The Aquatic Environment and Its Protection From Pollution (Marshes of Southern Iraq as a Model)

I Y Karim, M M Makki, A H Salman, N A A Al-Jassani*
College of Education for Girls/University of Kufa

*Corresponding author’s e-mail: nisreen.abdoon@uokufa.edu.iq

Abstract: The decrease of the marshes of southern Iraq represents a major problem as result of climatic changes and human conditions, especially the decrease in the water revenue of the Tigris and Euphrates rivers, which has resulted in the expansion of soil problems from waterlogging, desertification and salinity in the soil of the governorates of Basra, Maysan and Dhi Qar. Al-Hawizeh [11 billion m3 annually], and the decline of the marshes contributed to reducing the work of the Basra Paper Mill, which was previously working with about 168 tons of reed material, which had economic and social effects from 2002 to 2010 and now the marshes are fed with surface water, provided that this return The region with a wealth of fish and tourism represents the beating heart of Iraq.

1. Introduction
The aquatic environment is divided into two types according to the water quality, to a saline water environment, which is represented in the seas, oceans and salt lakes, and to a fresh water environment, which includes rivers, fresh ponds, oases, waterfalls and springs, and each environment differs from the other with a number of special components that are adapted to live within this environment. However, this aquatic environment has been subjected and exposed to change and variation in its climate and surfaces water, especially rivers, which is a limited resource and is subject to deterioration because of drought and the increase in consumption rates to meet the human requirements, as well as its pollution. Perhaps the main reason is due to technological progress and the steady increase in the production of chemical fertilizers and pesticides. Petroleum materials and the leakage of these materials into water in natural sources (rivers, lakes, seas and oceans) or into the waters of fish farms through agricultural or industrial wastewater or sewage, as well as population activity, which contributed to water pollution with disease organisms and chemicals contributing to the spread of epidemics Human exposure is increasing in recent times to many environmental pollutants, some of which pose a direct threat to his life, while others find their way from contaminated air, water and soil to food chains, whether plant or animal, and from there to Human tissues, which harms his health and well-being. Therefore, the researchers were interested in taking the marshes in the south as a model for the pollution of the aquatic environment, hence the importance of scientific research for this study.

In Iraq, the aquatic environment was characterized by the presence of rivers such as the Tigris and Euphrates rivers, which are considered running waters in which many living organisms
live, such as fish, and are used in drinking water after purification of impurities and in other uses. And since the lecture is not enough to talk about each of them, we confine ourselves to the change that took place in the marshes, especially in southern Iraq. Hence the research problem, which states the need to know the environment of the marshes in southern Iraq.

Figure 1

![Location of the marshes in southern Iraq](https://www.google.com/search)

As the quantities supplied to the Euphrates River decreased in 1990 to about \(12.4 \text{ m}^3/\text{s}\) and the Tigris River \(30.87 \text{ m}^3/\text{s}\), while it varied to reach in 2015 \(20.4 \text{ m}^3/\text{s}\) for the Euphrates River and \(28.2 \text{ m}^3/\text{s}\) for the Tigris River and this is the reason for the decrease in the amount of water reaching the marshes.

2-Materials and Methods

The research includes three themes as follows;

**The first axis: the concept of the marshes and the estimation of their areas according to researchers.** The marshes are combined into marshes, which is a wide lake and is usually shallow in most of its places where water forests grow, most of which are reeds and sedges. It was called the Waist Plain because the water swept through it, meaning that it flowed and expanded in the land, and it is a vast land. The marshes were also called albedo because of the color of the predominantly white water plate.\(^1\) It also means the marsh pond.\(^2\) Marshes and swamps are a vast area of low lands covered by water, whether at most times of the year or in some of them. The marshes are also known as a depression of the land in which the surplus of rivers, canals and drains collects, forming lakes of different depths. These lakes may be linked to each other by natural channels called kawaheen. Which roads are suitable for the movement of the population within the marshes or the neighboring areas, and these caves contain running water that descends to the low areas. And the Euphrates, the determination of its area varies from year to year, and from season to season, according to the water levels of the Tigris and Euphrates rivers. It is also known and characterized as being in constant change, in the years when high and long-term floods occur, the borders of the marshes expand, flooding vast areas, while these borders shrink in the years of drought. The area of the marshes in Iraq varies according to the opinions of researchers.
3. Results and discussion

Table 1. Estimations of a number of researchers for the area of the marshes in Iraq

| Researcher                  | Area (km²)                  |
|-----------------------------|-----------------------------|
| Dr. Ahmed Sousse            | 8780 km²                    |
| Dr. Hassan Al-Khayat        | 3000-4000 km² in Chihod season, 15000 km² in flood season |
| Weaver Thisker              | 8800 km²                    |
| Al-Tai                      | 10000 km²                   |
| Shaker Mustafa Salim        | 3885 km²                    |

Source: Research from the Internet, Plans and Development Magazine, 2012, website address.

