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STRATEGIES TO MITIGATE THE OCCURRENCE OF SAND AND DUST STORMS IN THE KURDISTAN REGION OF IRAQ

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ABSTRACT

A sand or dust storm is a meteorological phenomenon common in arid and semi-arid regions, causing great damage to the economy, human health, and the environment. Sand and dust storms occur more frequently with higher intensity now in Iraq and Kurdistan Region of Iraq (KRI) than they did in the past. This study proposes several pragmatic strategies to authorities in order to reduce the occurrence of sand and dust storms in KRI. The main cause of occurrence is associated with the decline in water resources in the region. Therefore, cooperation with neighboring countries is likely to be the most effective strategy. Control of a sharp rise in population and greenery expansion are other suggested mitigation strategies. Implementing these strategies by local and regional governments may reduce the occurrence of sand and dust storms to a certain extent. However, they cannot be eradicated as some of them originate from far countries and continents. Nevertheless, signs of climate change including sand storms are increasingly reported, we are, therefore, responsible to seek mitigation and adaptation strategies to the changes.

KEY WORDS: Sand and dust storm, Climate change mitigation, Climate change

INTRODUCTION

A sand or dust storm is a meteorological phenomenon common in arid and semi-arid regions. They can cause a number of environmental problems such as reducing visibility, generating clouds which in turn increase surface heat, damaging the fertile topsoil, increasing desertification, drought, reducing water supplies, and polluting the air. And with regard to human health, it is well documented that dust storms can carry pathogens such as bacteria, fungi, viruses, and heavy metals that can cause cardiovascular and respiratory diseases like congestive cardiovascular failure, coronary artery disease, asthma or chronic obstructive pulmonary disease and can, in some cases, lead to death (Miri *et al.*, 2007, Ebrahimi *et al.*, 2014).

Iraq is unfortunately, a country which experiences dust storms. Sand and dust storms occur more frequently with higher intensity now in Iraq than they did 30 years ago. As an example, between 19950 and 1990, the maximum length of the annual dust storm in Iraq was about 24 days. Whereas, in 2008, 122 dust storms were recorded, and it is expected that Iraq could witness 300 dust storms per year in the next ten years (Kobler, 2013). Kurdistan Region of Iraq (KRI) where this study mainly focused on is an autonomous region in the north of the country with approximately 7.2 million citizens (Figure 1). KRI is located in a zone of low to moderate potential for dust storms, whereas the rest of Iraq is located in a zone of moderate to very high (Desert Research Institute, 2013). Between 1950-1990, KRI had significantly few days of dust storms (less than 4 days) per year compared to the rest of the country, but Majid (2011) reported that between 2009-2010 Sulaimani has as many as 20 days of dust storms per year. Another study by Al-Kubaisi and Gardi (2012) on dust storms in Erbil also noted a gradual increase in dust storms from 35 in 1992 to 65 in 2009. All of this indicates that dust storms in both Iraq and the KRI have increased significantly in number and severity as compared to those occurring

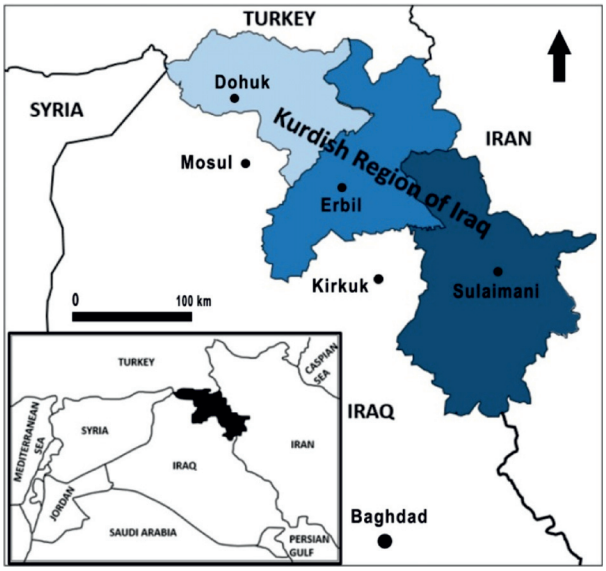

Fig. 1. Map of the study area. This study focuses on the Kurdistan Region of Iraq (KRI) in the northeastern part of Iraq

in the last century. Hence, this study was carried out aiming to suggest several pragmatic strategies to authorities in order to reduce the occurrence of sand and dust storms in KRI.

