International Journal of Mining Science (IJMS)
Volume 3, Issue 4, 2017, PP 34-51
ISSN 2454-9460 (Online)
DOI: http://dx.doi.org/10.20431/2454-9460.0304004
www.arcjournals.org

Assessment of Anthropogenic Influences on the Micro-Climate of Wetland Ecosystems: The Case of Hoor-Alazim Wetland in Iran

Manijeh Zohoorian-Pordel[1], Reza Bornaa[1], Hasibeh Neisi[1],Saeid Eslamian[2], Kaveh Ostad-Ali-Askari[3*], Vijay P. Singh[4], Nicolas R. Dalezios[5], Mohsen Ghane[6], Mohammed Matouq[7]

[1]*Department of Geography, Ahvaz Science and Research Branch, Islamic Azad University, Ahvaz, Iran*
[2]*Department of Water Engineering, Isfahan University of Technology, Isfahan, Iran*
[3*]*Department of Civil Engineering, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran*
[4]*Department of Biological and Agricultural Engineering & Zachry Department of Civil Engineering, Texas A and M University, 321 Scoates Hall, 2117 TAMU, College Station, Texas 77843-2117, U.S.A*
[5]*Laboratory of Hydrology, Department of Civil Engineering, University of Thessaly, Volos, Greece & Department of Natural Resources Development and Agricultural Engineering, Agricultural University of Athens, Athens, Greece*
[6]*Civil Engineering Department, South Tehran Branch, Islamic Azad University, Tehran, Iran*
[7]*Al-Balqa Applied University, Chemical Engineering Department, President of Jordan Japan Academic Society, JJAS, P.O. Box 4486, Amman 11131- Jordan*

Corresponding Author:** ***Dr. Kaveh Ostad-Ali-Askari*, Department of Civil Engineering, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran. Emails: Koa.askari@khuisf.ac.ir, Kaveh.oaa2000@gmail.com*

Abstract: *The Hoor-Al-Azim wetland, with an area with more than 450,000 hectares, is an environmental ecosystem and one of the most important diverse wetlands in Iran and internationally, because its hydrological, biological and ecological systems play a critical role in the life of the surrounding region. Due to limited rainfall, part of this wetland has dried up and the wetland's natural environment has been destroyed, because of the increase in drought episodes and increase in human activities and anthropogenic intervention in recent years. One of the most damaging factors of Hoorhs been the exploration of oil fields and drilling of oil wells since 2000. This study aims to assess the impact of anthropogenic intervention on the microclimate of the wetland caused by drilling company's activities on the Hoor-Al-Azim wetland ecosystem. To this end, an investigation of thechanges in microclimatic and water quality parameters of the area was conducted for a twenty-yearperiod (1991-2010). Results showed that the area's microclimatic factors have changed in a negative direction. The amount of evaporation, warming, and sunshine duration atHoorshave increased, whereas precipitation and relative humidity have decreased. The Hoor-Al-Azim has been destroyed during this period and its areal extent has been reduced. These negative impacts are expected to cause insecurity for the flora and fauna environment and increase disorder in the region.*

Keywords: *Hoor-Al-Azim, microclimate, water quality, drilling activities.*

1. INTRODUCTION

Wetlands occur where water meets land. Wetlands are areas, where water covers the soil, or is present either at or near the surface of the soil throughout the year or for several periods of time during the year, including periods during the growing season. The saturation by water largely determines the soil development, as well as the types of plant and animal communities living in and on the soil. Needless to say, wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions, which favor the growth of specially adapted plants, called hydrophytes, and promotes the development of characteristic wetlands, namely hydric soils.

Wetlands are the biggest contributors of water ecosystems and play a fundamental role in all ecological, economic and social aspects of a region (Davies and Claridge, 1993). Chinese were among the first, who used the wetlands for pica culture and rice cultivation thousands of years ago. There are several known significant values of wetlands, such as the accumulation and storage of organic substances, as well as the filtration and purgation of input waters and surface water storage, among others. Specifically, in Iran, wetlands and aquatic ecosystems are considered very significant valuable assets, since they contribute to the existence of ground setup and purgation in the surroundings, ground water recharge, and natural erosion control, microclimate adjustment, hunting, waterfowls and fish preying, supply sources for feeding animals, as well as mat weaving, which hall depend on the expected wetland protection. There are several studies, which justify the above statements with emphasis on the Hoor-Alazim pond in Iran. In particular, geographic information systems (GIS) have been used for the study of the distribution of wetland surfaces (Emady et al., 2010). Moreover, several studies have been conducted on the destruction of wetland ecosystems, assessment of environmental impacts, and investigation of the causes of wetland degradation (Fouladavand and Sayyad, 2015; Arvin et al., 2014; Navid Pour, 2012; Jafari, 2009).

The water shortage in wetlands in dry regions, such as Hoor-Alazim in Iran, has negatively affected welfare and economic practices and policies. Population growth and increased public demands for new agricultural lands have led to the growth of agricultural sector of the economy and the implementation of projects related to water resources, such as dam construction and water transportation in order to increase agricultural production(Masih et al., 2009; Jones et al., 2008). Nevertheless, one of the specific examples of this kind of natural ecosystem destruction is Tigris and Euphrates aquifers, which can be characterized as one of the largest destructions. In the underlying region, there have been developed more than 60 types of engineering projects during the last three decades, including dam construction, or channel deviation of seasonal floods and irrigation systems. As a result, there has been a decrease of the input water into the basin, as well as the destruction of the basin, which has significantly reduced in its areal extent (Mokhtari et al., 2009; JAMAB, 1999).

The objective of this paper is to examine the significance of Hoor-Alazim as a valuable wetland ecosystem in a natural environment and to assess the microclimate impacts caused by anthropogenic interventions. The Hoor-Alazim has reedy lands for feeding animals, which is used for handicrafts. There are fishing activities in Hoor, which contribute as a resource for people’s livelihood, and there is touristic potential in the region. However, a series of oil fields had been developed in the Hoor-Alazim wetland and four more oil fields have been developed lately, namely Yadavaran, Jafir, northern Azadegan and southern Azadegan. Although these oil fields contribute to the regional development, offering job opportunities, however, these oil fields are a major menace to the wetlands. This study aims to review the microclimate changes and the disasters caused by oil field operations during a 20-year period (1991-2010) in the Hoor-Alazim wetland ecosystem. The paper is organized as follows: first, a classification of different wetland types is presented, including a brief description of the main characteristics of each of them. This is followed by a description of the Hoor-Alazim pond. The next step involves analysis of results, which is followed by a discussion of the microclimate impacts due to explorations.

2. Classification and Types of Wetlands

Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation and other factors, including human disturbance (Majnonian, 1998). Indeed, wetlands are found from the tundra to the tropics and on every continent except Antarctica. Two general categories of wetlands are recognized: coastal or tidal wetlands and inland or non-tidal wetlands.

2.1. General Categories

Tidal wetlands in the United States, as their name suggests, are found along the Atlantic, Pacific, Alaskan and Gulf coasts. They are closely linked to the estuaries where sea water mixes with fresh water to form an environment of varying salinities. The salt water and the fluctuating water levels (due to tidal action) combine to create a rather difficult environment for most plants. Consequently, many shallow coastal areas are unvegetated mud flats or sand flats. Some plants, however, have successfully adapted to this environment. Certain grasses and grasslike plants that adapt to the saline conditions form the tidal salt marshes that are found along the Atlantic, Gulf, and Pacific coasts. Mangrove swamps, with salt-loving shrubs or trees, are common in tropical climates, such as in southern Florida and Puerto Rico. Some tidal freshwater wetlands form beyond the upper edges of tidal salt marshes where the influence of salt water ends.

Non-Tidal wetlands are most common on floodplains along rivers and streams (riparian wetlands), in isolated depressions surrounded by dry land (for example, playas, basins and "potholes"), along the margins of lakes and ponds, and in other low-lying areas where the groundwater intercepts the soil surface or where precipitation sufficiently saturates the soil (vernal pools and bogs). Inland wetlands include marshes and wet meadows dominated by herbaceous plants, swamps dominated by shrubs, and wooded swamps dominated by trees.

Certain types of inland wetlands are common to particular regions. Many of these wetlands are seasonal (they are dry during one or more seasons every year), and particularly in the arid and semiarid West, they may be wet only periodically. The quantity of water present and the timing of its presence in part determine the functions of a wetland and its role in the environment. Even wetlands that appear dry at times for significant parts of the year -- such as vernal pools-- often provide critical habitat for wildlife adapted to breeding exclusively in these areas.

