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## REVIEW ARTICLE

# Dust and its Environmental challenges and risks

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### ABSTRACT

*The aim of this study was to analyze the dust and its consequences in Iran. This research was performed using a survey methodology (documentation-library) and the results showed that it is the biggest environmental problems. Causes of the formation of dust in Iran are successive wars, disruption of physical texture of the soil, construction of dams on the Tigris and Euphrates River, moisture loss of land and erosion of soil particles due to the severe sun radiation. Deforestation and destruction of grasslands and destroying crops and starting periods of prolonged drought can increase the risk of this phenomenon. Dust storms as one of the most common natural disasters of the last century have numerous positive and negative effects on the ecosystems. These storms by increasing the amounts of soil nutrients in the sedimentation areas and oceans increase productivity and phytoplankton growth, and by reducing the amount of radiation affect increased growth and performance of vegetation and cause outbreaks various diseases among human societies. Dust with deposition on plant tissues and also reducing the amount of light hitting them has much impact on crop yields. Planting sapling and natural species drought-resistant plants such as Haloxylon, tamarisk, Calligonum, Mesquite, cow tail, acacia, Garadagh, Panicum, eucalyptus, ethereaplex, cactus, Zygophyllum, Peganum as well as creating barriers and building live and artificial wind breaker on hills that prevent the destructive power of the winds are some dust reduction strategies in current conditions. Many soil conservation experts also believe that to control wind erosion on farms, in addition to operating windbreakers such as strip cropping, covering soil by crop residues, crop rotation, minimal tillage, and removal of loosening hunk should be taken into account.*

**Keywords:** dust, dust storm, environmental degradation

Received 17/12/2016

Revised 10/06/2017

Accepted 28/07/2017

### How to cite this article:

Mohammad Reza Sheykh Rabiee. Dust and its Environmental challenges and risks. Adv. Biores., Vol 8 [5] September 2017: 12-17.

### INTRODUCTION

According to the definition of Meteorological Agency if the wind speed exceeds 15 meters per second and horizontal visibility reach less than a kilometer due to dust, dust storm is reported [7]. In recent years the phenomenon of dust or in other words dust storms has become one of the major problems of the country that in addition to reducing the air quality has an impact on health society [6]. Phenomenon of dust is one of the most important natural dangers that has influenced West and South West of Iran during the last few years, and other than many social and economic problems, has jeopardized people's health [8, 10, 22].

Some researchers believe that climate changes play an important role on the regional dust storms. They also showed that high temperature, low rainfall, poor vegetation cover and high speed of wind provide favorable conditions for the occurrence of dust storms [21]. Dust phenomenon is the biggest environmental problem. Deforestation and destruction of grasslands and destroying crops and starting periods of prolonged drought, can increase the risk of this phenomenon [8]. Since factors such as desertification and extreme fluctuations in climate and weather events (such as floods, droughts and dust) threaten human life and other living organisms in earth planet, they should be seen as an immediate security threat. Environmental crisis greatly depends on improvement of diplomatic relations and decrease of security concerns [16]. The recent droughts in southern and central regions of Iraq, and western and northern areas of Saudi Arabia have caused drying up marshes and on the other side, Iraq's eight-year war against Iran has resulted in destruction of palm groves of Abadan and Khorramshahr in Iran and Basra in Iraq (15 million date palms). [13]. These palms with the role of wind breaker and cause

the deposition of suspended particles and like a dust filter reduce the amount of arisen dust originated from Saudi Arabia and the neutral Arabic zone, unfortunately, have been gone. So in any area where the soil is dry and the wind speed reaches threshold, soil particles are lifted and suspended in the air. Therefore, the lack of rainfall causes reduced soil moisture, increased erosion and the movement of it. So, whatever the rainfall is less followed by lower moisture, storm frequency increases. Increased storm reduces visibility [10, 22]. The visibility due to dust storms is indirectly dependent on the parameters that are involved in lifting soil particles. So by having the effective parameters such as rainfall, humidity, temperature and wind velocity we can determine visibility power that is characteristic of the intensity of the storm. On the other hand, because the relationship between these parameters and the frequency of dust storms, as much as in a weather station more parameters have had dependance with the visibility caused by dust storms, the origin distance is closer [12, 17, 19].