CAUSES OF OCCURRENCE

The dust storms in both Iraq and KRI can be either regional or local. In the case of the former, a much larger area is affected and more severe health effects are felt than with the latter. Each type of those storms has its own causes. The main causes behind the development of the regional dust storms are the climatic changes in the region (especially the remarkable decrease in the annual rate of rainfall), the significant increase in mean annual temperatures, and the notable increase in mean annual evaporation, besides environmental changes, such as dried marshlands, land degradation, and desertification. The causes of local dust storms are often down to military actions, construction operations, deforestation, cultivation, and unpaved roads (Sissakian *et al.*, 2013).

All studies about dust storms in Iraq suggest that the principal cause of increasing dust storms over time is the drastic decline in annual precipitation (Sissakian *et al.*, 2013, Al-Dabbas *et al.*, 2012, Al-Kubaisi and Gardi, 2012). The amount of rainfall in Iraq varies from the south and southwest parts (100 to 300 mm precipitation) toward the north and northeast parts (300 to 800 mm precipitation). Thus, KRI in the northeast receives a higher amount of precipitation (300 to 800 mm) than the rest of Iraq, which may explain why dust storms occur less often in the KRI than in the rest of the country. A model study by Al-Ansari *et al.* (2014) found a significant downward trend in precipitation between 1961-2099. This expectation of a future reduction in precipitation in Iraq is also supported by USAID (2017), believing there will be a decrease in the mean annual rainfall by 9% by 2050. The effect of lack of precipitation in a developing dust storm was also highlighted by Hussain (2012) when he noticed that the frequency of dust storms in Iraq was significantly higher in summer than in winter. When there is no or less water in the area, the surface loses its vegetation cover, contributing to the loosening of the topsoil cover, and contributing to the development of particles of clay and sand size. These particles will begin moving when the wind is blowing, causing a dust storm to develop.

Rising temperature is also noted to be a major cause of increasing dust storms. Al-Kubaisi and Gardi (2012) observed that the average annual temperature in Erbil rose from 20.7 °C in 1992 to 22.7 °C in 2009, meaning a 2 °C rise within 17 years. As well, Ibrahim (2017) found that the highest land surface temperature for barren lands and build-up areas in Dohuk increased from 47 °C in 1990 to 56 °C in 2016. The temperature in Iraq including the KRI is expected to rise 2 °C more by 2050 (USAID, 2017) and will contribute to a higher evaporation rate, drought, salinization, desertification, and agricultural land degradation which, in turn, will increase the prevalence of dust storms.

PROPOSED MITIGATION STRATEGIES

Cooperation with neighboring countries

As mentioned above, some causes of increasing dust storms in both Iraq and KRI are dried marshland, increased evaporation, and desertification which are all related to water. Regarding water resources, Iraq was considered rich due to the presence of the Tigris and Euphrates Rivers. However, about 80% of water in Iraq and 40% of water in KRI is controlled by their neighbors (Figure 2). Turkey and Syria have built more than 30 dams on the Euphrates River, causing only a 25% to 50% of Euphrate's normal flow reaches Iraq. Turkey is also building a large number of dams including the Ilisu dam on the Tigris River. When the dam is complete, it blocks a substantial amount of water so that residents in Baghdad can