2.2. Classification of Wetlands

One commonly used classification system for wetlands has been developed by Cowardin (year 2002). The Coward in system is used by the U.S. Fish and Wildlife Service for the National Wetlands Inventory. In this system, wetlands are classified by landscape position, vegetation cover and hydrologic regime. The Coward in system includes five major wetland types: marine, tidal, lacustrine, palustrine and riverine. Another common wetland classification system, used by the Army Corps of Engineers, was developed by Brinson (year 2001) and is described in "A Hydrogeomorphic Classification for Wetlands." As the title implies, wetlands are classified by their geomorphic setting, dominant water source, e.g. precipitation, groundwater or surface water, and hydrodynamics. The hydro geomorphic (HGM) classification includes five major wetland types: riverine, slope depressional, flat and fringe. Wetlands include mangroves, peatlands and marshes, rivers and lakes, deltas, floodplains and flooded forests, rice-fields, and even coral reefs. Wetlands exist in every country and in every climatic zone, from the polar regions to the tropics, and from high altitudes to dry regions [1-13].

Peatlands. These are wetlands with a thick water-logged soil layer made up of dead and decaying plant material. Peatlands include moors, bogs, mires, peat swamp forests and permafrost tundra. Peatlands represent half of the Earth's wetlands and cover 3% of the global total land area. They are found all over the world. Peatlands are important due to water, food, species and climate change.**Water**: Peatlands absorb heavy rainfall, providing protection against floods, and release water slowly, ensuring a supply of clean water throughout the year. **Food:** Millions of people depend on peatlands for herding cattle, catching fish, and farming. **Species:** Tropical peat swamp forests are home to thousands of animals and plants, including many rare and critically endangered species such as the orangutan and Sumatran tiger. **Climate change:** Peatlands contain twice as much carbon as the world's forests. When disturbed or drained, peatlands can become significant sources of greenhouse gas emissions.

Rivers and deltas. A river is a natural watercourse, usually freshwater, flowing towards an ocean, a lake, a sea, or another river. Rivers originate as rain on high ground that flow downhill into creeks and streams. Deltas are found on the lower reaches of rivers, where the flow of water slows down and spreads out into expanses of wetlands and shallow water. Rivers and deltas are important due to the following factors. **Water and food:** Rivers serve as important sources of drinking water, food and irrigation for crops. River waters also recharge lakes and transport fertile sediments that enrich floodplains and marshes. **Transport:** Rivers also play an essential role as highways for transportation and commerce and as sources of energy. **Species:** Rivers and deltas provide critical habitat for fish and other freshwater animals, such as amphibians and shellfish.

Mangrove forests. Mangroves are a crossroad where oceans, freshwater, and land meet. Mangrove forests are among the most complex ecosystems on the planet, growing under environmental conditions that would kill ordinary plants very quickly. Mangrove forests are found in tropical and subtropical regions in tidal areas, which are frequently inundated with salt water. Strongly in decline, mangrove forests occupy about 15.2 million hectares of tropical coast worldwide: across Africa, Australia, Asia and America. Mangroves are significant for the following points. **Disaster reduction:** Mangrove forests provide protection and shelter against extreme weather events, such as storm winds and floods. Mangroves absorb and disperse tidal surges associated with these events: a mangrove can reduce the destructive force of a tsunami by up to 90%.**Species:** Mangrove leaves and roots provide nutrients that nourish plankton, algae, fish and shellfish. Mangroves are also home to many birds and mammals, such as mangrove monkeys in South Asia. **Climate change:** Mangroves rival the carbon storage potential of rainforests.

Wetlands in dry regions. Arid and semi-arid areas are often characterized by seasonal rainfall and wetlands that retain water long after the rest of the landscape has dried out.

These wetlands include rivers, swamps, and lakes and springs that dry up for portions of the year. Dry regions are found in Asia, Australia, Africa, the Middle East and North and South America. These wetlands in dry regions are important for food and species. **Food:** These wetlands are essential for farmers, pastoralists who graze animals, and the livelihoods of people who fish and collect plants. **Species:** They are also important to millions of water birds that breed in Europe and Asia, such as waders and herons. **Climate and disaster risks**: Arid wetlands are vital water stores in otherwise uninhabitable landscapes. They help strengthen the capacity of local people to survive droughts and fight desertification. A changing climate and upstream diversions is putting at risk these wetlands and the communities they support.

A typical example is how people and nature can survive at the edge of the Sahara Desert. For centuries wetlands in the arid Sahel region of Africa have provided lifelines for local people and wildlife. Yet these wetlands are shrinking. They are threatened by a changing climate, rapid population growth and increasing competition for water. There is continuous work to safeguard and restore these freshwater flows. The wetlands of the Sahel include rivers and their floodplains, seasonal lakes and ponds are situated amid arid and semi-arid landscapes. Rivers and wetlands are critically important life-support systems running through the Sahelian drylands. They provide food, water supplies and fertile soils for tens of millions of people. The loss of wetlands results in increased water scarcity, hunger and instability. This freshwater provides food and fodder for farmers, fishers, and pastoralists. It also supports seasonal patterns of migration for people and animals, including millions of water birds that breed in Europe. Water is already very scarce in this region and likely to become scarcer. The need for food and energy production is driving upstream water withdrawals, often at the expense of the seasonal floods. This jeopardizes downstream wetlands and the communities and nature that depend on them. The area of floodplain wetlands in the Sahel is shrinking. To halt and reverse this trend, there is an effort to improve the understanding of their values and build the capacity of governments, civil society organizations and local communities to take action to develop sustainably and adapt to a changing climate. The objective is to increase the reach of this work across the Sahel from coast to coast.

High altitude wetlands. Glacial lakes, marshes, wet grasslands, peat lands and rivers support unique ecosystems and services that sustain the livelihoods of people. High altitude wetlands store water from rain and glacial melt, feed groundwater stores, trap sediments, and recycle nutrients, enhancing both the quantity and quality of water. **Species:** These wetlands are important stopping points for migratory birds and breeding grounds for birds, fish and amphibians. **Disaster reduction:** Their ability to promote vegetation growth lessens soil erosion and buffers water flow, providing a steady flow of water downstream, while reducing the severity of disasters, such as landslides, floods and droughts.

Arctic wetlands. Wetlands are the main ecosystem in the Arctic. These peat lands, rivers, lakes, and shallow bays cover nearly 60% of the total surface area. Arctic wetlands store enormous amounts of greenhouse gases and are critical for global biodiversity. They are also the main source of livelihoods for local indigenous peoples.

Species: Arctic wetlands offer unique habitats to both plants and animals. For many migratory species the Arctic provides indispensable breeding and feeding areas. Livelihoods: Over four million people, including more than 30 different indigenous groups, live in the Arctic. People living in the Arctic depend on wetlands for fish and waterfowl hunting, harvesting of plants and as pastures for grazing. Climate change: Arctic wetlands contain enormous stocks of organic carbon in their soils, and are dependent on frozen permafrost for their ability to store carbon. As temperatures rise and the permafrost thaws, huge amounts of greenhouse gases may be released into the atmosphere.

3. THE HOOR-ALAZIM POND

Hoor-Alazim wetland is located in the southwest part of Iran, at Khuzestan province, in the Iran and Iraq borderline (JAMAD, 2006) with coordinates at47^{0} longitude and 31^{0} latitude (UNEP, 2001) (Figures 1 and 2). Karkheh river originates from Lorestan Mountains and after passing through Azadegan plane and an area called Hamidieh, the Karkheh noor branch is divided into two, namely Hoofl and Nisan branches at Soosangerd city, and each of these branches is divided into several branches at Hoor. About two thirds of the area is located within Iraq, called HoorAlHoveizeh (Jamei, 2003) and the remaining one third is located within Iran. The area of the pond is affected by flood sand torrential sediments from Karkheh River in Iran and Tigris and Euphrates Riversin Iraq, respectively (Coppin et al., 2004; Augustine and Warrender, 1998).