The occurrence of dust storms has a close relationship with local climatic conditions like rainfall, temperature and surface features such as vegetation, snow cover on the ground and soil texture [18]. The high air temperature, low rainfall, poor vegetation cover and high speed of wind provide favorable conditions for the occurrence of dust storms and there is a relationship between these parameters and the occurrence of dust storms and by inspection of environmental and climate conditions, being local or regional of the storm can be pointed out. Since the opinions of the experts and officials of different organizations in the fight against dust are different, using a method that would enable us in choosing the best criteria and alternatives to deal with dust will be essential [8]. This research that has been done using a survey methodology (documentation-library) while explaining the mechanism of occurrence of dust in the country and its consequences aims to suggest strategies to prevent dust consequences on the basis of conducted studies.

#### **CAUSES FORMATION OF DUST IN IRAN**

Some of these factors can be interpreted as follows:

##### 1. successive wars and disruption of soil physical texture:

In a region where Iran is also placed in it, in recent 50 years there have been three cases of prolonged droughts; also the invasion of Iraq to Iran, the war between Iraq and Kuwait and then America military invasion to Iraq, have become lands of the area into a sensitive ecosystem because with the beginning of the war, the area becomes an arena for military equipment and indeed it was plowed by tanks and artileries causing the disturbance of the ecosystem vulnerable to damage.

##### 2-Construction of dams on the Tigris and Euphrates rivers as one of the main reasons of the formation of dust:

Construction of dams on the rivers of the area such as dam built on Tigris and Euphrates river has caused disturbance of soil texture followed by the occurrence of dust. After the construction of dam, the river bed was out of the ordinary conditions and indeed water area of the river fell and then humidity of the surrounding decreased. After moisture loss of rivers due to the construction of dam, wetlands were turned to dry land along with dust and dirt.

##### 3-Decrease of land moisture and erosion of soil particles due to the severe sunlight:

Iraq is a part of alluvial areas and whole Iraq plain has been covered by river sediments that has become Mesopotamia as the best area for cultivation, but by reducing water and moisture followed by reducing vegetation and traffic of military equipment such as tanks in this land, stable Desert has been plowed. After damage to the desert in these regions, followed by intense solar radiation, low rainfall and severe winds, sediment soil gradually releases and the physical texture of the soil is exhausted. With soil erosion and disruption of its physical structure and lack of vegetation, soil particles in it if not so long ago lifted by the wind with a speed of 15 meters per second, after these physiological changes, by wind at 6 to 7 meters per second, large amounts of soil particles are lifted. Main centers of the formation of dust phenomenon in Iraq and between the Tigris and Euphrates are western and southern regions of Iraq, Kuwait, northern Saudi Arabia, East of Jordan and South shores of the Persian Gulf [20]. Wind storms refers to a wind that can move particles with a diameter of 0.15 to 0.30 mm up to a height of 15 meters. While dust storms are composed of very fine particles from 0.05 to 0.1 mm in diameter, moving at the height above the ground surface. They travel very long distances. In recent years the frequency of dust storms has increased in the regional and global level. Multiple effects has been considered for this natural disaster that sometimes are positive for some ecosystems and negative for others. Studies have divided the effects of these storms into two human and environmental groups.

## DUST CONSEQUENCES

Dust storms as one of the most common natural disasters of the last century have multiple positive and negative effects on ecosystems [15]. These storms by increasing the amounts of soil nutrients in the sedimentation areas and oceans increase productivity and phytoplankton growth, and by reducing the amount of solar radiation affect increased growth and performance of vegetation and cause outbreaks various diseases among human societies. The effects of such changes create short-term and long-term threats to human security. Dust deposition on plant tissues and also decrease of the amount of light reaching them have a big impact on the reduction of crop yields [6]. From environmental impacts, hardening rocks, coral reef deterioration, impaired radiant energy, Eastern wave resonance and addition of nutrients to the plants can be pointed out. Air pollution, animal madness, asthma, business closures, machinery problems and polluting drinking water are some of the most important anthropogenic impacts of dust storms. Dust storms are formed when the total annual rainfall is significantly less than the long-term average rainfall [2]. As temperature rises in late winter and early spring in the Saudi Arabia Peninsula, air temperature near the soil surface increases; this increase in temperature can cause wind turbulence in the lower layers of the atmosphere. If the wind speed exceeds the threshold velocity, a significant amount of soil particles detached from its bed and come in the form of dust into the atmosphere. The phenomenon of dust as well as causing a variety of health problems such as lung diseases like asthma, chronic bronchitis and fibrosis of the lung, sensitive allergies, creating difficulty in breathing cardiovascular patients, will lead to economical losses, including loss of sight in the streets, buildings and industrial installations erosion, land and air travel disruption, reduced levels of harvest due to dust cover on the levels of beneficial plants and agricultural land and social implications such as increased immigration [3, 4]. Dust particles are an important factor aggravating respiratory illnesses and lead to the prevalence of lung diseases such as asthma, chronic bronchitis and fibrosis of the lung, sensitive allergies, creating difficulty in breathing cardiovascular patients [3, 4].

