

Dust effect on photovoltaic utilization in Iraq: Review article



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ABSTRACT

The term Dust is called for any substance that spreads in the air which includes soil and dust particles (suspended dust), smoke, fog and particulate matters. It is formed from organic and inorganic substances of terrestrial origin. Such substances are like sand storms, factory smoke, bacteria, pollen, Forrest fires and volcanoes vapors. Also, they include solid atmospheric particles that stay suspended in the air for long periods, and that are able to move with wind movements for long distances. It represents large differences in volume, shape, distribution and concentrations. Dust-storms are an environmental phenomenon that transcends boundaries and their growing intensity and frequency-as a result of increasing desertification and decreasing vegetation coverage-has a tremendous negative impact on national and regional human and socio-economic development.

In this study, a review of Iraqi geographical and meteorically characteristics will be made. In addition, a review of the human activities that increased desertification in Iraq areas that reflects on increasing sand and dust storms in the country will also be reviewed. The focus on dust causes, types and specifications was a priority in order to analyze its effects on PV systems. PV systems performance is affected by dust and dust storms highly influence the energy collected. A comprehensive review for the effect of dust on PV in Iraq is represented to researchers; designers and engineers dealing with PV systems in Iraq.

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1. Introduction

Marten Cobler the representative of Secretary General of the UN in Iraq said in his word in Nairobi Conference about the environment on 21st February 2013 that Iraq faced 122 sand-dust

storms and it is expected that Iraq will face 300 storms per year within the next five years. "Environmental issues impact everyone in Iraq. Dust storms, desertification and water scarcity are only three of many pressing issues", said Martin Cobler. Addressing these challenges has to start with each of us [1].

Iraq suffered from nearly a decade of war and two decades of drought, a new dust bowl appears to be forming. Chronically plagued by overgrazing and over plowing, Iraq is now losing irrigation water to its upstream riparian neighbors—Turkey, Syria,

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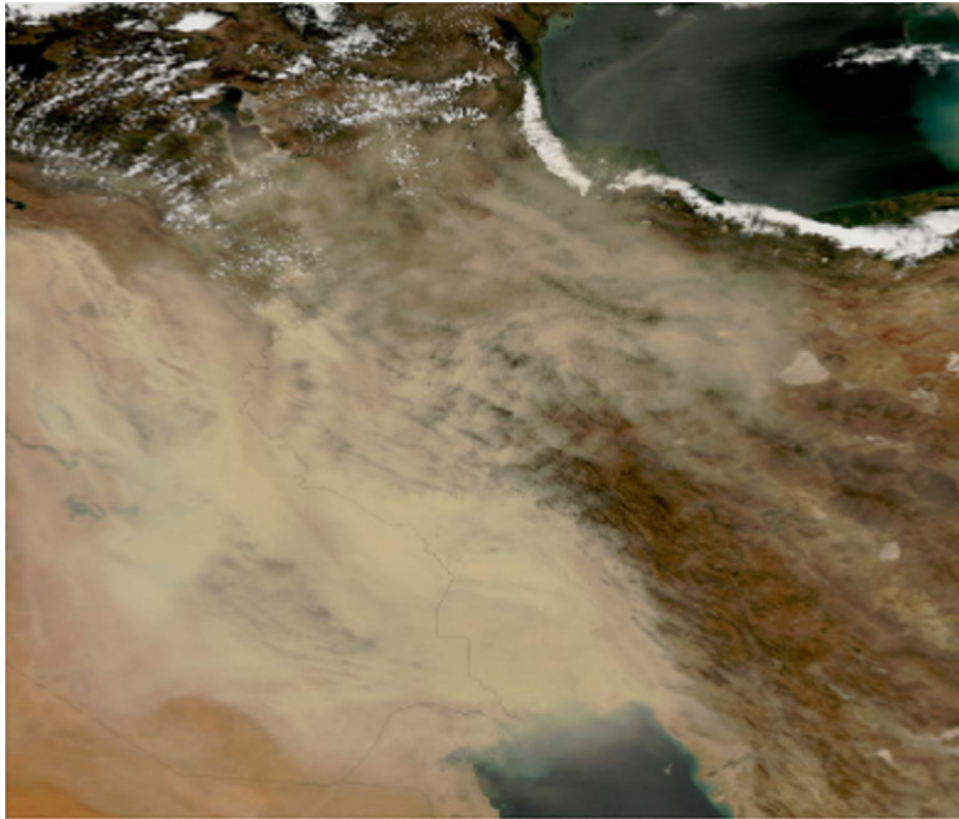


