A study of Meighan wetland (IRAN) hydrological changes and its environmental impacts by using satellite images

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Abstract

In the current world, wetlands have a very critical ecological role in ecosystem equilibrium. The harmful effects of drying wetlands are very extensive and on diverse dimensions. An obvious example of this phenomenon is the dust caused by the drying of wetlands and its harmful effects on the people of the region. Also, wetland water level changes caused by various criteria can affect regional wildlife and vegetation. Understanding the process of change and its evolution and the current trend can be helpful in predicting the future status of wetlands. In this research, the area of Meighan wetland was investigated by using Landsat satellite images in the last two decades. The results showed that over Meighan wetland area has fallen by about 9.14 km^2.

Keywords: Common Crane, Environment, Landsat, SWI

Introduction

Dry areas cover more than 30% of the earth. In terms of ecological conditions, most of the area of Iran is dry. Wetland is a habitat where water is the main factor in its environment. Wetlands are usually formed when the body of water is at or near the surface of the earth. Wetlands in dry areas are the only ecosystems that are able to moderate the extreme environmental conditions of these areas and they can create diverse vital areas (Khumjani Farahani, 2005). Urbanization, global warming, land cover changes, and agricultural activities highly affect the size and quality of wetlands (Eid et al., 2020). In the current world, Wetlands have a very ecological important role in ecosystem equilibrium. Iran's wetlands are located in the migration routes of water and

waterside birds that migrate from cold northern regions to tropical southern lands. In recent decades, Iran's wetlands, like wetlands in other parts of the world, have been polluted and destroyed which has caused to decrease in the number of birds (Bagherzadeh Karimi, 2014). Changes in the water of wetlands can affect the wildlife and vegetation of the area. Human activities accelerate this process and lead to the destruction of the wetlands (Jafari et al., 2016). Meighan wetland as a valuable ecosystem is not exempted from this rule and it has been affected by increases in population and industrialization of its adjacent cities (Piri, 2011). Due to their dynamic hydrology, wetlands are one of the largest biological ecosystems in the world (Halabisky et al., 2016). These ecosystems are always polluted due to industrial, agricultural, and domestic activities, and they receive the resulting wastewater from their catchment area. Then it transports to the seas, but in the internal waters of the country, it is a place of accumulation of pollutants and finally, it transfers to birds and fish. Finally, all of its good and evil go back to the last link, i.e. humans (Vosoughi & Mostajir, 2005). These ecosystems are the most vital habitats with rich biodiversity and a high range of ecosystem services, such as mitigating flood and drought, conserving biodiversity, supplying freshwater and groundwater and etc. (Liu et al., 2020). During the last century, more than 50% of the wetlands on the planet have been destroyed and the remaining ones have been heavily influenced by human activities and they are on the path of destruction. The harmful effects of drying wetlands, especially in arid and semi-arid regions such as Iran, are very wide and diverse. A clear example of this issue is the phenomenon of dust caused by the drying wetlands and its harmful effects on the people of the region (Bagherzadeh Karimi, 2014). Monitoring the process of changes in wetlands and their surrounding lands can be a breakthrough in the management of these valuable ecosystems (Ozesmi & Bauer, 2002). Considering the importance of the Meighan wetland in the region, in this research we tried to investigate the amount of water in this study area by using satellite images.

Material and methods

Meighan Wetland is one of the largest salt flats in the center of Iran. This wetland extends from longitudes to $50^{0}/02'/00''$ E and latitudes to $34^{0}/21'/30''$ N (Fig. 1), it's between Zagros and Central Iran mountains, and this area is located in Markazi Province. Meighan wetland is one of the most important habitats of migratory and native birds, and in winter this is a stopover for many groups of migratory birds including the Common Crane (*Grus grus*) which fly from northern regions to the southern lands. Compared to other wetlands, Meighan Wetland has more common Cranes. So,

it is one of the most important habitats in the country (Alah dadi & Ghadimi, 2013)**.** So a symbol of wetland conservation is the Common Crane (*Grus grus*) (Ojaste et al., 2020).
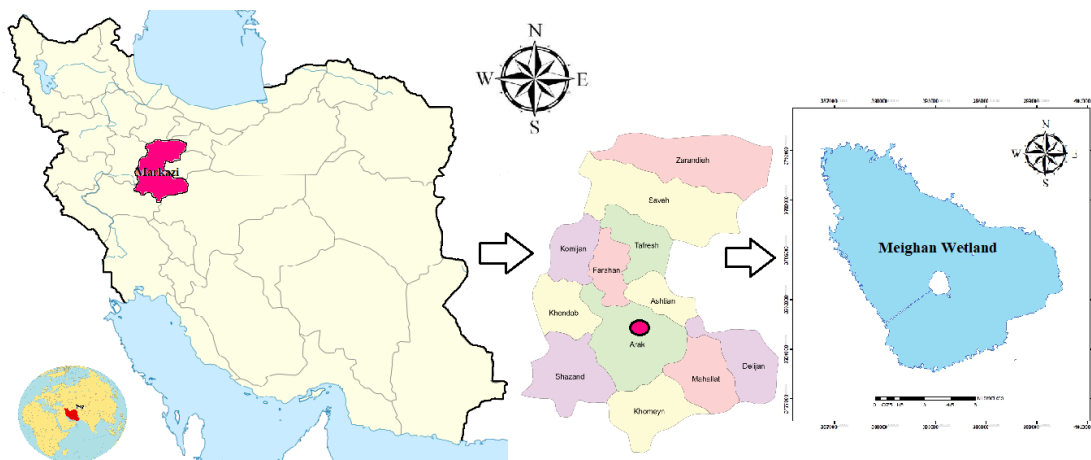
Figure 1. Location of study area