## RESEARCH HISTORY

The results of Falehgari and *et al* [6] showed that irrigation and dust deposition have a significant effect on yield and its components. Drought stress reduces yield and its components. By applying dust in vegetative stages, podding and pod filling decreased that the highest yield loss was related to the vegetative stage. But by washing the leaf surface in the late stages of growth and podding, yield reduction was partly compensated. Galbond and Sharifzadeh [9] based on their results reported that the climate crisis have imposed detrimental effects on crop yield in recent years. The purpose of Galbond and Sharifzadeh was to explain contributors of the compatibility of Palm owners with dust crisis. The present survey population consisted of 157 Palm owners in Ahvaz city. Data were gathered by a structured questionnaire whose validity was confirmed by a panel of experts. Findings showed that the most important measures to adapt to the dust crisis among palm owners have been washings date, the use of protective tours, utilizing the process of spraying, cultivation of other crops among the palm trees and search for other sources of income. The results of the analysis of route showed that perceptual evaluation of Palm owners and supernal motivation have positive, direct and significant impact on consistent behavior of Palm owners. Also, social dialogue has indirect, positive and significant effect on consistent behavior of Palm owners. The results of Ghorbanian [8] showed that the best way to fight the dust in Horolazim wetland is meadows and forest restoration that have minimum cost and spraying sand allocated minimum time to ownself. In terms of performance as well, providing water for wetlands and providing the role player machine that by hammering surface layers of soil provides water storage are the best options. According to the high weight of time criterion among other criteria, spraying sand should be a priority choice. The results of Ghorbanian [8] showed that other than the criteria and investigated options, various other methods can be considered to combat dust. But the choice of the type of criteria and options depends on the conditions and opportunities of each region in each country. Supplying water for wetlands, creating and spraying mulch will have higher costs and the use of polymers and restoration of pasture and planting vegetation and spraying sand, will have the lowest cost. Water supply for wetlands and restoring grasslands and planting vegetation need more time, but the role of ward and spraying sand and mulch and the use of polymer will need a shorter time. Water supply for wetlands and the role of ward and mulching and polymer have a better performance than restoration of pastures and planting vegetation and spraying sand. Also, supplying the role of ward devices, mulching and providing water for wetlands are far cheaper and easier than polymeric materials, restoration of rangelands, planting of vegetation and spraying sand. In general, considering heavy losses of dust for each region in economic, social and public health terms, it is essential to pay more attention to time and efficiency