Table 2. Revenues of the Tigris and Euphrates rivers and their per capita share in Iraq for the period 2000-2019

| Year | Tigris River | Euphrates River | per capita m³ | population |
|------|--------------|-----------------|---------------|------------|
| 2000 | 17.23        | 18.85           | 1543.1        | 18363904   |
| 2001 | 17.56        | 18.85           | 1274.2        | 18931860   |
| 2002 | 17.91        | 18.85           | 2174.2        | 19517381   |
| 2003 | 17.95        | 18.85           | 3007.3        | 20121012   |
| 2004 | 17.99        | 18.85           | 2507.6        | 20743311   |
| 2005 | 17.98        | 18.85           | 2051.2        | 21384857   |
| 2006 | 17.98        | 18.85           | 2331.7        | 22046244   |
| 2007 | 17.98        | 18.85           | 2054.5        | 22046244   |
| 2008 | 17.98        | 18.85           | 24085748      | 22702211   |
| 2009 | 17.98        | 18.85           | 24813365      | 23382068   |
| 2010 | 17.98        | 18.85           | 25564835      | 24085748   |
| 2011 | 17.98        | 18.85           | 26340227      | 22702211   |
| 2012 | 17.98        | 18.85           | 271340585     | 23382068   |
| 2013 | 17.98        | 18.85           | 27962968      | 24085748   |
| 2014 | 17.98        | 18.85           | 28810441      | 22702211   |
| 2015 | 17.98        | 18.85           | 29222081      | 23382068   |
| 2016 | 17.98        | 18.85           | 30577798      | 24085748   |
| 2017 | 17.98        | 18.85           | 31496406      | 22702211   |
| 2018 | 17.98        | 18.85           | 32437946      | 23382068   |
| 2019 | 17.98        | 18.85           | 33402567      | 24085748   |
| 2020 | 17.98        | 18.85           | 34392179      | 22702211   |

Source: Republic of Iraq, Central Statistical Organization, Water Statistics, Unpublished Data, 2021.

while it reached 4,990 m³ in 1990 and 4,316 m³ in 1994. These figures cannot be compared with the per capita share of previous decades, as the per capita share exceeded 7000 m³ during the decade of the seventies, and 6000 m³ during the eighties of the last century,
which is due to Water imports rise and population size decreases. As for the discharge rates, they are not comparable to their counterparts during the sixties of the last century and later stages, if we know that these rates exceeded 445 m$^3$/t in 1966 and 827 m$^3$/t in 1969. Based on the foregoing, the governorates of southern Iraq were exposed to floods caused by the tyranny of river waters towards neighboring lands. The last one was in 1988. This was reflected on the area of the marshes during a period of 30 years if the area before drying in 1973 in Al-Hawizeh in the provinces of Maysan and Basra was about 1800 and 550 km$^2$ and the submerged area was about 534 and 1 km$^2$ and the rate of flooding was 29.6, 0.2%, in When the area of the central marshes in Qurna reached about 1450, 500 and 1050 km$^2$ during 1973, while the area reached 152, 35 and 320 km$^2$, the same was the case for the Hammer Marsh in the study area.

![Figure 2: The relationship between the flow of rivers and the per capita share in Iraq](image)

**Table 3: The Area of the Marshes before and after Drying**

| Hor name          | Governorate | Space before drying 1973 | Currently submerged area 2010 KM$^2$ |
|-------------------|-------------|--------------------------|------------------------------------|
| Al-Hawizeh        | Maysan      | 1800                     | 534                                |
| Basra             | 1           | 550                      | 1                                  |
| Maysan            | 152         | 1450                     | 372                                |
| Basra             | 35          | 500                      | 861                                |
| Dhi Qar           | 320         | 1050                     | 3275                               |
| Qurna             | Dhi Qar     | 1050                     | -                                  |
| Hammer Marsh      | 320         | 1200                     | 8350                               |

Source: Hamdan Baji Numas and his colleagues, Hydrological changes in the southern Iraqi marshes, Basra Literature Journal, Issue 80.2017, p292.