The spectral characteristics of water are very different from other land surface types (e.g. soil, vegetation and …) due to its strong absorption. Clean water has a small spectral reflectance in the visible spectral region and other surface covers have greater reflectance than water. The surface Wetness Index (SWI) is calculated using at-satellite-based reflectance showing minimum values for dry lands and maximum values for water bodies. Values higher than 2 indicate water and lower values are considered no water (Gamshadzaei and Rahimzadegan, 2015). In this study, SWI index was calculated by using ENVI 5.3 software. The formula of SWI is as follows:

SWI=((BLUE*0.2626)+(GREEN*0.2141)+(RED*0.0926)+(NIR*-0.0656)+(MIR*-0.7629)+(SWIR*-0.5388)

In this research, the area of Meighan wetland was investigated by using Landsat satellite images in about last two decades (1998-2021).

Results and discussion

The study area has changed in recent years (Fig 2). results showed that the area of Meighan wetland decreased by 9.14 km^2 from 1998 to 2021 (Table 1).
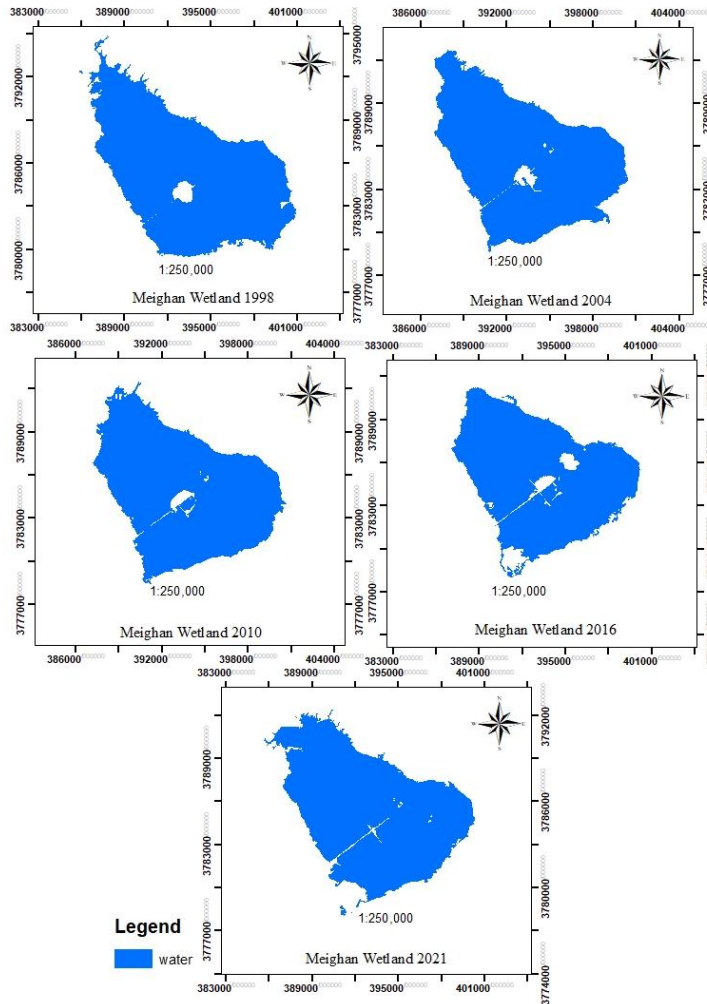
Figure 2. wetland changes from 1998 to 2021

Table 1: wetland area from 1998 to 2021

year	1998	2004	2010	2016	2021
Area (km²)	108.33	101.32	99.13	89.54	99.19

Excessive consumption from the wetland mines, Construction and widening of a road inside the wetland and ecological disconnection of north and south parts of the wetland, construction of a dam upstream of the drainage basin and reduction to enter the water in the wetland, Entering the sewage of wastewater treatment plant from Arak city, change of land use in around the wetland, overgrazing of pastures, and illegal hunting of migratory birds especially common crane (*Grus grus*) are threatening factors of Meighan wetland. Compensation for these damages is one of the important issues that should be pursued as soon as possible with a targeted program. Because loss

of the value of this ecosystem and the acceleration of its desertification have a negative effect on the air quality of Arak and human societies' life will be disrupted. In addition, it will have a negative impact on the area's wildlife and migratory birds.

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