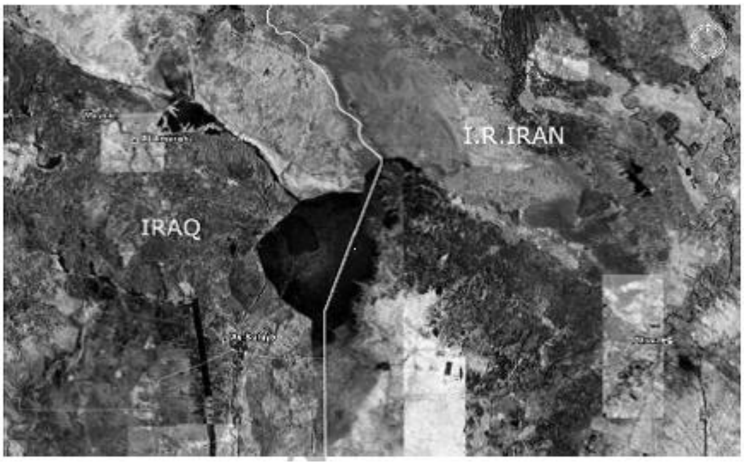

Figure1. *Location of Hoor-Al-Azim wetland at the border of Iran and Iraq (Google Earth,2008)*

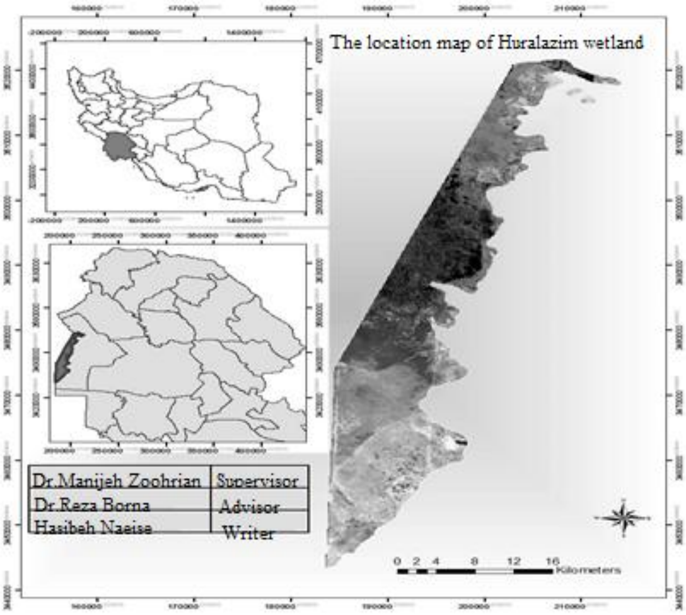

Figure2. *Location map of Hoor-Al-Azim wetland in Iran*

In 1377, Iran began to construct the largest dam on the Karkheh River. This is one of the biggest water resources of Hoor-Alazim lagoon, which has been designed to irrigate the lands of Khuzestan plane, 320,000 hectares in size (Meghdad, 1998).The areal extent of Hoor-Alazim is 176,000 hectares, of which 70,000 hectares are affected by floods and has reedy lands and extended lakes. The wetland extent depends on thesediments entering the river and its supply. By 1998, Iran has started to exploit from the largest dam on Karkheh River, which is one of the largest watery sources in Hoor-Alazim wetland. Indeed, the Azadegan oil fieldis one of the biggest oil fields in Iran, as well as internationally, with an oil capacity of 33 billion barrels of oil and daily production of 33 thousand barrels. As a result, this wetland has turned to be a special economic zone.

According to environmental regulations any industrial operation in wetland areas is prohibited and the oil fields must be 1500 m away from the wetland. However, this regulation had allowed to implement operations in 7500 hectares of the wetland, where in some parts of this land there were wetland functions, which were completely filled with water. The supply of water from the dam has caused the decline of the quantity of water entering the wetland, resulting, thus, into a remarkable reduction of the wetland extent. Specifically, the area of Mesopotamia marshy lands, which have been more than 8000 km^2 in size in 1966, have decreased to about 750 km^2 in 2002(Jone et al., 2005). Similarly, based on remote sensing techniques, it was estimated that the area of Hoor-Alazim ponds has decreased from 900 km^2 in 1991 to 400 km^2 in 2002 (Jamei et al., 2006; Chen, 2002). This study was intended to investigate the transfer of water entering the Hoor-Alazim pond quantitatively during a specific period. Although there have been some studies about the flow into the pond before and after the exploitation of Karkheh dam in quantitative terms, there is still a need to consider the impact of this trend on the area of Hoor-Alazim pond.

Historically, Iran’s black gold fields of oil and gas supply are considered national asset and constitute the country’s energy wealth, which provides 90% of Iran’s national revenue. Specifically, Khuzestan province, the country's oldest province, is located in the southwest of Iran, borders Iraq and the Gulf. This province produces 35 percent of the Iran’s water and electricity. However, despite residing amid incredible oil and gas, as well as agricultural wealth, the people in Khuzestan suffer from severe poverty, under-development, and environmental deprivation. Recently, an array of treacherous plans has been carried out in Khuzestan, which have led to disastrous air pollution and frequent water and power cut-offs. Moreover, there have been central drastic actions, such as the diversion of the Karun and Karkheh River waters, an excessive building of dams, and the use of quick and inexpensive methods of oil extraction, and the drying up of ponds and lakes in the area, including the famous Hoor-Alazim wetland, and Shadeganlagoon.

The Hoor-Al-Azim is one of the Bein Al-Nahrein wetlands, which has survived throughout the years. The Hoor-Alazim wetland is considered one of the most sensitive ecosystems in southwest of Iran and Khuzestan province on the Iran-Iraq boarders. This wetland is faced with frequent droughts. Moreover, there are anthropogenic interventions in recent years, which have a negative effect on the wetland ecosystem. Many environment experts claim that the human factor constitutes the main reason of wetland destruction, such as in Hoor-Al-Azim. Indeed, human and natural factors interfere, such as the occurrence of Holy War, the continued droughts in recent years, the limited upstream water resources and the oil exploration activities. Drought is also another problem caused by a reduction or even lack of precipitation that has a significant role in Hoor-Al-Azim wetland condition. Indeed, the inhibition of the wetlands has turned them to arable lands or even barren lands affecting the livelihood of societies.

Oil companies have created several problems to Hoor-Al-Azim wetland. Specifically, the drilling companies have constructed a road in the center of wetland for transportation and easy accessibility to the oil installations. Drilling wastes and their depletion into wetlands have deposited huge amounts of wastes, such as heavy metals and dangerous organic compounds. In addition, petroleum hydrocarbons enter into water, which create a lot of harms to ecosystem and wetland organisms. Moreover, oil companies in order to facilitate accessibility to oil have divided the wetland into five sub-regions. Furthermore, settled drilling companies in Hoor proceeded to dig deep and shallow pits in the area, which have caused groundwater resources evaporation and environmental imbalance. Moreover, oil exploitation in the wetland has caused additional environmental problems due to sand and dust movement into area (Fouladavand and Sayyad, 2015). Another potential environmental problem is acid rain, which is one of the water pollution causes resulting into acid water due to the decrease of PH. In addition, acid rain affects the fish population and can potentially destroy the generation of fish population totally.

4. Study Area and Data Base

4.1. Study Area

As already mentioned, Hoor-Alazim wetland is located in southeast of Iran in Khuzestan province, in the Iran-Iraq border, where two thirds of its area are located within Iraq lands and one third is located within Iran lands. This wetland with 500,000 hectares' extent is a wide area, which extends to the north at Hoor-Al-Nesaf and to the south at the low-lying fields. The Hoor eastern border is in Iran at the northeast of Bostan, the western border is in Iraq, the northern border is located in Iran at Seveyle village and the southern border is around the 31^0 latitude. Specifically, the eastern part of Hoor is located at the end of the southeast of Iran-Iraq border. This wetland is known by the name of Hoor-Al-Hoveizeh in Iraq. The location of Hoor-Alazim wetland between Iran and Iraq is shown in Figure 1 and Figure 2 shows the geographic location of the wetland in Iran. The images indicate the changes that have occurred in the Hoor-Al-Hemar, the central Hoor and Hoor-Al-Hoveize (Hoor-Al-Azim) and have caused many problems in these wetland ecosystems during recent years. The operation of Anatoly (GAP), southeast part of Turkey, which includes 22 dams and powerhouses, causes serious impacts on these wetlands (Friedl and Wuest, 2001).Generally, operations related to oil wells are associated with pollutants. There are different types of pollution, such as oil pollution, heavy metals, sewerages, toxic pollutants and pesticides. These pollutants have various harmful effects on the wetland environment and its affiliated entities.

Part of the study area is Karkheh River basin located at the end of it. Karkheh is the third full-water river of the country and one of the most important rivers of the aquiferous basins of the Persian Gulf. The Karkheh runs a wide area of Ilam, Kermanshah, Lorestan, Hamedan and the areas of Kurdistan and Khuzestan, then enters into Khuzestan plain passing through Bakhtar DezfulShosh, Soosangerd and Boostan cities, and then enters into Hoor-Alazim pond along with some branches. The basin area is about 50,727 km^2. This river doesn't enter into the Persian Gulf directly, rather it first enters into Hoor-Alazim, then ends at the Persian Gulf via Arvand River (Chen, 2002; Ramesht, 1987).

4.2. Data Base

There are two hydrometric stations, namely the Hoffel-Sousangerd hydrometric station and the Nissan-Sousangerd hydrometric station. A brief description follows.

The Hoffel-Sousangerd hydrometric station. This station with 21-488 code is located on one of the Karkheh River main branches, named Hoffel, and its geographic coordinates are 47˚, 11˜, 20" eastern longitude and 31˚, 30˜, 50" of northern latitude. The height of this station from the sea is 13 meters and was established in 1987.

Nisan-Sousangerd hydrometric station: This station with 21-489 code is located on one of the Karkheh branches, called Nisan, and the geographic coordinates are 48˚, 11˜, 20" in eastern longitude and 31˚, 32˜, 50" in northern latitude. The height of this station is 14 meters from the sea and was stablished in 1987.