The emergence of the marshes in southern Iraq is related to the genesis and development of the sedimentary plain because it is part of it. On the basis of what applies to the whole applies to the part, what applies to the emergence of the sedimentary plain of opinions and analyzes mostly apply to the emergence of the marshes.

**The second axis: the geographical distribution of the marshes in southern Iraq**

The marshes are part of the sedimentary plain spread in three governorates [Basra, Maysan and Dhi Qar] and are fed by the waters of the Tigris and Euphrates rivers and extend between latitudes 50° 32° and 50° 30° from north to south and longitudes 50° 44° and 48° east from east to west. They are not connected marshes but rather a group of marshes and it can be
divided in southern Iraq into three longitudinal areas parallel to each other, which are the following:

1-The range of the eastern marshes located on the Tigris River [Al-Hawizeh Marshes].

It is located on the left side of the Tigris River and is considered a natural drain for the rivers coming from Iranian lands, including the rivers Al-Tayyib, Dureij and Karkheh. Al-Hawizeh Marsh is the largest marsh in southern Iraq, with an area of about [965 square miles] 2500 km² with an extension of 80 km and a width of [30]. This marsh can absorb 7 billion/m³ of water at a level ranging between [6.5] -13 feet above sea level.

The area of the marsh varies from season to season as it increases during the flood season to about [3500 km²], while its water recedes and shrinks in the Chihod season during the autumn to about [650 km²]. The water level in the marsh varies from season to season as well, as the lowest level ranges during the autumn between [1-2 m], while the maximum level ranges between [3-4.5 m] above sea level.

2-The range of the central marshes located between the Tigris and Euphrates rivers (Marshes of Qurna).

It includes the Marshes of Qurna and Gharrraf. The Qurna marshes are located on the left side of the Euphrates River between the cities of Kut, Nasiriya and Qurna. It includes the marshes of [Al-Ghamuka, Al-Dawaya, Umm Al-Ajul, and Al-Awainah], as it also connects to the right of the Tigris River, forming a water body that extends from the valleys of Shatt Al-Gharra to the direction of Al-Hammar and Shatt Al-Hammar. As for the outlets for the drainage of these marshes, they are towards the Euphrates stream and the Hammar marshes through a group of openings and bridges on the Madinah-Al-Jbayish road, especially within the confined distance between the city and the Cheetahs. The area of these marshes in wet seasons reaches8000 km², while it decreases in dry years to 2400 km².

3-The range of the western marshes located on the Euphrates River (Hammer Marsh).

It is the largest natural superficial depression of water on the right side of the Euphrates River, extending from Nasiriya in the west to the outskirts of Shatt al-Arab in the east. It is fed by the branching streams of the Euphrates River, the most important of which are Gliween, Al-Saffah, and its branches are Akika, Bani Hassan, Al-Haffar, Umm Nakhla and Karma Bani Saeed. The length of the Hammer marsh from the donkey side to the vineyard of Ali is [90 km], while its width ranges between [25-30 km]. There are other secondary marshes, the most important of which are: Al-Adl, Al-Karmashiyah, Umm Nakhla, Al-Shweariyah, Al-Abdrat, Ayser Gliween, Al-Mashab, Al-Hilal and Hor Al-Shafi.[5]

As for the natural and human aspect, the marshes are distinguished by important features that qualify them to be a nature reserve through the following:

A-The marshes are represented by the natural environment that combines the natural beauty of the marshes with the plant and animal living creatures that live in it, as some researchers and explorers considered it one of the treasures of the earth, and some described it as the Garden of Eden.

B-The marshes are of great importance in improving climatic conditions through their role in increasing the relative humidity, as the surface evaporation from the water of the Al-Hawize Marsh is about 11.2 billion/m³ annually. As for the amount of evaporation from the Hammer and Al-Qurna Marsh together, it amounts to 6.5 billion m³ annually, which helps that in lowering temperatures.