Fig. 1. Dust storms as observed from space images (5/7/2009).

and Iran. The reduced river flow—combined with the drying up of marshlands, the deterioration of irrigation infrastructure and the shrinking irrigated area is drying out Iraq. The Fertile Crescent, the cradle of civilization, may be turning into a dust bowl [2].

Dust storms are occurring with increasing frequency in Iraq. In July 2009 a dust storm raged for several days in what was described as the worst ever storm in Iraq's history (Fig. 1) as it traveled eastward into Iran, the authorities of this country closed government offices, private offices, schools and factories [2].

The output of PV is rated by manufacturers under Standard Test Conditions (STC), temperature = 25 °C; solar irradiance (intensity) = 1000 W/m², and solar spectrum as filtered by passing through 1.5 thickness of atmosphere. These conditions are easily recreated in a factory but the situation is different for outdoor. With the increasing use of PV systems it is vital to know what effect active meteorological parameters such as humidity, dust, temperature, wind speed, etc., have on its efficiency. The wide spreading usage of PV depends mainly on its applications at Iraqi atmospheric condition. Iraq is characterized by its high temperatures in summertime, in addition to its dusty environment. In Basra (south Iraq) high humidity weather is normal condition that must be taken into consideration when decision makers want to build a PV station.

The commercial PV panel efficiency is between 15% and 20% and dust accumulation on PV panel highly reduces its efficiency; its cleaning needs time and effort. This means higher maintenance costs with lower efficiency. This condition reduces PV market especially in countries with large oil and gas production and reserves like Iraq. Dust storms cause fractures in the PV panel that reduce live time. Humidity existence with dust accumulation on PV gives a magic mishmash of a hard layer cleaning resistance. Darwish et al. [3] clarifies that there are limited current research characterizing deposition of dust and their impact on PV system performance. As a result, the dust deposition is a complex phenomenon that must be dealt with its diverse site-specific environmental and weather conditions sources.

In spite of this pessimistic picture, Iraq lies in the high intensity region of solar energy [4,5]. Iraq is connected with Europe through Jordan, Syria and Turkey. In Iraq there are available areas suitable for the establishment of large power plants [6]. The huge reserve of natural gas available in Iraq will support the implementation of power generation for the short run in parallel with renewable energy projects [7]. Iraq has sufficient water for the requirement of cleaning the solar plant from dust and birds residues'. Huge amounts of electrical energy are needed at the time being in Iraq. This situation makes thinking in the production of electricity by solar energy and assisted with that generated by gas turbines stations at night a very brilliant and acceptable idea. This can be achieved whenever gas and solar energy are available in the same area as in Iraq [8,9].

This paper is a review of the Iraqi investigation of the effect of dust on PV performance. The study of the effects of dust on PV performance must take into considerations dust source, its constituents, pollutants particles that added to dust and finally its wipe away and how much of the performance can be recovered. In this paper dust sources, specifications and effect on PV performance in Iraq are reviewed. All the formerly mentioned points were subjected to intensive research but still many challenges are being faced by Iraqi researchers and many researchers are still not satisfied. This paper attempts to give comprehensive look on the most important Iraqi studies in this field defining the challenges that need more interest to improve PV performance in Iraqi environments.

2. The Iraq geography

One of the keys to the understanding of the importance and the complexity of Iraq and its role in current events lies in its location. Iraq, with a total area of 438,320 km², is bordered by Turkey to the

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