At the present time, these hydrometric stations are adequately equipped with instruments and the current condition of stations is considered operational. After collecting data from the electricity and water authorities, the hydrometric stations data are processed and analyzed using also statistical tools.

5. Data Processing

Data processing includes three specific steps. The first step covers the collection and classification of previous studies and any background information being conducted about the region. The available sources of information include the internet, books, articles, letters, reports of public and international organizations, as well as private institutions and other additional sources. The procedure involves catalogues of the collected information following a comparison and checking, which is also valid for the obtained topographic, geophysical and other types of maps and aerial photos of the region from different organizations and agencies. Needless to say, special attention is given to the primary maps and aerial photos of the study area. The second step includes fieldworks and the status of the existing observation network in the region. The third step consists of data analysis and interpretation of results, where all the required software tools are considered and specifically the necessary tools for digital processing of maps and photos. The analysis results are presented in the form of tables, figures and maps.

After collecting the available meteorological data from Bostanstation, the nearest station to wetland, data analysis has been conducted. Different methods and approaches are used to assess the climatic conditions of the area, such as Amberge formula and Domarton method, respectively.

Amberge factor. Amberge factor is given by the following formula, which shows the relation between temperature and humidity:

In this Amberge climate factor, **p** is the annual rainfall (mm), **M** is the average maximum temperature in the warmest month of year (Kelvin), and **m** is the average minimum temperature in the coldest month (Kelvin). Table 1 presents the climatic classification of the synoptic station Bostan based on the Amberge factor. Moreover, Table 2 presents the climatic parameters of the Bostan station, which classify this station as moderate warm desert.

Table1. *Climatic classification based on Amberge factor*

The Type of climate	Abrreviation Signs	The Type of climate	Abrreviation Signs
Half dry cold	H	A hot warm desert	A
Half humidity mild	I	Middle warm desert	B
Half humidity cold	J	Mild warm desert	C
Humidity mild	K	Temperate desert	D
Very humidity	L	Cool dry	E
Cold humidity	M	mild	F
Climate Highlands	N	Half dry mild	G

Table2. *Climatic type of Synoptic station Bostan based on the Amberge factor*

station	Average Annual rainfall	Average maximum temperature in the warmest month of the year	Average minimum temperature in the coldest month of the year	Average maximum temperature in the warmest month of the year	Average minimum temperature in the coldest month of the year	Amberge Index	The type of climate
Bostan	**193.2**	**38.3**	**8**	**311.3**	**281.0**	**21.6**	**Moderate Warm Desert**

Domarton method. The Domarton classification method depends on the average annual temperature and annual rainfall values. The dryness index is calculated through the Domarton method. The Domarton method is given by the following formula, which presents the relation between temperature and humidity:

where **I** is the domarton indicator, **Pis** the average annual rainfall, and **M** is the average annual temperature. According this, the prevailing climate is type 2. Results of this method show that the region of Hoor-Al-Azim is characterized by drought.

Table3.*Climate type of synoptic station Bostan based on theDe Martone index*

Station	Average annual rainfall	Average Annual temperature	DeMartonne Index	The type of climate
Bostan	194.2	24.5	5.6	Dry

6. Analysis and Discussion Of Results

The water sources for feeding the Hoor-Al-Azim wetland. The Hoor-Alazim wetland receives water from the Karkheh River in Iran and Dejle in Iraq, although in recent years most of the water comes from the Karkheh River. The above mentioned rivers have a torrential water regime with maximum discharges during winter and early spring, especially in the Esfand and Farvardin reaches. Due to low water withdrawals for farming and low level evaporation, the floods of these rivers enter the Hoor from the northeast of Karkheh, north of Dejle and west of For at and have a major role in the creation and restoration of the wetland. The Karkheh River comes from the north of Lorestn and after entering into Dasht Azadeganat Hamidie, it is dividedinto Karkheh Noor and the main Karkheh branches. Moreover, at Sousangerd it is dividedinto three branches, including Nisan and Sable Rivers and the remaining of the main Karkheh flowing in specific ways and finally enters theHoor from the northeast. As already mentioned, in this analysis statistics of Hoffel and Nisan hydrometric stations on the Karkheh system have been used, thus, the registered level at the stations represents the development of water input to the wetland [14-30].

6.1. Assessing the Impact on the Microclimate of the Region

Analysis of results shows that the Hoor-Al-Azim wetland is a complicated ecological system, since during the study period, several factors and parameters are in full disorder and have regressed the system. As a result, the system is not in ecological balance during this period and the areal extent of the wetland has decreased significantly.

Results of microclimate changes in Hoor-Al-Azim wetland. In order to evaluate the area microclimate changes, the microclimatic parameters in the Bostan weather station have been analysed during the period before the drilling acrivities (1991-1999) and after starting drilling activities (2000-2010). The results are shown in Table 4. Specifically, Table 4 presents the results of statistical analysis of the basic microclimatic parameters, such as temperature, precipitation, evaporation, relative humidity, and sunshine duration. Results indicate that after drilling operations there is an increase in temperature and sunshine duration and a decrease in precipitation, evaporation and relative humidity, leading to drier climatic conditions for the period after drilling.

Table4. *Statistical analysis of microclimatic parameters before and after drilling operations*

Variable	Statistical period	Number of years	Average	Standard deviation	Coefficient of variation
Evaporation	1995-1999	5	3709.0	319.60	0.09
	2000-2010	11	3669.2	298.05	0.08
Relative humidity	1991-1999	9	49.9	3.01	0.06
	2000-2010	11	42.9	2.08	0.05
Sunshine duration in hours	1991-1999	9	2763.6	828.40	0.3
	2000-2010	11	3114.7	176.80	0.06
Temperature	1991-1999	9	23.8	0.81	0.03
	2000-2010	11	25.0	0.53	0.02
Precipitation	1991-1999	9	221.8	95.40	0.43
	2000-2010	11	171.6	62.05	0.36

6.2. Quantity and Quality of Input Water to Hoor-Al-Azim

This study aimed to examine the quantity of input water to Hoor-Alazim in terms of discharge and rainfall, as well as the quality of input water to the wetland during a certain period of time (1991-2011) by using the recorded data and information from the Khuzestan Water and Power Authority during this 20-year period (Jamei, 2003).In terms of water quantity, the results from this study have shown that the main factor for reducing the expansion of the Hoor-Alazim wetland is the reduction of input water to it caused by the Karkheh River drainage (Fouladavand and Sayyad, 2015; Ghobadil et al., 2012; Fouladavand, 2011; Zibanchi, 2009). Although rainfallhas not changed significantly during the recent years (Table 4), the quantity of input water to the wetland has been reduced. Figure 3 presents a plot of annual discharges of the two hydrometric stations during this 20-year period (1991-2011). Indeed, the amount of discharge has decreased dramatically. Specifically, the river discharge has been trending downward over time, where this decrease is significant after the initiation of drilling activities. According to the results, the areal extent of the wetland has changed from 900 km^2 in 1991 to about 300 km^2 in 2008 (Fouladav and and Sayyad, 2015).

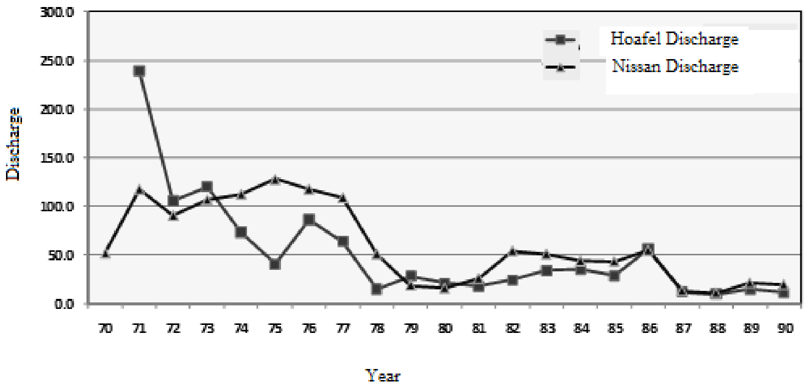

Figure3. *Annual discharge at Hoofel and Nissan Hydrometric Stations*

Data provided by the Khuzestan Water and Power Authority, as well as water resources management from hydrometric stations of Hoffel and Nisan during the 20-year period (1991-2011) have been used to assess the status of water quality (Chambari et el., 2006). This assessment includes theresults of analysis of basic anions (carbonate, bicarbonate, chloride, sulfate), basic cations (calcium, magnesium, sodium, potassium), total soluble salts (TDS), electrical conductivity (EC) and PH, as well as water temperature. Specifically, Table 5 presents the analysis of water quality parameters at Hoefel hydrometric station during the period before drilling activities (1991-1999) and after starting drilling activities (2000-2010), whereas Table 6 presents the corresponding analysis at Nissan hydrometric station, respectively. Results show that there are differences in the water quality parameters (soluble salts, electrical conductivities, cations and anions) for the period before drilling (1991-1999) and after drilling (2000-2011), indicating an increase of these parameters during the second period.