C- The marshes act as a natural store of water, as they store large quantities of the waters of the Tigris and Euphrates rivers, especially during the flood period, as the absorptive capacity of the water in the Hammar Marsh is more than 7 billion m³ during the flood season. The absorptive capacity of the Hammar Marsh ranges between (3.5-5.4 billion/m) In the flood season and in the dry season, its carrying capacity ranges 0.6-1.2 billion / m.[6]

D- Economic characteristics[7]

- Plant wealth: The marshes area is rich in the presence of many aquatic plants. Reed and papyrus are among the most important plants of that region and play an important role in supporting its economy, as they are considered among the most important resources of industrial wealth. The sedge needed by the Basra Paper Mill, which used to work previously, is about 168 tons per day of cane, and the annual need is estimated at 50,400 tons.
Livestock: The marshes are an ideal environment and natural pastures for different types of animals, whether those that live in the water or on the edges of the marshes, including fish, birds and buffalo. In terms of fish, the marshes bloom with different types of fish. The aquatic environment of the marshes provided the appropriate conditions for their existence, and studies have proven. However, there are more than 18 thick species found in the southern marshes, especially the Hammar Marsh, which are (Hamri, Al-Bunni, Kattan, common carp, Al-Bayah, Shiga, Sabbour, and Shilluk) and other fish. The inhabitants of the marshes hunt for fish, whether for the purpose of selling or for daily food. The marshes are also important in hunting birds, especially the Huwaiza marsh and the Qurna marsh, as a number of birds are sheltered there, including al-Khudairi, water chickens, salt geese, European geese, herons, gulls and Abu Mullaqah. There are also animals such as buffalo, cows, goats and sheep, which are an important source for the production of milk, meat, wool and other products.

Agricultural wealth: The area is an important center for agriculture, as various types of agricultural crops are grown, which are more important to the population and a main food for them.

Oil wealth: The southern marshes are one of the richest oil regions in the world and are located in the Basra marshes, the largest and most important oil fields. The Majnoon oil field is located in the heart of Hawizeh Marsh within the administrative borders of Basra Governorate, while the West Qurna and Bahla oil fields are located within the city district. It is one of the Basra marsh areas, and the Nahr Omar field is located in the Al-Haritha district, adjacent to the marsh areas.

The marshes, with their natural potentials represented in water, plants, birds and fish, in addition to the shape of dwellings, boats, and land and water fishing methods, make them an important center for tourism activity, as it is possible to take enjoyable fishing trips for fish and birds, especially in winter amidst the reed and sedge forests and enjoy the water views along the length of the marshes. sight. As a result of these characteristics, the marshes occupy the second place in terms of their economic value.

These marshes with distinct natural characteristics, which constitute an area of more than 80%, according to studies, of the total area of the Iraqi marshes were subjected to drying, which led to environmental changes that affected the nature of its resources such as climate, vegetation cover and abundance of water, as it became a dry desert environment in which the storm phenomenon intensified. Dusty with the emergence of the phenomenon of salinization in the soil, and drying processes led to the emergence of spots of oil that is naturally present in all areas of the marshes. The area is rich in oil and the wells, by virtue of the natural balance, thousands of years ago were controlled by a watery crust over the earthen crust, and after the water dried up, the oil began to seep out in the form of wet spots that emit odors. The figure 3 shows the stages of drying the marshes during different years.
The General Conference of the United Nations Educational, Scientific and Cultural Organization [UNESCO], held in November 1972, adopted a treaty for the protection of cultural and natural heritage, which included recommendations for international cooperation in preserving sites of universal value, considering them the property of future generations. There are currently 192 signatories to it. Distinguished sites from around the world have been included in the World Heritage List, including important Arab sites to which the Iraqi marshes were annexed on July 17, 2016.

The inclusion of any site in the list means that it has become one of the unique sites that must be preserved and the risk of its extinction removed. The responsible authorities are expected to provide appropriate conditions for global tourism, and UNESCO monitors these sites and organizes visits to assess their conditions, and issues warnings to the responsible authorities to remove any threats to them. In the absence of progress in rectifying the situation that convinces the experts, the site may be placed on the list of threatened sites.[8]

The third axis: the water environment and its characteristics in the marshes region in southern Iraq and the possibilities of its development.

