainfall and strong winds, the sedimentary soil was gradually released and the physical texture of the soil was worn out. If the soil is worn out and its physical texture is disturbed, as well as the lack of vegetation, if until recently the soil particles in it were separated from the ground by the wind at a speed of 15 m/s, then this physiological change by the wind at a speed of 6 to at 7 m/s, a huge volume of soil particles rises from the ground.

### **Southwest of Iran**

The increase in dust in recent years in the south-

west of the country has been the result of drought and the unfavorable use of natural resources in the country and neighboring countries, which has caused habitats and desert areas in these countries, are not protected and have reached the level of wind erosion. This phenomenon is becoming more and more widespread. Low rainfalls in the southern and southwestern regions, dryness and dehydration of wetlands and reservoirs, non-greening of desert plants and as a result of strong winds, have increased dust in these areas [13, 14]. Numerous large and nomadic plains located in this region of the country are mainly covered with alluvial deposits and fine sediments of Karkheh, Karun, Dez, Jarahi and Hindijan rivers and their tributaries, which is a suitable bed for becoming the center of wind erosion and dust is considered. In addition, the presence of wind-blown sediments, sand dunes and sand dunes in different parts of the country from northwestern Karkheh to around Ahvaz aggravate the phenomenon of fine dust. The city of Ahvaz, as the capital of Khuzestan province, with its large industries, plays a major role in increasing air pollution. In the last few years, dust has increased in the city and has repeatedly exceeded the status of quantity and air quality. The results of surveys and interviews with relevant experts show that the drying up of swamps and wetlands in southwestern Iran and southeastern Iraq, a sharp decrease in vegetation, cutting down most trees, especially palm trees during the war. The imposition of a significant reduction in the flow of water from the Tigris and Euphrates rivers and the rerouting of these rivers, the significant pressure difference and pressure between Iraq and northern Saudi Arabia are important factors in the intensification of dust in the region. In other studies, three main sources of dust in Khuzestan province have been reported, one is the destruction of vegetation and

the drying up of wetlands in Khuzestan province, Iraq, as well as the Saudi desert, and the other is the untapped withdrawal of water from the river watershed. Leading to this plain, including Karun, Dez and Karkheh in Iran, as well as the Tigris and Euphrates in Iraq and the phenomenon of climate change [15-17].

### ***Southeast Iran***

Due to its geographical location, Sistan region has a dry and unfavorable climate, and sandstorms and the movement of sand dunes are among the threatening factors. In recent years, the complete drying of the bed of Hamoon Wetland and its conversion of 450,000 ha into sand and dust production centers has caused the removal and transportation of a large volume of wind sediments from the bottom of the wetland, which is the source of all kinds of damage. And economic damage has been done in the region as well as in rural areas. Sistan and Baluchestan province is one of the areas that witness the phenomenon of dust in its territory every year. The process of researching and analyzing data in the form of non-parametric methods used showed that the rate of increasing trend in the dust series varies in the eastern and western halves of the province. If the dust passage to the province is from neighboring countries in the east, the amount of dust in the east of the province is higher than in the west, but the results of the analysis of monthly, seasonal and annual trends showed that the eastern half of the province, especially the station. Khash and Saravan do not have a significant trend in their dust series; instead the western half has a significant trend in most seasons. According to studies by the World Meteorological Organization, winds with a speed of more than 15 m/s are known as storms. With the onset of drought and dust storms in Sistan and Baluchestan province, it is obvious that dust is causing a lot of damage to society ev-

ery year. On average, dust days in July and January had the highest and lowest average monthly dust days, respectively. In general, in the stations of Sistan and Baluchestan province, Zabol station with an annual average of 156.87 days/year, had the most dust days and Rask station with 12.66 days/year had the lowest dust days. In terms of frequency of drought, Iranshahr, Zahedan, Zabol, Saravan and Zahak stations had the highest frequency. In all the stations studied, 2008 had the dustiest days and 2011 had the lowest dust days. In terms of statistical comparison in the province, in 2008 there was a severe drought and in 2011 in some stations it was scary. And in others, normal drought has occurred. As a result, it can be concluded that the number of dusty days is directly related to the drought phenomenon. The main source of dust in southeastern Iran, which is more intense in Sistan and Baluchestan province and its scope extends to the provinces of South Khorasan, Khorasan Razavi, Kerman, Yazd, is the phenomenon of local seasonal winds of 120 days. It starts from the Indian Ocean and after passing through Pakistan and Afghanistan in the southeastern region of Iran due to drought and lack of moisture in the soil with very strong dust [18- 20].