Table5. *Qualitative and Quantitative water parameters before and after drilling operations at Hoeffel station*

Variable	Statistical period	Number of years	Average	Standard deviation	Coefficient of variation
TDS	1991-1999	9	1069.8	283.4	0.3
	2000-2010	12	1350.0	286.6	0.2
EC	1991-1999	9	1647.4	452.0	0.3
	2000-2010	12	2097.4	483.3	0.2
Cation	1991-1999	9	16.6	4.5	0.3
	2000-2010	12	21.7	5.1	0.2
Anion	1991-1999	9	16.6	4.5	0.3
	2000-2010	12	21.7	5.1	0.2
Discharge	1991-1999	9	92.3	68.1	0.7
	2000-2010	12	24.3	13.2	0.5
The total soluble in mg/lit and electrical conductivity in mml/lit					
The total anions and cations in miliequivalent / lit					

Table6. *Qualitative and quantitative water parameters before and after drilling operations at Nissan station*

Variable	Statistical period	Number of years	Average	Standard deviation	Coefficient of variation
TDS	1991-1999	9	1071.5	236.4	0.2
	2000-2010	12	1361.5	337.8	0.2
EC	1991-1999	9	1639.6	366.7	0.2
	2000-2010	12	1986.7	497.3	0.3
Cation	1991-1999	9	16.7	3.8	0.23
	2000-2010	12	20.8	5.2	0.25
Anion	1991-1999	9	16.7	3.8	0.23
	2000-2010	12	20.8	5.2	0.25
Discharge	1991-1999	9	98.3	28.6	0.3
	2000-2010	12	30	17.0	0.6
The total soluble in mg/lit and electrical conductivity in mmol/lit					
The total anions and cations in miliequivalent / lit					

Water temperature. Water temperature is a function of air temperature and has a major effect on water quality, gas dissolution, and chemical equilibrium. The oxygen and carbon dioxide solubility depends on water temperature and decreases by an increase of temperature. Moreover, water temperature affects the biological status and self-purification of rivers directly and indirectly. Specifically, the indirect impact is the effect on the dissolution of gases, whereas the direct effect of increasing the water temperature consists of the activities of microorganisms and decomposition of organic materials. The average water temperature at Hoffel and Nisan hydrometric stations is 21 and 21.4 centigrade, respectively.

Water PH. The results of analysis on the water pH at the two hydrometric stations indicate that the water quality for drinking purposes is acceptable and there are no limitations or restrictions. Specifically, the average pH values for Hoffel and Nisan hydrometric stations are 8.1 and 8.04, respectively.[31-50]

Electrical conductivity(EC) and total soluble salts(TDS). The water electrical conductivity measurements are summarized in Figures 4 and 5 for the two hydrometric stations Hoffel and Nissan, respectively. From figures 4 and 5, it is concluded that the average water EC at Nisan and Hoffel stations for the 20-year period (1991-2011) is 1839.9 and 1904.6 Micromhos per second, respectively. Moreover, the amount of water total dissolved salts (TDS) have a direct relationship with EC and are used as one of the quality indicators for the standard of drinking water. From the results of TDS measurements, it can be stated that the average water TDS at Nisan and Hofel stations is 1237.2 and 1229.9 milligrams per liter, respectively [51-70].

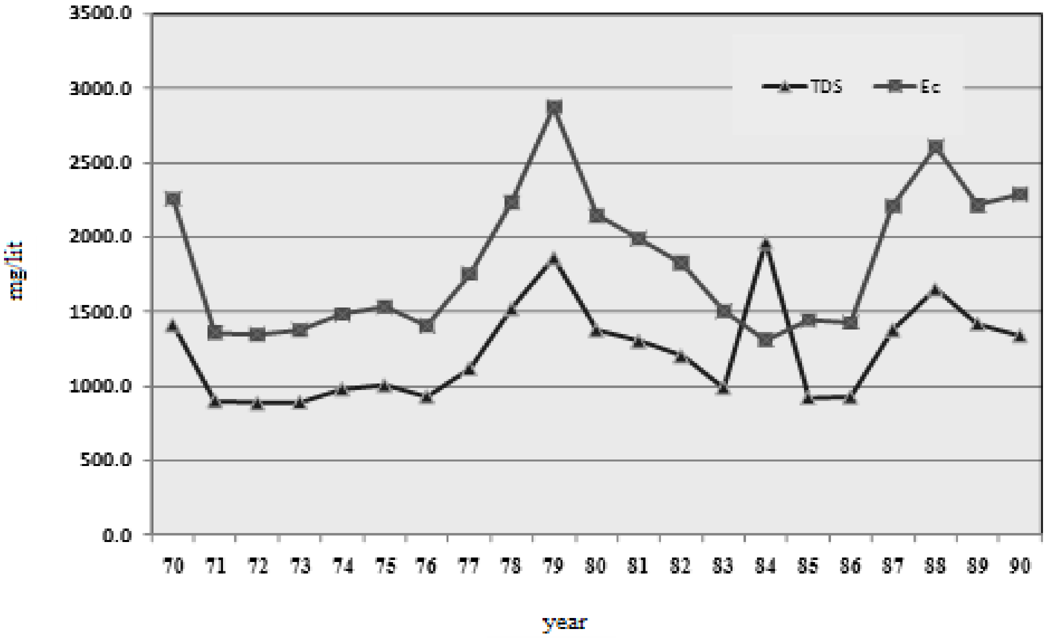

Figure4. *Time series plot of electrical conductivity (EC) and TDS at Hoffel station (1991-2011)*

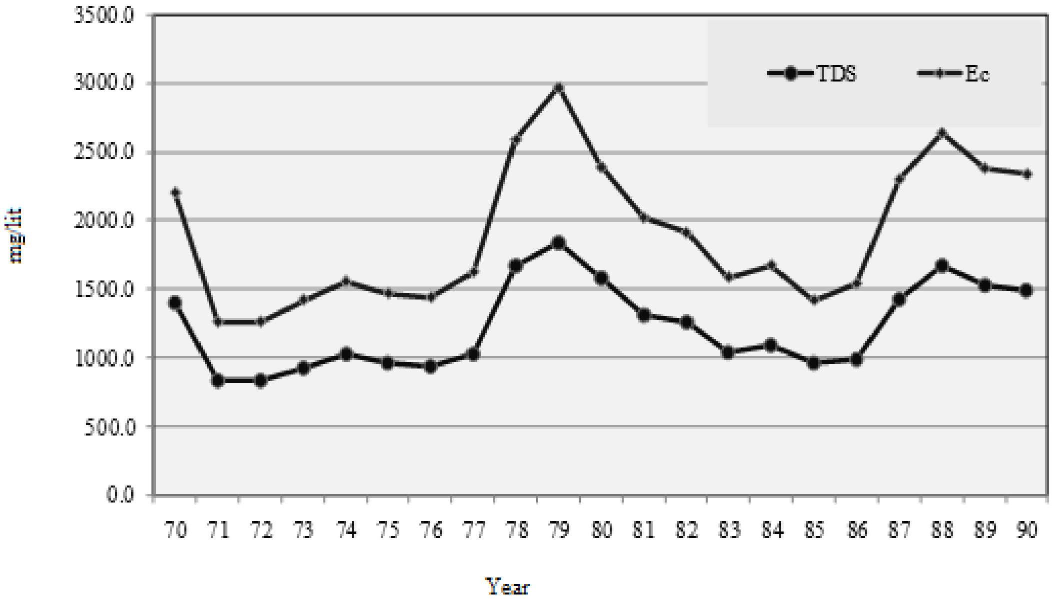

Figure5. *Time series plot of electrical conductivity (EC) and TDS at Nissan station (1991-2011)*

Quality of drinking water. The Scholler diagram (Figure 6) is one way to classify water for drinking purposes. The physical and chemical properties of drinking water can be classified by measuring the total amount of Anions and Cations through the Scholler diagram. According to this diagram, the quality of water for drinking purposes in this region is considered as good to average (Figure 6).