Despite the ecological recovery of the marshes in southern Iraq and their selection on the World Heritage List, and despite the passage of years since drying out and despite their recovery, it is difficult to fully revive them, especially with the emergence of the main cause, which is the decreasing amounts of water allocated from neighboring countries and the prevalence of dry climatic characteristics. The environmental impacts were characterized by the following:

A - The salinity of the soil in the low plain of Mesopotamia is a very important problem caused by the water used for irrigation and because of the capillary action of the saline groundwater, the saline soil is exposed to serious problems in reviving it, and that the seeds will not arise in highly salinized soil, as the calculations showed that one meter The irrigation water used contains [100] parts per million salt, that is, about [1000] kilograms of salt is added to the soil per hectare. It is estimated that every year, irrigation water adds 3 million tons of salt to the [irrigated] soil in Iraq and within [6000] After a year of irrigation, huge amounts of salt were added to the soil of the plain.[9]

| Web site name                      | salinity | soil texture    | the color  |
|------------------------------------|----------|----------------|------------|
| Agricultural areas near Hor Abi Zark area | 11       | alluvial clay  | dark gray  |
| Hor Abi Zark area                  | 21       | alluvial clay mixture | dark gray  |
| North Hor Al-Hawizeh City          | 24       | alluvial clay  | Dark gray  |
| The area near Hor Al-Hammer         | 25       | alluvial clay  | Dark gray  |

Iqbal Abdul-Hussein Abu Jari, Environmental Effects of Drying the Marshes in Southern Iraq, Ph.D. Thesis, College of Education Ibn Rushd, University of Baghdad,2007,P106.

B - Environmental and climatic effects: The climate of the marshes was affected by the drying that took place in it, which led to an increase in the proportion of water vapor and led to a rise in the general temperature as a result of the increase in the night temperature as a result of the occurrence of global warming. An important and clear rise in the average maximum
temperature for the month of July, especially in the Basra monitoring station, and this is
evidence of the high daytime temperature and that the drying of the marshes reduced the role
of water in not increasing the daytime temperature.[10]
C- Environmental impact on industrial activity. The industry in the marshes of southern Iraq
was affected by environmental changes and the deterioration of the biosphere of the land and
its desertification, which changed the quality of the vegetation cover. For the disappearance of
most of the local industries of a manual nature, such as the manufacture of trees, boats and
huts, as for the food industries, such as the dairy industry and date pressing, more than 70% of
them have been eliminated due to the decrease in the number of livestock and the shrinking of
the areas planted with palms.[11]

D- The shrinking of the area of the marshes of southern Iraq as a result of the decrease in the
water revenue of the Tigris and Euphrates rivers resulted in the expansion of the soil problems
from waterlogging, desertification and salinity in the soil of the governorates of Basra,
Maysan and Dhi Qar, as the total lands affected by salinity reached (616,735 hectares) out of
the total arable lands (1372,937 hectares). As reflected in the area of land used in agriculture,
which amounted to 331,586 hectares (Table 5). This is due to the quality of the water from
the high electrical conductivity and the total amount of dissolved salts that affected the nature
of agriculture and the life of living organisms, especially fish.

Table 5: Agricultural lands affected by waterlogging and salinity (ha) for the year 2014 in the
marshes of the southern region of Iraq

| the site | agricultural land | Agricultural land actually used | Soil affected by salinity and waterlogging |
|----------|------------------|---------------------------------|------------------------------------------|
| Maysan   | 636818           | 154568                          | 225359                                   |
| Dhi Qar  | 439842           | 145568                          | 228039                                   |
| Basra    | 296277           | 31450                           | 163337                                   |
| **the total** | **1372937**  | **331586**                      | **617735**                               |

Hussein Abdul Wahed Aktami, Hydrological Changes in the Marshes of Southern Iraq, Basra
Literature Journal, Issue 80, 2017, P301.

E- As for the quality of water in the marshes of southern Iraq, it reached the highest acidity
function in the Hammar marshes by about [8.25 mg / liter], as well as dissolved oxygen (8 mg
/liter) and the group of dissolved salts by about [4847 mg / liter], while nitrates reached the
highest in the marshes Al-Hawizeh by about [9.1 mg/l] and phosphates in the Hammar Marsh
amounted to about 0.31 mg/l, while sulfates were highest in Al-Hawizeh Marsh by about
7575 mg/l and about 374 mg/l in the Hammer Marshes (Table 6).

Table 6: Water quality of the marshes in southern Iraq

| Chemical and physical properties | Hawizeh Marshes | Hammer marshes | Central Marsh |
|---------------------------------|----------------|----------------|---------------|
| acid function                   | 7.6            | 8.25           | 7.7           |
| dissolved oxygen                | -              | 8              | 6.48          |
| Total Dissolved Salts           | 2.86           | 4847           | 3.14          |
| EC dsi-siemens/m                | 3.2            | 7.6            | 4.7           |
| nitrates                        | 9.1            | 10.2           | 1.23          |
| phosphate                       | 0.1            | -              | 0.31          |
| Sulfates                        | 7575           | 5.5            | 833           |
| Magnesium                       | 198            | 374            | 165           |