### **Central regions of Iran**

In recent years, the uncontrolled extraction of groundwater resources and extensive watershed management and watershed management operations in some watersheds have led to major changes in water rights and the status of downstream ecosystems. The frequency of dust storms in Iran reaches its maximum in central holes such as Lut plain and Kavir plain and eastern holes. In the region between Zahedan and Kerman, the number of days of dust storms reaches 150 days a year. The maximum location of these storms occurs in dry areas without vegetation and in terms

of time distribution in August. Different synoptic patterns of dust storms persist in the warm seasons and months of the year in Qom province and even the country with high pressure of the tropics at the upper atmosphere and low thermal pressure at the ground and lower atmosphere. However, high pressure along the tropics causes global air subsidence and overheating of the upper layers, which naturally causes air stability. But the constant movement of atmospheric waves in the form of gusts (ridges) and ridges (ridges) sometimes facilitates the upper levels for the whole ascent of the air, which means the reduction of the high-pressure effect next to the tropics and the fall of cold at the upper levels. In such conditions, with instability throughout the air, westerly and southwest winds spread throughout the day and night, and if there is enough moisture, it may even lead to very deep cumulonimbus clouds in the summer months, usually to summer floods. However, in the absence of moisture, these conditions are conducive to the formation of dust storms, especially in the Iraqi desert, and taking into account the general currents of the atmosphere from west to east in temperate regions located in the geographical latitudes of 30 to 60 degrees north of the plateau and the weakening of the high pressure range on the Iranian plateau provides a gradual movement of dust mass from west to east. Especially during the day, due to the low depth of thermal pressure on the Iranian plateau and its spread on Iraq, these currents are strengthened and with them in the study area reduce the parameters of pressure, visibility and sunny hours on dusty days return [21, 22].

### **Dust days of Iran**

The number of dusty days in Iran is directly related to temperature and inversely related to rainy days. This means that the dust phenome-

non is specific to the hot and low rainfall regions of Iran. On the other hand, the number of dusty days in Iran shows that the number of dusty days increases in the warm and low rainfall months. East Iran in June is due to the scattered monsoon season. In addition, wind is effective in creating dust and there is a direct relationship between the number of dust days and wind. The average dust days in Iran are 35 days a year, while the dustiest days in the country are in the center and east of Iran. Also, in the southwestern and western regions of the country, the average daily dust days are significant. In August, it is more than other months of the year, but in recent years this rate has increased significantly [23].

### ***Problems and effects***

Desertification and climate change are the most important environmental challenges in arid regions of the world, and their effects, including air pollution, affect people all over the world. Although air pollution is a harmful and pathogenic phenomenon for all people and at all ages, a wide range of people, including the elderly, pregnant women, children and the sick, are more vulnerable. Most air pollution is related to the respiratory system and lungs, the immune system, the heart, and the visual system. Every year, more and more people around the world die from air pollution due to traffic accidents. Air pollution caused by particulate matter can lead to diseases such as irritated asthma, bronchitis, heart and lung diseases, and respiratory allergies. There have been many studies around the world on the effects of dust. Pulmonary, ocular, skin, and heart problems are common diseases in areas affected by particulate matter. Reducing vision impairment and the occurrence of plane crashes are another part of its effects. Increasing the concentration of fine dust on plant surfaces can reduce plant photosynthesis

and reduce crop yields and thus economic losses. Also, fine dust causes a lot of economic damage, including reduced visibility on roads, severe erosion of buildings and industrial facilities, disruption of land and air travel, reduced crop yields due to dust cover on the surfaces of edible plants and excellent plants and agricultural lands. It will have social consequences, such as increased immigration. As a result of this phenomenon, the field of travel and normal activities of the people has become narrow. Sometimes the radius of vision is less than 10 m, and schools and even offices have been closed many times. This phenomenon has overshadowed the lives of millions of residents of the country's most important agricultural, industrial and oil hubs, and in addition to making people's daily lives difficult, they have made many economic, production and service activities and projects difficult. Dust also causes adverse environmental effects on natural resources (water resources, forests and pastures), wildlife, desert and ecosystems, and can also have negative effects on human health, agriculture, industry, social and economic issues, health, air quality, crops, railways, snowmelt and seas with red tides, the main damage in the field of damage to infrastructure facilities including electricity and telecommunications networks, spaces Urban and rural and damages to residential, agricultural and livestock units.