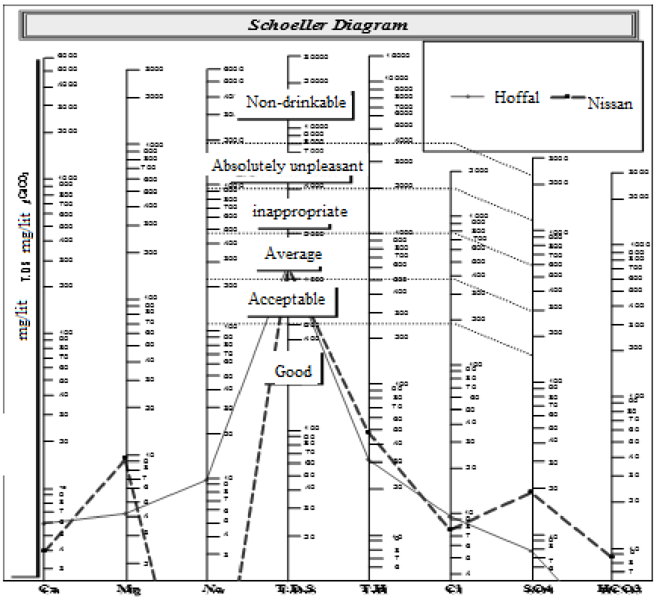

Figure6. *Qualitative status of water for drinking according to Schuler chart*

Water quality for agricultural purposes. One of the most common methods for water classification for agricultural purposes is the Wilcox classification (Figure 7), which is based on the Sodium Attraction Relative (SAR) and electrical conductivity (EC). Specifically, in the Wilcox diagram (Figure 7), the horizontal axis is related to the salinity (micro MOs per centimeter) and the vertical axis is specified for sodium attraction relative (SAR). The classification of water into quality groups based on the Wilcox diagram is as follows:

1. Very good waters, where the EC is less than 250 micromhos per centimeter, which are characterized as C1S1 class;
2. Good waters belonging to one of C2S1, C2S2, C1S2 classes.
3. Waters with average quality related to one of C3S3, C1S3, C3S1, C3S2 classes.
4. Rough waters that belong to C1S4, C2S4, C3S4, C4S4, C4S1, C4S2, C4S3.

According to Figure 7, the water in the region for agricultural uses is characterized as C3S1 class in both hydrometric stations. As a result, the waters are considered to be of good quality for agricultural purposes [71-90].

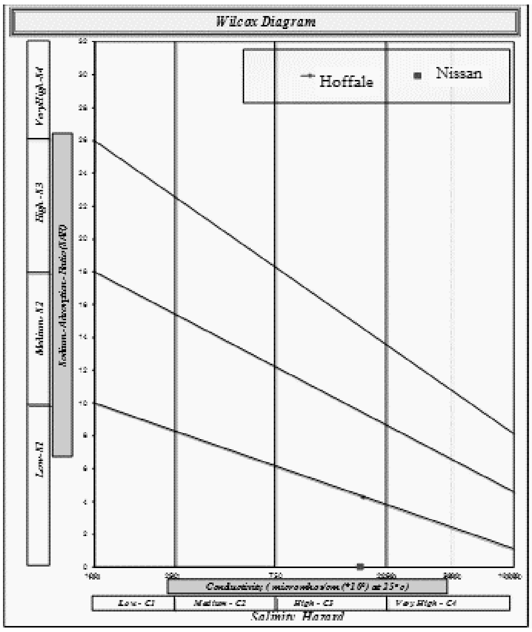

Figure7. *Qualitative status of water of Barajin River for agricultural consumption according to Wilcox chart*

7. Summary and Conclusions

At the present time, the aquatic and terrestrial habitats around the world are exploited and used by humans for various purposes. In most of these natural areas the necessary environmental rules and regulations for a sustainable ecosystem are not followed. Analysis shows that the Hoor-Al-Azim wetland is a complicated ecosystem, which, during the study period, as a result of various factors and parameters, is in a disorder situation and has regressed as a system. In other words, the ecosystem has been destroyed during this period and there are negative impacts on the microclimatic and water quality parameters, as well as an increase in the number of drought episodes and an overall reduction of the areal extent of the wetland.

These findings justify the negative impact from the increase in human and anthropogenic intervention and the continuing activities of the drilling companies in the region. Specifically, there are several factors, which contribute to the deterioration of the ecosystem sustainability, such as an increase in road-building, additional ways around the wetland leading to fragmentation and gradual dryness in the wetland. On the other hand, in drilling oil wells there is lack of rules and regulations for labor protection. All the above lead to an increase in drought episodes inHoor-Al-Azim wetland, increasing, thus, the possibility of wetland destruction and turning it to an arable land. In addition, construction of dams at the entrance of the wetland accelerates the loss of breadth and depth of water.

This construction cycle and processes have an impact on the ecological cycle and the natural resources, leading to limited food resources in the region. In other words, the construction and drilling activities prevent the normal and regular distribution of resources on the Hoor sidelines. Accordingly, since the wetland's migratory birds are mostly fed by water and spend the winter in shallow waters, the appearance of these dry spotsat such large-scale results in the concentration of the birds in one spot, increasing, thus, the population density in one place. This high population density has led to an increase of food competition, leading toan increase of poor nutrition for birds. The continuation of this process ultimately causes environmental imbalance and insecurity for animals in the food chain, as well as an ecological disorder in the wetland. These changes around the wetland area, along with other factors, such as water withdrawals during some time periods, as well as waste waters entering the wetland upstream, can also exacerbate the effects of destructive factors within the wetland and increase the rate of degradation.

Analysis also indicate that the water quality has been dropped after drilling operations at Hoffel and Nisan stations. It seems that drilling operations in the wetland and construction of water wells by the oil company has led to a change in the hydraulic gradient and a decrease in the level of river water, which finally leads to an increase of the density of soluble salts and the salinity of water, thus, decreasing the water quality of the wetland. Moreover, the reduction of water outflow and the decrease of water quality of the wetland are the results of Karkheh dam dewatering in order to enhance agricultural projects around the Karkheh, and the return of water for irrigation and drainage purposes from downstream of Karkheh.

References

[1] Arvin, A.A., M. Rahimi and M. A.Qoli, 2014.Deadly Tsunami and the negative impact on Iran border regions (Case study: Ahvaz, Iran).Journal of Novel Applied Sciences. Available online at www.jnasci.org ©2014 JNAS Journal-2014-3-7/719-723.

[2] Augustine M.F., Warrender C.E, 1998, Wetland classification using optical and radar data and neural network classification, Int. J. of Remote Sensing. Vol. 19, 1545-1560.

[3] Chambari, s., Jafarzadeh, N., & Nabavi, M. (2006). Investigation of organic pollutants of Horealamim wetland using water qualitative factors and biological indices. Third National Conference on Iranian Environmental Crisis and its Improvement (pp. 77-89). Ahvaz: Azad University.

[4] Chen, X., 2002. Using remote sensing and GIS to analyze land cover change and its impacts on regional sustainable development, Int. J. Remote Sensing, Vol. 23, pp. 107-124.

[5] Coppin, P., Jonckheere, I., Nackaerts, K., Muys, B., and Lambin, E., 2004, Digital change detection methods in ecosystem monitoring; a review, International Journal of Remote Sensing. Vol. 25, pp. 1565-1596.

[6] Davies, J. C., &Claridge, C. (1993). Wetland benefits: the potential for wetlands to support and maintain development (Vol. 1). (A. Ayaft, Trans.) Tehran: Department of Environment Dayere Sabz.

[7] Emadi, M. Baghernejad, M. Pakparvar, and S. A. Kowsar .(2010). "An approach for land suitability evaluation using geostatistics, remote sensing, and geographic information system in arid and semiarid ecosystems," Environmental Monitoring and Assessment. vol. 164, 2010, pp. 501–511.

[8] Fouladavand, S. and G.A. Sayyad, 2015. The Impact of Karkheh Dam Construction on Reducing the Extent of Wetlands of Hoor-Alazim. Journal of Water Resources and Ocean Science. Volume 4, Issue 2, April, 33-38.

[9] Fouladavand, S. (2011). Investigation of qualitative and quantitative changes of water flow into the Hooralazim Wetland due to the construction of Karkheh Reservoir Dam. 71-85.

[10] Friedl, G., and Wuest, A.(2001). Southeastern Anatolia Project in Turkey-GAP. Seminar for Doctoral Students at the ETH Zurich: 21-24. http://WWW. Eawagech/research_e/apec/damsworldwide_e.html.

[11] Ghobadi1, Y., Pradhan1, B. Kabiri, K., Pirasteh, S., Shafri, H. Z.M. and Sayyad, G. A. (2012). Use of Multi-Temporal Remote Sensing Data and GIS for Wetland Change Monitoring and Degradation.2012 IEEE Colloquium on Humanities, Science &Engineering Research (CHUSER 2012), December 3-4< 2012, Kota Kinabalu, Saban, Malaysia.

[12] Jafari, N.(2009). Ecological integrity of wetland, their functions and sustainable use. Journal of Ecology and Natural Environment Vol. 1(3), pp. 045-054, June, 2009.Available online at http://www. academic journals.org/JENE.

[13] JAMAB, 2006, Water balance report of Karkheh River Basin area: preliminary analysis, JAMAB Consulting Engineers in Association with Ministry of Energy, Iran.

[14] JAMAB, 1999, Comprehensive assessment of national water resources: Karkheh River Basin, JAMAB Consulting Engineers in Association with Ministry of Energy, Iran (In Persian).

[15] Jamei, M., 2003. Introducing theKhuzestan Wetlands and estuaries,first ed., Water Research Council Publications, Khuzestan Water and Power Authority, 39-44.