criteria and their related options among the four studied criteria. Ansari [1] investigated the correlation of parameters such as relative humidity, temperature, wind speed and rainfall with the occurrence of dust storms in the province of Zahedan. Among the studied parameters, wind speed and relative humidity allocated the highest significant and the lowest adverse correlation to itself, respectively. Since the wind erosion rate is a function of soil erosion and wind erosion, any factor that increases the ability of erosion can be a factor aggravating wind erosion followed by increase of dust storms. Salahshoori and Javanmard [23] reported that a lack of management of dust in recent years has caused these particles to be observed as uninvited guests in all months of the year. By analyzing data and sampling particles, we can obtain the origin and amount of the particles to by the favor of them reduce the problems for the living things created by these particles. And by investigating and analysis of these particles, it was determined that the highest and the lowest rate of deposition of dust are proportionate with the prevailing wind in the dry months of the year with eastern and northeastern wind direction and in humid months with west and southwest wind direction which are a reason for the possible origin of the dust from the desert areas of East of Esfahan and drying wetlands of Zayandehrood and Gavkhooni. It justifies negative significant correlations between the rate of deposition of dust with the amount of rainfall and relative humidity, and positive relation with temperature in the all months. In the dry months finer particles of dust from the East of Esfahan traveled farther distance and deposit in western areas of the city and in humid months due to the adhesion of soil particles and reduced wind carrying ability the particles are larger. Research of Lee and colleagues showed that the number of days with dust storms is less than the number of windy days in Mongolia, China and this shows that in addition the appearance and intensity of these storms are affected by climatic conditions such as wind speed, are affected by the impact of ground-level features such as vegetation, soil moisture etc. If the average stone grain diameter is 30 mm, wind speed in one millimeter on the ground surface reaches zero, It is therefore important that larger grains by preventing the wind prevent the movement of smaller grains, therefore surfaces covered with scattered boulders or rocks as an armored protection greatly reduce wind erosion. Matrood [14] investigated the ways of prevention of the effects of dust phenomenon in Ahvaz and introduced vegetation cover as an excellent option to combat dust. The actually creation of dust can be a response to changes of vegetation cover that in this regard, the role of human activities as well as the natural conditions of the geographical areas should be considered. Also, planting sapling and natural species drought-resistant plants such as Haloxylon, tamarisk, Calligonum, Mesquite, cow tail, acacia, Garadagh, Panicum, eucalyptus, ethereaplex, cactus, Zygophyllum, and Peganum can be a step for reduction of dust. Also, creation of barrier and constructing live and artificial wind breakers prevent the destructive power of the winds. Windbreak may be constructed from synthetic materials or trees and shrubs in the region. Stone, metal, wooden, plastic, rattan walls or walls made from cut branches of trees, walls of canvas can be named as synthetic windbreaks. It is noteworthy to say that when environment conditions do not allow vegetation cover to construct tree wind breaker, artificial wind breakers are used. Tree wind breaker usually composed of one or several tree rows placing perpendicular to the main wind direction. Many soil conservation experts believe that to control wind erosion on farms, in addition to create windbreakers such as strip cropping, covering soil by crop residues, crop rotation, minimal tillage, and removal of loosening hunk should be taken into account [5].

## CONCLUSIONS

Dust storms is a climatic phenomenon that has multiple effects on climatic parameters and takes several effects of them. Previous studies evaluated the correlation between climatic factors and the occurrence of dust storms and report the positive and negative correlations, which is different for different geographical areas. In general, the results showed that with increasing distance from Arab countries such as Iraq and Saudi Arabia, the source of storms becomes local. Pourdeihimi and Bina [21] reported that dust has created precarious conditions in living space in the southwest of Iran and has damaged the air health they breathe; therefore, to devise and remove this problem it is necessary the experts of various fields such as environment, environmental health, geology, natural geography, chemistry of polluted air, fluid dynamics, environment design, meteorology, and natural resources help each other, because on expert group cannot solve this dilemma. Destruction of environment in Iran is originated from this issue that problems related to environment are not consigned to environmentalists. Dust phenomenon has existed in the past but dust problem has been become more serious in recent years. Dust phenomenon reaches Iran from Saudi Arabia, but Zagros Forests acted as a filter against it. When vegetation cover of Zagros forests reached less than 40 percent, dust problem became more serious. Such a phenomenon occurred in Himalaya Mountain, when the amount of vegetation cover reached less than 40 percent and

yearly, twelve-year, and fifty-year floods took place. Environment is an ecological action and reaction phenomenon that is accompanied by biologic magnification and positive and negative synergy. For planning, programming and taking decision about environmental issues, at first the issue must be recognized and identified. In addition to deforestation, construction of dams and other local destructive factors as the origin of dust, persistence of some people to development is incorrect. Improvement of forestation in Zagros and also solving the improper condition of development are as some approaches to fight dust. Dust can be similized to a blotch which has been created due to the lack of attention to environmental considerations in the area including Iran, Iraq, Turkey, Syria, Saudi Arabia, Jordan, and Kuwait. The extraction of new energies, movine toward green business, improvement of reliable localization, fortification of touristic, cultural, and historical infrastructures, and the use of and the 4600 km sea border are advantages that can provide stable income in the country and steps in these fields must be taken and by preserving these wetlands, the origins of dust formation can be harnessed in the country. It can be said that factors such as changes in land use, drying and leaving lands, poor water management and projects in Turkey and Syria are of the causes of a phenomenon which is named dust. In conjunction with local factors of creation of dust, an issue that has received little attention in the country is agricultural lands. It must be noted that the solution of dust in Iran is not "Mulching" and these are agricultural lands that are in the path of destruction.