### **Conclusion**

In general, there are two approaches to environmental change. The first approach is to ignore these changes and continue the current situation, which will only result in more environmental degradation. Another approach is to identify these changes from the past to the present and to develop an environmental management program to control these changes and to plan to improve

the environmental situation. Wetlands, while having a high potential for food storage and food cycle for early producers, are unable to withstand shocks and pressures due to stagnation and stagnation, and are rapidly declining. Therefore, the smallest disturbance disturbs this balance and causes the destruction of the wetland. Examining the potential of wetlands and determining the design in their margins helps us to know what important issues are involved in the ecosystem of a wetland area and the lack of coordination of a project in the margins of the wetland has serious consequences for a wetland area. In the meantime, the environmental organization has a major role to play. Improving monitoring of environmental warnings and installation of necessary equipment in the provinces, implementation of the program of rehabilitation of wetlands in the wetlands in the provinces affected by the phenomenon of dust, monitoring and warning of the situation of dust, announcing the situation Air quality, the provision of support services and the required items in the provinces affected by the dust phenomenon are among the tasks of the Environmental Organization. Also, holding expert meetings with the presence of esteemed members of the Islamic Consultative Assembly, the Research Center of the Assembly and the Government Infrastructure Affairs Commission, negotiating and coordinating with representatives of international organizations based in the Islamic Republic of Iran to use scientific ability and Technical and credit, collection and analysis of regular and continuous satellite images related to the phenomenon of dust from all reputable global centers, data collection and analysis of air pollution measurement network and environmental conditions in the country and the region, Preparation and analysis of meteorological maps at different atmospheric levels to predict the time

of occurrence of dust phenomenon, implementation Analysis of atmospheric particulate matter emission models for dust routing, monitoring of water resources management and land use in the affected provinces, field visits to countries in the region and compliance with maps and station information Models and models with the conditions of the region, preparation of health instructions and notification to the affected provinces by the Ministry of Health, Treatment and Medical Education, creation of a national dust portal, follow-up of relevant matters to present new plans by the department Private, universities and research centers on the discussion of desertification and biological mulching, conducting field visits by the Secretary The National Dust Committee of biological mulching projects in two regions of the country, which has been piloted by the Ministry of Jihad Agriculture, has set up a temporary secretariat in Tehran to coordinate the countries of the region to transfer scientific and technical experience. Pursuing the implementation of contract approvals by the temporary regional secretariat until the final result, preparing a report on the damage caused by the dust phenomenon, providing part of the damage to farmers and beekeepers in coordination with the country's Crisis Management Organization and the Ministry of Jihad Agriculture, coordination with the Ministry of Interior In order to increase the amount of green space around the cities. Even the effect of the phenomenon (through the governorate), the provision of health services during the occurrence by the Ministry of Health, Treatment and Medical Education, the updating of modeling and forecasting software by the Meteorological Organization to timely announce the occurrence of dust, follow-up It is necessary to equip the airports of the provinces involved in the phenomenon of dust in order to perform flights during the

occurrence of the dust phenomenon, increase the level of protected areas by the Ministry of Jihad Agriculture and Environmental Protection Organization in order to prevent land use changes and desert.

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The authors declare that there are no competing interests.

### Ethical considerations

Ethical issues have been completely observed by the authors.