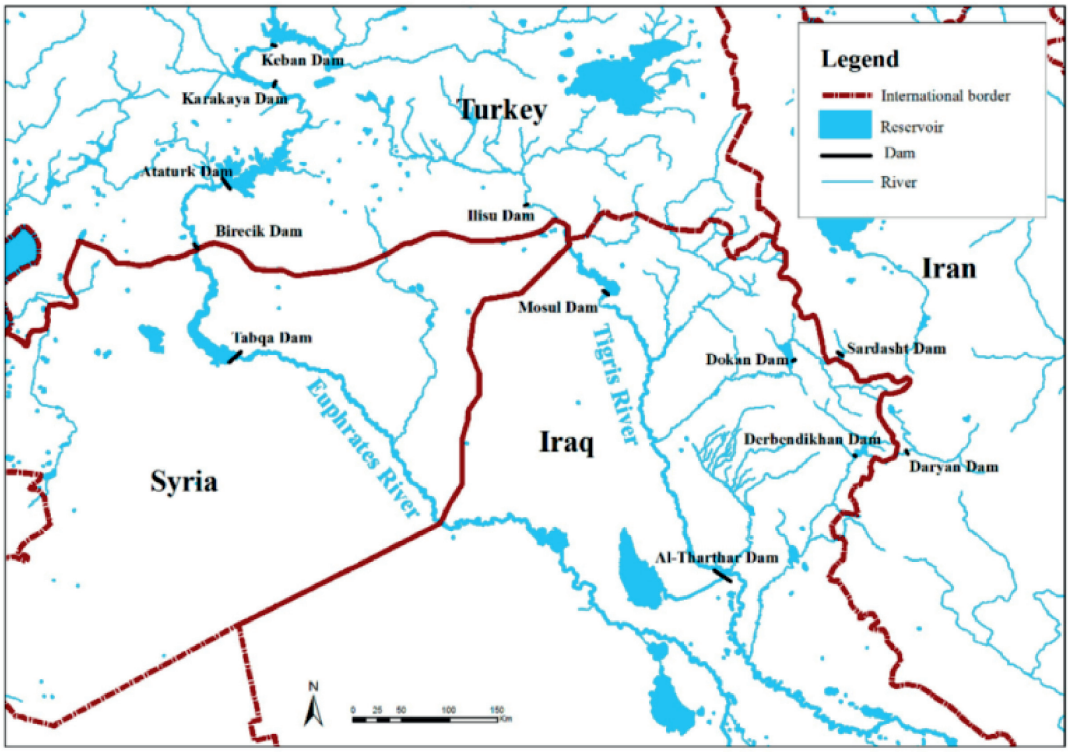

Fig. 2. Map of the water resources in the study area and the region.

cross the Tigris River by foot (Ellis, 2019). Iran has also built many dams on Tigris River tributaries flowing mostly through KRI. The two most recent examples are the completion of the Daryan Dam on the Sirwan (Diyala) River and the Sardasht Dam on the Lesser Zab River. A river diversion tunnel is being built for each dam in order to change the flow of the rivers to other parts of Iran. With the completion of both dams and their tunnels, water flows to the KRI would be completely cut, which could lead to a humanitarian and environmental catastrophe. Neither Turkey nor Iran respects Iraq's share of water. Iran is not just constructing a dam; it is diverting the direction of a river, hereby putting a complete region at risk of drought (Chomani and Bijnens, 2016).

As the source and catchment area of the Tigris and Euphrates Rivers and their tributaries are not only in Iraq and KRI but also and mostly in Turkey and Iran, agreement on shared water resources among these countries is extremely important, especially for the downstream regions such as Iraq and KRI. Cooperation among governments is probably the best strategy to tackle a regional or global environmental issue. A great example of this is the Montreal protocol in 1987 when 36 nations first met to cut the production of ozone-depleting chlorofluorocarbons (CFCs) by 50%. The agreement now is signed by 197 countries and the production of CFCs has fallen by 95%, and the Ozone layer started recovering since the mid-1990s. (Withgott *et al.*, 2016). As KRI is not an independent country, the law dictates only the central government in Baghdad can sign agreements with neighboring countries over water resources. Numerous protocols and agreements have been signed in the last century among or between the transboundary countries including Lausanne agreement in 1923 and treaty of neighborly relations in 1946 with Turkey, Istana, the Protocol in 1913, and the Protocol of Algiers in 1975 with Iran. However, unfortunately, none of these agreements have been respected, on account of the strong positions of both Turkey and Iran compared to Iraq and Syria. Turkey dominates the Tigris and Euphrates against Iraq and Syria, while Iran has control of most of the tributaries of the Tigris (Yousuf *et al.*, 2018). Thus, it is crucial and urgent for Iraq to sign new agreements with both Turkey and Iran regarding shared water resources. Iraqi authorities must ensure that the agreements are respected by upstream countries; otherwise claims should be submitted to the United Nations (UN). Many water disputes have been resolved through the mediation of the UN and its agencies, such as Al-

Sindh waters (India and Pakistan) and the Helmand River (Afghanistan and Iran), so Iraq and KRI can seek help from the international community to put pressure on upstream countries to fulfill the agreements.

For Iraqi and KRI residents, agreements will not only reduce the number of dust storms but also improve the overall environmental and economic condition including increasing food productivity, flourishing marshlands and enhancing biodiversity, and most importantly securing water for drinking. Moreover, the sand and dust storms occurring in Iraq and KRI do not only affect these regions but also neighboring states. Iran, for instance, has recently experienced an increasing number of dust storms. Studies such as (Amanollahi *et al.,* 2011, Keramat *et al.,* 2011) indicate that such dust storms in Iran, especially in the western part, originate mainly from Iraq. Therefore, the cooperation of Turkey and Iran with Iraq and KRI will improve the environmental quality not only of the latter but also of the former.