## REFERENCES

1. Ansari Ranani, M. (2011). Climatic-Statistical Analysis of Zahedan Dust in time interval of 1986-2005. 1st International Congress on Dust Phenomenon and Encountering Its Harmful Effects. 26-28 Bahman, Ahwaz.
2. Brunson, M. W. (2012). Monitoring Road Dust Emission and Related Dust Effects and Dust Management in National Parks.
3. Dabiri, M. (2006). "Environmental pollution". Tehran: Ettehad Publication.
4. Mansour, Gh. (2006). "Air pollution, Resources, effects and control". Tehran: Tehran University press.
5. Naddafi, K. (2011). "Air pollution, Origin and control". Tehran: Nas publication. 2nd edition.
6. Falehgari, H., Eghbal Ghobadi, M., Ghobadi, M., Jalali Honarmand, S., Saeedi, M., (2016), The effect of sedimentation of dust on performance and performance components of pea in complementary and dry farming irrigation in Kermanshah, 10(4).
7. Fattahi, E., Ghannad, H. (2010), Analysis of synoptic patterns of dust storms in west south of Iran, Scientific-Research Journal of Geography, pp. 49-63.
8. Ghorbanian, J., (2015), Preventing dust storm and weighing prevention measures under study: Horolazim, Geography, 13(47), pp. 269-286.
9. Galband, S., Sharifzadeh, M., (2016), Consistency with dust crisis outcomes among Ahwaz palm owners: application of route analysis, Scientific-Research Journal of Environmental Science, 14(1), pp. 105-116.
10. He, G., Zhang, L., Mol, A. P., Wang, T., & Lu, Y. (2014). Why small and medium chemical companies continue to pose severe environmental risks in rural China. *Environmental Pollution*, 185, 158-167.
11. Jones, D., Kociolek, A., Surdahl, R., Bolander, P., Drewes, B., Duran, M., ... & Nahra, M. (2013). Unpaved road dust management, a successful practitioner's handbook (No. FHWA-CFL/TD-13-001). Federal Highway Administration.
12. Karimi, M., Hashemi Mohammad, N., Karimi, A., (2010), Investigating the environmental effects of suspended particles and dust (aerosols) in air, 4th Conference of Geophysics, Tehran, Iran, 3-5 May, Institute of Geophysics, pp. 221-224.
13. Kazem, A. A., Chaichan, M. T., & Kazem, H. A. (2014). Dust effect on photovoltaic utilization in Iraq: Review article. *Renewable and Sustainable Energy Reviews*, 37, 734-749.
14. Matroudi, Fatemeh (2011), Investigating and ranking the prevention of adverse effects of dust phenomenon using mathematical AHP technique, 1st International Congress on Dust Phenomenon and encountering its harmful effects, Ramin University of Agriculture and Natural Resource, Khuzestan, pp. 749-756.
15. Mohmand, J., Eqani, S. A. M. A. S., Fasola, M., Alamdar, A., Mustafa, I., Ali, N., ... & Shen, H. (2015). Human exposure to toxic metals via contaminated dust: Bio-accumulation trends and their potential risk estimation. *Chemosphere*, 132, 142-151.
16. Toofan, M. (2010), *Foreign Policy Journal*, 24(4), pp. 943-958.
17. Kingel, H (2006), Analysis on human importance, Translated by: Ahmadreza Tagha, *Environment journal*, 1(1).
18. Mehrabi, S., Soltani, S., Jafari, R., (2015), Investigating the relationship between climatic parameters and occurrence of dust (case study: Khuzestan province), *Soil and water science (agriculture and natural resource science and technique)*: 9(71), pp. 69-80.
19. Jafari, R. 1390. Importance and nature of dust storms. *Scientific, Social, and Economic Journal of Forest and Ranch*, 89.
20. Naddafi, K. (2009). "Air pollution with emphasis on dust and its health and environmental effects". Book of papers of 12th National Conference on Environment Health, Shahid Beheshti University of Medical Science, Tehran.

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21. Pourdeihimi, S., Bina, M., (2014), Investigating the effect of building direction on reduction of pollution resulted from dust in residential complex (case study: Dezfoul buildings), Iranian architectural studies, 6, pp. 41-63.
22. Prospero, J. M., Collard, F. X., Molinié, J., & Jeannot, A. (2014). Characterizing the annual cycle of African dust transport to the Caribbean Basin and South America and its impact on the environment and air quality. *Global Biogeochemical Cycles*, 28(7), 757-773.
23. Salahshouri, R., Javanmard, E., (2015), Managing dust in Esfahan, National Conference on management ocean, organization and non-governmental centers, Supporter: Iranian new training development center, 1.

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