### References

- Velayatzadeh M, Emami SD. Investigating the effect of vegetation on the absorption of carbon dioxide (Case study: Yadavaran oil field, Iran). *Journal of Air Pollution and Health*. 2019; 4(3): 147-154.
- Eslami A, Ghasemi SM. Determination of the best interpolation method in estimating the concentration of environmental air pollutants in Tehran city in 2015. *Journal of Air Pollution and Health*. 2018; 3(4): 187-198.
- WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS WAS), Science and Implementation Plan 2011-2015, Research Department. Atmospheric Research and Environment Branch. WMO. 2012.
- Chun Y, Boo KO, Kim J, Park SU, Lee M. Synopsis, transport, and physical characteristics of Asian dust in Korea. *Journal of Geophysical Research: Atmospheres*. 2001; 106(D16):18461-9.
- Cao J, Shen Z, Chow JC, Qi G, Watson JG. Seasonal variations and sources of mass and chemical composition for PM10 aerosol in Hangzhou, China. *Particuology*. 2009; 7 (3): 161-168.
- Nazari S, Kermani M, Fazlzadeh M, Alizadeh-Matboo S, Yari AR. The origins and sources of dust particles, their effects on environment and health and control strategies: A review. *Journal of Air Pollution and Health*. 2016; 1(2): 137-152.
- Hassan EM, Fatahi E, Khan M K, Noori F. The effect of wind direction on dust transfer toward the Persian Gulf. *Journal of Air Pollution and Health*. 2019; 4(1): 33-52.
- Shao Y, Dong CH. A review on East Asian Dust storm Climate, Modeling and monitoring. *Global and Planetary Change*. 2006; 52(1-4): 1-22.
- Farahani VJ, Arhami M. Contribution of Iraqi and Syrian dust storms on particulate matter concentration during a dust storm episode in receptor cities: Case study of Tehran. *Atmospheric Environment*. 2019; 117163.
- Soleimani M, Amini N. Source identification and apportionment of air pollutants in Iran. *Journal of Air Pollution and Health*. 2017; 2 (1): 57-72.
- Cao H, Liu J, Wang G, Yang G, Luo L. Identification of sand and dust storm source areas in Iran. *Journal of Arid Land*. 2015; 7(5): 567-578.
- Givehchi R, Arhami M, Tajrishy M. Contribution of the Middle Eastern dust source areas to PM10 levels in urban receptors: case study of Tehran, Iran. *Atmospheric Environment*. 2013; 75: 287-295.
- Kamal A, Wu C, Lin Z. Inter annual variations of dust activity in western Iran and their possible mechanisms. *Big Earth Data*. 2019 Nov 13: 1-6; DOI:10.1080/20964471.2019.1685825
- Bolorani AD, Nabavi SO, Bahrami HA, Mirzapour F, Kavosi M, Abasi E, et al. Investigation of dust storms entering Western Iran using remotely sensed data and synoptic analysis. *Journal of Environmental Health Science and Engineering*. 2014; 12(1): 124.
- Najafi MS, Sarraf BS, Zarrin A, Rasouli AA. Climatology of atmospheric circulation patterns of Arabian dust in western Iran. *Environmental Monitoring and Assessment*. 2017; 189 (9): 473.
- Javadian M, Behrang A, Sorooshian A. Impact of drought on dust storms: case study over Southwest Iran. *Environmental Research Letters*. 2019; 14: 124029.
- Bolorani A D, Nabavi SO, Azizi R, Bahrami HA. Characterization of Dust Storm Sources in Western Iran Using a Synthetic Approach. *Advances in Meteorology, Climatology and Atmospheric Physics*. 2013. 415-420.
- Alizadeh-Choobari O, Zawar-Reza P, Sturman A. The wind of 120 days and dust storm activity over the Sistan Basin. *Atmospheric Research*. 2014; 143: 328-341.
- Rashki A, Kaskaoutis DG, Rautenbach CW, Eriksson PG, Qiang M, Gupta P. Dust storms and their horizontal dust loading in the Sistan region, Iran. *Aeolian Research*. 2012; 5: 51-62.
- Rashki A, Eriksson PG, Rautenbach CD, Kaskaoutis DG, Grote W, Dykstra J. Assessment of chemical and mineralogical characteristics of airborne dust in the Sistan region, Iran. *Chemosphere*. 2013; 90(2): 227-236.
- Cao H, Liu J, Wang G, Yang G, Luo L. Identification of sand and dust storm source areas in Iran. *Journal of Arid Land*. 2015; 7 (5): 567-578.
- Khazaei M, Darejeh M, Beigi AM, Fahiminia M, Azizifar M, Karami Gh, et al. Patterns of annual fluctuation of dust concentrations along with meteorological parameters: A case study in Qom province, central Iran. *Journal of Air Pollution and Health*. 2016; 1(2): 99-110.
- <https://data.irimo.ir>