Controlling population

Some actions such as informal settlements, unpaved roads, agriculture operations, and construction operations which are associated with a sudden rise in population are responsible for developing dust storms, especially local dust storms. A great number of environmental scientists such as (Miller and Spoolman, 2010, Withgott *et al.,* 2016, Chertow, 2000) indicate that increase in population is a major cause of pollution as has been formulated into a common pollution equation (I=PAT), where I is impact or pollution, P is population, A is affluence, and T is technology. The population of the KRI has more than doubled in the last two decades, rising from 3 million in 1997 to approximately 7.2 in 2019 (Menmy, 2019, Mohammed *et al.,* 2019). The KRI population intensity (177 people/km^2) is more than twice that of the population intensity in the rest of Iraq (83 people/km^2). Population intensity in KRI is found to be higher than those of the neighboring countries. Iran's population, for instance, increased in the last two decades by approximately 25%, from 65.9 million to 82.1 million, and its population density in 2020 is 52 people/km^2 (Trading Economics, 2020).

This recent increase in population is attributed to the natural migration from rural to urban centers, forced migration, and international immigration. The conflicts inside and outside Iraq including the US-led occupation in 2003, the Iraqi civil war afterward, the Syrian civil war since 2011, and the Islamic State of Iraq and Levant's (ISIL) invasion of Mosul and the surrounding territories in 2014, all forced approximately 1.5 million Iraqis and non-Iraqis to leave the war zones and resettle in the KRI, where one in every four people is either a refugee or an internally displaced person (UNHCR, 2019). For example, over 250,000 Syrian refugees now live in the KRI which is about 99% of all Syrian refugees in Iraq (Durable Solutions Platform, 2019). The sharp rise in population became a further burden on poor KRI infrastructure and resulted in an increase in informal settlements, unpaved roads, and large construction activities in the cities. Though it is cruel, authorities in KRI should begin controlling the rise of the population to some extent.

Greenery expansion

Greenery whether it is vegetation or tree could significantly restrain dust storms through accumulating aboveground biomass and increasing surface roughness. It was found in a model study based on visibility measurements from more than 2400 meteorological stations worldwide that dust storm frequency is inversely correlated with vegetation density (Engelstaedter *et al.,* 2003), meaning that the more vegetation the land has the less frequency of dust storm to happen. Al-Dousari *et al.* (2019) also found that native plants and green belts in Kuwait have contributed to the reduction in the annual rates of mobile sand by up to 95%, and dust by 68%. They come to the conclusion that green belts and native plants could be considered the most effective applications for tackling sand and dust storms. Therefore, many countries combat dust storms with enlarging greenery. China launched its Green Great Wall program in 1978 to achieve several goals including increasing vegetation and reducing sand storms. By 2006, China has planted more than 100 billion trees since 1978. It is found that the implementation of this program greatly improved the vegetation index and effectively reduced dust storm intensity in northern China (Tan and Li, 2015). Greenery areas in Kurdistan in the last two decades have decreased not increased. According to Abdullah (2018), more than 890,000 ha (i.e. 47% of the total forest in the region) of the natural and manmade forest has been destroyed. There were several main reasons for the decline, namely the increasing rate of population, expansion of cities, oil companies, deliberately burning forests, Turkish

airstrikes and Iranian artillery bombardments. The KRI's Ministry of Agriculture conducted a survey of green sites in 2018 in cooperation with local universities, using satellite imagery and remote sensors. It was found that green areas now make up just over 12% of KRI territory. The province of Duhok has the highest rate of green space with over 27%, Sulaimani and Erbil both have 9% green space (Wali, 2019). Authorities now would like to increase the green areas of major cities in the region to reach 15%, which is the minimum ratio provided by the International Organization for Standardization (ISO) (Hussein, 2019). Examples of this attempt are the construction of Sami Abdulrahman Park, which was built in 1998, covering about 200 ha in Erbil city, and the construction of Hawary Shar Park, which was built in 2016, covering 1,100 ha in Sulaimani city. Authorities, therefore, can increase greenery space through several ways such as preventing locals from cutting trees in rural and suburban areas, enforcing residential construction companies to enlarge public green space, constructing greenbelts around cities, and constructing large parks inside cities.

CONCLUSION

Sand and dust storms are increasingly occurring now in Iraq and KRI. Yet governments have not taken an action to tackle this issue. Therefore, this study was carried out aiming to suggest a number of pragmatic strategies to authorities in order to reduce the occurrence of sand and dust storms in KRI. The principal cause of this increasing occurrence is the reduction in water resources in the region; therefore, collaboration between countries might be the first and the most important strategy. Other suggested measures include control of population and enlargement of greenery. Implementing these measures will reduce the occurrence of sand and dust storms only within limits. It is recommended to all countries of concern worldwide to come together and tackle the issue on a global scale.

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