[16] Jones, C., Sultan, M., Yan, E., Mileweki, A., Hossein, M., Al-Dousari, A., Al-Kaisy, S., and Becker, R., 2008. Hydrological impacts of engineering projects on the Tigris-Euphrates system and its marshlands, Hydrology, 353, 59-75.

[17] Hemadi, K., Nozarian, L., &Tajdari, K. (2008). The Effect of Time Scale on Estimating Total Soluble (TDS) of the river. Third Conference on Water Resources Management (pp. 196-200). Ahvaz: Chamran University.

[18] Majnonian, H. (1998) Wetlands classification and protection (values and functions) (Vol. 2). Tehran: The Environmental Protection Agency, 49-56.

[19] Masih, M. D. Ahman. S. Uhlenbrook, H. Turral, and P. Karimi, 2009, Analyzing stream flow variability and water allocation for sustainable management of water resources in the semi-arid Karkheh river basin, Iran, Physic and Chemistry of the Earth, Vol. 34, 329-340.

[20] Meghdad, A., 1998, Water Quantity in Border Marshlands between Iran and Iraq, Vol. 1, first ed., Baghdad University, Baghdad, 104-108.

[21] Mokhtari, S., Soltani, H., Yavari, A., 2009, SelfOrganizingatHoor-Alazim/ HoorAlhoviezeh wetland with emphasison ecology Landscape, Journal of Natural Geography Researches, No. 70, 93-105.

[22] Navidpour, S., Vazirianzadeh, B., Harbach, R., Jahanifard, E., and Moravvej, S. A. (2012). The identification of culicine mosquitoes in the Shadegan wetland in southwestern Iran. Journal of Insect Science: Vol. 12 | Article 105.

[23] Ramesht, M., H., 1987. Natural GeographyHoor-Alazim,1st ed, Art Publications, Tehran, 15-24.

[24] UNEP, 2001, the Mesopotamian Marshlands: Demise of an Ecosystem Early Warning and Assessment Report, UNEP/DEWA/TR.01-3 Rev.1. Division of Early Warning and Assessment, United Nations Environmental Programe, Nairobi, Kenya.

[25] Zibanchi, M. H. (2009). Describing a Qualitative Quantitative Balance Sheet Model for Determining the Right of Wetlands (Hoor-Alazim Wetland). Retrieved from https://www.civilica.com/Paper.

[26] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Study of sensitivity of Autumnal wheat to under irrigation in Shahrekord, Shahrekord City, Iran. International Journal of Agriculture and Crop Sciences, 8 (4), 602-605.

[27] Shayannejad, M., Akbari, N., Ostad-Ali-Askari, K. 2015, Study of modifications of the river physical specifications on muskingum coefficients, through employment of genetic algorithm. International Journal of Development Research, 5(3), 3782-3785.

[28] Ostad-Ali-Askari, K., Shayannejad, M. 2015, The Reviews of Einstein's Equation of Logarithmic Distribution Platform and the Process of Changes in the Speed Range of the Karkheh River, Khuzestan province, Iran. International Journal of Development Research, 5(3), 3786-3790.

[29] Ostad-Ali-Askari, K., Shayannejad, M., Ghorbanizadee-Kharazi, H. 2015, Assessment of artificial neural network performance and exponential regression in prediction of effective rainfall, International Journal of Development Research, 5(3),3791-3794.

[30] Shayannejad, M. Akbari, N. and Ostad-Ali-Askari, K. 2015, Determination of the nonlinear Muskingum model coefficients using genetic algorithm and numerical solution of the continuity. Int. J. of Science: Basic and Applied Research, 21(1),1-14.

[31] Ostad-Ali-Askari, K., Shayannejad, M. 2015, The Study of Mixture Design for Foam Bitumen and the Polymeric and Oil Materials Function in Loose Soils Consolidation. Journal of Civil Engineering Research, 5(2), 39-44. DOI: 10.5923/j.jce.20150502.04

[32] Sayedipour, M., Ostad-Ali-Askari, K., Shayannejad, M. 2015, Recovery of Run off of the Sewage Refinery, a Factor for Balancing the Isfahan-Borkhar Plain Water Table in Drought Crisis Situation in Isfahan Province-Iran. American Journal of Environmental Engineering, 5(2): 43-46. DOI: 10.5923/j.ajee.20150502.02

[33] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Developing an Optimal Design Model of Furrow Irrigation Based on the Minimum Cost and Maximum Irrigation Efficiency. International Bulletin of Water Resources & Development, 3(2), 18-23.

[34] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Presenting a Mathematical Model for Estimating the Deep Percolation Due to Irrigation. International Journal of Hydraulic Engineering, 4(1), 17-21. DOI: 10.5923/ j.ijhe.20150401.03.

[35] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Usage of rockfill dams in the HEC-RAS software for the purpose of controlling floods. American Journal of Fluid Dynamics, 5(1), 23-29. DOI: 10.5923/j.ajfd. 20150501.03.

[36] Ostad-Ali- Askari, K., Shayannejad, M. 2015, The effect of heterogeneity due to inappropriate tillage on water advance and recession in furrow irrigation. Journal of Agricultural Science, 7(6), 127-136.

[37] Shayannejad, M., Ostad-Ali-Askari, K. 2015, Effects of magnetized municipal effluent on some chemical properties of soil in furrow irrigation. International Journal of Agriculture and Crop Sciences, 8(3), 482-489.

[38] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Optimal design of pressurized irrigation laterals installed on sloping land. International Journal of Agriculture and Crop Sciences, ISSN 2227-670X. 8(5), 792-797.

[39] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, Jahangiri A.K, Shabani A.H, Environmental Hydraulics of Open Channel Flows. Kankash Publisher. First Edition, 2015. ISBN: 978-600-136-303-0.

[40] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, Navab-Pour B. 2016, Comparison of solution of Saint-Venant equations by characteristics and finite difference methods for unsteady flow analyzing in open channel. International Journal of Hydrology Science and Technology, 6(3), 9-18.

[41] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, et al. 2017, Deficit Irrigation: Optimization Models. Management of Drought and Water Scarcity. Handbook of Drought and Water Scarcity, Taylor & Francis Publisher, USA. Vol. 3. 1th Edition, pp: 373-389.

[42] Eskandari S, Hoodaji M, Tahmourespour A, Abdollahi A, Mohammadian-Baghi T, Eslamian S, Ostad-Ali-Askari K. 2017, Bioremediation of Polycyclic Aromatic Hydrocarbons by Bacillus Licheniformis ATHE9 and Bacillus Mojavensis ATHE13 as Newly Strains Isolated from Oil-Contaminated Soil. Journal of Geography, Environment and Earth Science International, 11(2): 1-11.

[43] Shayannejad M, Ostad-Ali-Askari K, Eslamian S, et al. 2017, Development of a new method for determination of infiltration coefficients in furrow irrigation with natural non-uniformity of slope. Sustain. Water Resour. Manag., 3(2): 163-169.

[44] Shojaei N, Shafaei-Bejestan M, Eslamian S, Marani-Barzani M, P. Singh V, Kazemi M, Ostad-Ali-Askari K. 2017, Assessment of Drainage Slope on the Manning Coarseness Coefficient in Mountain Area. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(1): 33-40.

[45] Bahmanpour H, Awhadi S, Enjili J, Eslamian S, Ostad-Ali-Askari K. 2017, Optimizing Absorbent Bentonite and Evaluation of Contaminants Removal from Petrochemical Industries Wastewater. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(2): 34-42.

[46] Shayannejad M, Eslamian S, Gandomkar A, Marani-Barzani M, Amoushahi-Khouzani M, Majidifar Z, Rajaei-Rizi F, Kazemi M, P. Singh V, Dehghan SH, Shirvani-Dastgerdi H.R, Norouzi H, Ostad-Ali-Askari K. 2017, A Proper Way to Install Trapezoidal Flumes for Measurements in Furrow Irrigation Systems. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(7): 1-5.

[47] Dehghan Sh, Kamaneh S.A.A., Eslamian S, Gandomkar A, Marani-Barzani M, Amoushahi-Khouzani M, Singh V.P., Ostad-Ali-Askari K. 2017, Changes in Temperature and Precipitation with the Analysis of Geomorphic Basin Chaos in Shiraz, Iran. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(2): 50-57.

[48] Ostad-Ali-Askari K, Shayannejad M. 2016, FLOOD ROUTING IN RIVERS BY MUSKINGUM'S METHOD WITH NEW ADJUSTED COEFFICIENTS. International Water Technology Journal, IWTJ, 6(3): 189-194.

[49] Ostad-Ali-Askari K, Shayannejad M, Ghorbanizadeh-Kharazi H. 2017, Artificial Neural Network for Modeling Nitrate Pollution of Groundwater in Marginal Area of Zayandeh-rood River, Isfahan, Iran. KSCE Journal of Civil Engineering, 21(1):134-140. Korean Society of Civil Engineers. DOI 10.1007/ s12205-016-0572-8.