Hussein Abdul Wahed Aktami, Hydrological Changes in the Marshes of Southern Iraq, Basra
Literature Journal, Issue 80, 2017, P291.
4. Conclusion
Possibilities of protecting the environmental situation in the marshes of southern Iraq:
A- Finding ways and methods to protect and develop fisheries and birds and prevent the use of poisons for hunting them because this pollutes the water first and reduces biodiversity secondly, which requires providing them with natural reserves in order to develop the area as a tourist.
B- Benefiting from studies and research that focused on the marshes and swamps area in order to know the defects and the areas that have been polluted in their waters and the decrease in their areas in order to advance the reality of the marshes and rehabilitate them for a pure environment of a beautiful tourist nature.
C - The establishment of a number of circuit regulators on the drains of the marshes to ensure that the quantities of water entering them are not lost.
D- The necessity of closer cooperation and contracting with neighboring countries in order to provide a large amount of water flow that feeds the areas on both sides of the Tigris and Euphrates rivers and to provide a large amount of water supplying the marshes in order to achieve a pollution-free environmental balance to ensure the sustainability of the marshes and make them an important tourist attraction.
C - Monitoring the biological diversity of living plant and animal organisms and controlling them well by benefiting from the experiences of neighboring countries.
H- Providing services to the residents of the marshes area and providing them with services, especially health, electricity, fresh water, and developing roads and infrastructure in order to raise their morale in preserving the environment of the air and not polluting it.
g- Treating wastewater and trying to develop it through filtering it in order to benefit from it instead of polluting it.

References
[1] Ali Hassan Khalaf, The Marshes, A Historical, Demographic, Topographical Study, 1st Edition, Dar Al-Fayhaa for Publishing and Distribution, Lebanon, 2017, P23-25.
[2] Naji Sari Faris, The Reality of Tourism Investment in the Marshes of Southern Iraq and its Effects on Employing Manpower, Center for Arab Gulf Studies, University of Basra, p110.
[3] Al-Matzar and Development Magazine, No. 25, 2015
[4] Hassan Al-Khayyat, Geography of the Marshes and Swamps of Southern Iraq, Institute of Arab Research and Studies, 1975, p20.
[5] Ministry of Water Resources, Marsh Recovery Center, a report on the marshes of southern Iraq, unpublished data, 2004, p11-12.
[6] Ilham Khazal Nashur and Sonia Arzuni, The Reality of the Marshes in Basra Governorate and Its Future Prospects, Journal of Economic Sciences, Issue, Cut, Volume Eight, 2012, P10.
[7] Naji Sari Faris, a previous source, pp. 112-113.
[8] https://www.bbc.com/arabic/artandculture/2016/07/160718_iraq_marshes_unesco_world-heritage
[9] Iqbal Abdul-Hussein Abu Jari, Environmental Effects of Drying the Marshes in Southern Iraq, Ph.D. Thesis, College of Education Ibn Rushd, University of Baghdad, 2007, P105.
[10] Youssef Muhammad Ali Al-Hathal, Drying the Marshes and its Impact on the Different Climatic Characteristics of Southern Iraq, Diyala Magazine, Issue Twenty-first, 2009, p15.
[11] Safia Shaker Maatouq, Hydrochemical Changes of the Marshes of Southern Iraq and Their Environmental Effects, Center for Studies of Basra and the Arabian Gulf, P239.
[12] https://www.google.com/search.
[13] Research from the Internet, Plans and Development Magazine, 2012, website address https://uirp.uobaghdad.edu.iq/?p=116
[14] Republic of Iraq, Central Statistical Organization, Water Statistics, Unpublished Data, 2021.

[15] Hamdan Baji Numas and his colleagues, Hydrological changes in the southern Iraqi marshes, Basra Literature Journal, Issue 80, 2017, p292.

[16] Ayman Abdul-Latif Kwais Al-Rubaie, An Environmental and Morphological Study of the Marshes of Southern Iraq, marina mesopotamica, 23(2), 2008, p440

[17] Iqbal Abdul-Hussein Abu Jari, Environmental Effects of Drying the Marshes in Southern Iraq, Ph.D. Thesis, College of Education Ibn Rushd, University of Baghdad, 2007, p106.

[18] Hussein Abdul Wahed Aktami, Hydrological Changes in the Marshes of Southern Iraq, Basra Literature Journal, Issue 80, 2017, p301.