[50] Shayannejad M, Ostad-Ali-Askari K, Ramesh A, Singh V.P., Eslamian S. 2017, Wastewater and Magnetized Wastewater Effects on Soil Erosion in Furrow Irrigation. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(8): 1-14. http://dx.doi.org/10.20431/2454-6224.0308001.

[51] Shayannejad M, Soltani-Toudeshki A.R, Arab M.A, Eslamian S, Amoushahi-Khouzani M, Marani-Barzani M, Ostad-Ali-Askari K. 2017, A Simple Method for Land Grading Computations and its Comparison with Genetic Algorithm (GA) Method. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(8): 26-38.

[52] Mohieyimen P, Eslamian S, Ostad-Ali-Askari K, Soltani M. 2017,Climate Variability: Integration of Renewable Energy into Present and Future Energy Systems in Designing Residential Buildings. International journal of Rural Development, Environment and Health Research(IJREH), 1(2): 18-30.

[53] Shayannejad M, Ostad-Ali-Askari K, Eslamian S, et al. 2017, Flow Hydraulic Investigation of the Wastewater on the Soil and Magnetic Field Effects in This Field. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(3): 1-15.

[54] Shayannejad M, Eslamian S, Singh V.P., Ostad-Ali-Askari K, et al. 2017, Evaluation of Groundwater Quality for Industrial Using GIS in Mountainous Region of Isfahan Province, Koh-Payeh, Isfahan, Iran. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(3): 24-37.

[55] Eslamian S, P. Singh V, Ostad-Ali-Askari K, R. Dalezios N, Yihdego Y, et al. 2017, Assessment of Aridity Using Geographical Information System in Zayandeh-Roud Basin, Isfahan, Iran. International Journal of Mining Science (IJMS), 3(2): 49-61.

[56] Askari Z, Samadi-Boroujeni H, Fattahi-Nafchi R, Yousefi N, Eslamian S, Ostad-Ali-Askari K, P. Singh V, R. Dalezios N. 2017, Prediction Comparison of Flow Resistance in Channels with Rounded and Angular Coarse Rough Beds. American Research Journal of Civil And Structural, 3(1): 1-15.

[57] Ghane M, Alvankar S.R., Eslamian S, Amoushahi-Khouzani M, Gandomkar A, Zamani E, Marani-Barzani M, Kazemi M, Soltani M, Dehghan SH, P. Singh V, Ostad-Ali-Askari K, HaeriHamedani M, Shirvani-Dastgerdi H.R., Zalaki-Badil N. 2017, Sensitivity Analysis of Runoff Model by SWAT to Meteorological Parameters: A Case Study of Kasillian Watershed, Mazandaran, Iran. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(10): 1-20.

[58] Shayannejad M, Abedi M.S., Eslamian S, Ostad-AliAskari K, Gandomkar A, Cheng A, et al. 2017, The Contribution of Artificial Charging in Optimal Exploitation of Water Resources, Isfahan, Iran. InternationalJournal of Mining Science (IJMS), 3(3): 9-20.

[59] Eslamian S,Ostad-AliAskari K, et al. 2017, Guidelines to Optimal Design of Furrow Irrigation Based on Plants, Soil and Furrow Specifications. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(4): 20-39.

[60] Coles, N. A. and Eslamian, S., 2017, Definition of Drought, Ch. 1 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 1-12.

[61] [61] Dalezios, N. R., Dunkel, Z., Eslamian, S., 2017, Meteorological Drought Indices: Definitions, Ch. 3 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 24-44.

[62] Goyal, M. K. Gupta, V., Eslamian, S., 2017, Hydrological Drought: Water Surface and Duration Curve Indices, Ch. 4 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 45-72.

[63] Dalezios, N. R., Gobin, A., Tarquis Alfonso, A. M., and Eslamian, S., 2017, Agricultural Drought Indices: Combining Crop, Climate, and Soil Factors, Ch. 5 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 73-90.

[64] TishehZan, P. and Eslamian, S., 2017, Agricultural Drought: Organizational Perspectives, Ch. 6 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 91-108.

[65] Bazrkar, M. H., Eslamian, S., 2017, Ocean Oscillation and Drought Indices: Application, Ch. 8 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 127-136.

[66] Basu, R., Singh, C. K., Eslamian, S., 2017, Cause and Occurrence of Drought, Ch. 9 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 137-148.

[67] Bazrafshan, J., Hejabi, S., Eslamian, S., 2017, Drought Modeling Examples, Ch. 11 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 167-188.

[68] Jonathan Peter Cox, Sara Shaeri Karimi, Eslamian, S., 2017, Real-Time Drought Management, Ch. 13 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 209-216.

[69] Garg, V. and Eslamian, S., 2017, Monitoring, Assessment, and Forecasting of Drought Using RemoteSensing and the Geographical Information System. Ch. 14 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 217-252.

[70] Dalezios, N. R., Tarquis Alfonso, A. M., and Eslamian, S., 2017, Drought Assessment and Risk Analysis, Ch. 18 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 323-344. Dalezios, N. R., Spyropoulosand, N. V.,

[71] Eslamian, S., 2017, Remote Sensing in Drought Quantification and Assessment, Ch. 21 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 377-396.

[72] Araghinejad, S., Hosseini-Moghari, S. M., Eslamian, S., 2017, Application of Data-Driven Models in Drought Forecasting, Ch. 23 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 423-440.

[73] Vafakhah, M., and Eslamian, S., 2017, Application of Intelligent Technology in Rainfall Analysis, Ch. 24 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 441-460.

[74] Vafakhah, M., Akbari Majdar, H. and Eslamian, S., 2017, Rainfall Prediction Using Time Series Analysis, Ch. 28 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 517-540.

[75] González, M. H., Garbarini, E. M., Rolla, A. L., and Eslamian, S., 2017, Meteorological Drought Indices: Rainfall Prediction in Argentina, Ch. 29 in Handbook of Drought and Water Scarcity, Vol. 1: Principles of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 541-570.

[76] Gaaloul, N., Eslamian, S., and Laignel, B., 2017, Contamination of Groundwater in Arid and Semiarid Lands, Ch. 16 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 291-314.

[77] Banjoko, B., Eslamian, S., 2017, Sanitation in Drought, Ch. 17 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 315-330.

[78] Davari, A., Bagheri, A., Reyhani, M. N., Eslamian, S., 2017, Environmental Flows Assessment in Scarce Water Resources, Ch. 18 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 331-352.

[79] Qian, Q., Eslamian, S., 2017, Streamflow Quality in Low-Flow Conditions, Ch. 20 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 375-386.

[80] Mohammadzade Miyab, N., Eslamian, S., Dalezios, N. R., 2017, River Sediment in Low Flow Condition, Ch. 21 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 387-408.

[81] Pérez-Blanco, C. D., Delacámara., G., Gómez., C. M., Eslamian, S., 2017, Crop Insurance in Drought Conditions, Ch. 23 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 423-444.

[82] Kahrizi, D., Esfahani, K., Ashraf Mehrabi, A., Ghaheri, M., Azizi Aram, Z., Khosravi, S., Eslamian, S., 2017, Biotechnology for Drought Improvement, Ch. 24 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 445-460.

[83] Wade, P., Eslamian, S., 2017, Water Issues from a System Dynamics Perspective, Ch. 25 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 461-488.

[84] Rahman, A., Hajani, E., Eslamian, S., 2017, Rainwater Harvesting in Arid Regions of Australia, Ch. 26 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 489-500.

[85] Mukherjee, S., Yadav, K., Eslamian, S., 2017, Soil Contaminations in Arid and Semiarid Land, Ch. 29 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 547-556.

[86] Dayani, S., Sabzalian, M. R., Hadipour, M. Eslamian, S., 2017, Water Scarcity and Sustainable Urban Green Landscape, Ch. 30 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 557-604.

[87] Gohari, A., Zareian, M. J., Eslamian, S., Nazari, R. 2017, Interbasin Transfers of Water: Zayandeh-Rud River Basin, Ch. 32 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 619-630.

[88] Banjoko, B., Eslamian, S., 2017, Environmental Evaluation: Lessons Learned from Case Studies, Ch. 33 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 631-664.

[89] Abbasova, D., Eslamian, S., Nazari, R., 2017, Paleo-Drought: Measurements and Analysis, Ch. 34 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 665-674.

[90] Yihdego, Y., Eslamian, S., 2017, Drought Management: Initiatives and Objectives, Ch. 1 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 1-26.

Citation: *Dr. Kaveh Ostad-Ali-Askari et al. (2017). Assessment of Anthropogenic Influences on the Micro-Climate of Wetland Ecosystems: The Case of Hoor-Alazim Wetland in Iran***,** *International Journal of Mining Science (IJMS), 3(4), pp.34-51, DOI: http://dx.doi.org/ 10.20431/2454-9460.0304004.*