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Geographical Assessment of the Natural Environment at Al-Huwaizah Marsh, Eastern of Misan Governorate (Iraq)

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Abstract: In this article, Al-Huwaizah Marsh, one of the biggest wetlands in southern Iraq, has been studied. The spatial analysis approach was used to study the spatial relationships between the elements of the natural environment on the one hand, and their relationship to the distribution of organisms in Al-Huwaizah Marsh on the other hand. A geographic information system (GIS) was established and fed with the data contained in the topographical, geological, pedological, and hydrological maps issued by the various Iraqi institutions. The study hypothesis indicated that the abiotic elements of the ecosystem (location, surface, geological structure, climate, and soil) played a direct role in the geographical distribution of biotic elements (animals and plants) of Al-Huwaizah Marsh. Al-Huwaizah Marsh is a natural depression that collects water during floods and is distinguished by providing an ideal environment for different species of birds, fish, mammals, and plants to live. The four most significant waterbodies of Al-Huwaizah Marsh are Al-Edhaim, Umm Al-Na'aj, Al-Sanaf, and Al-Jakka.

Keywords: Environmental Geography; Wetlands; Ecosystem Biodiversity; Al-Huwaizah Marsh.

1. Introduction:

Marshes are lowlands covered by water on all days of the year or in particular seasons and include shallow and relatively deep areas. Some of these are covered with aquatic plants, reeds, and sedges,

and others are open, called the water pond (Gan, 2004). The marshes are an integrated ecosystem, rich in natural resources, and contain many and varied wealth (Maaroof, 2022b). This helped to establish population centers, being innate, due to the abundance of natural resources in them. It helped the population to invest in it, establish some simple industries and crafts, and establish simple and uncomplicated social activities (Al-Musawi & Maaroof, 2019).

Geographically, Al-Huwaizah Marsh is one of the natural depressions in the southeastern parts of the Mesopotamian Plain (Al-Nussairi & Hassan, 2020). This marsh is subjected to the process of being flooded with water during times of floods resulting from heavy rains, and in times of great floods it extends to unite the eastern marshes, including Al-Huwaizah marsh, with the western marshes, thus, the Tigris River, along with its banks, disappears (Maaroof, 2022a). Al-Huwaizah Marsh, along with the rest of the marshes of southern Iraq, constitutes a natural system with all its components (water, soil, topography, climate, natural vegetation, and animals) (Al-Ansari, 2020). The natural diversity of Al-Huwaizah Marsh made it a suitable environment for the emergence and development of many organisms (birds, fish, mammals, and plants).

The problem statement is the geospatial interaction of the ecosystem elements (biotic and abiotic components) with each other. This geospatial interaction led to the formation of a unique homogeneous spatial complex, different from the rest of the wetlands in the world. The research hypothesis indicated that the geographical location of Al-Huwaizah Marsh was the most important factor that led to the interaction of geographical elements (slope, geological structure, climate, pedological diversity, hydrological system, and biotic components) with each other to form this unique ecosystem. While Al-Huwaizah Marsh is surrounded by the Iranian highlands from the east, the estuaries of the (Al-Teeb and Al-Duwairej) rivers from the north, the streams branching from the Tigris River from the west, and low and flat lands from the south. The research aims to conduct a geographical survey of Al-Huwaizah Marsh, to give a spatial view of the relationships between the non-living environmental components, and their mutual effects on the living components of the ecosystem.

2. Data and Methods:

In this study, the spatial analysis approach was used, which included analyzing the spatial relationships between the terrestrial features on the one hand, and the living organisms that inhabit the environment of Al-Huwaizah Marsh on the other hand. The geographical analysis of these spatial relationships required the use of a variety of data and several spatial analysis tools. This data was represented by the wide use of topographic maps at a scale of 1:100,000, geological maps at a scale of 1:250,000, and hydrological maps at a scale of 1:100,000, in addition to pedological maps and NDVI maps. All of this data, in addition to the data issued by the Misan Environment Directorate, was analyzed within the Geographic Information System (GIS). A GIS software package was used to analyze data related to Al-Huwaizah Marsh ecosystem, which included: (ArcGIS V.10.8), (ArcGIS Pro V.2.5), (Global Mapper V.11), (ArcGIS Earth 1.10), (Google Earth). As well as the use of field survey methods.

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3. Study Area:

Al-Huwaizah Marsh is located in Misan Governorate, east of the Tigris River, bounded on the eastern and southeastern sides by the administrative borders of Iran (Fig.1), from the south and southwest by the Basra Governorate, and to the north and west by Misan Governorate (Hason et al., 2020). The total area with the buffer zone of the property is about (90,691) hectares, the marsh consists of fresh water (wetlands) (Abdul Jabbar et al., 2010). The component is the first site declared within Ramsar Wetlands of International Importance. Where the site contains (5) criteria out of (9) criteria required for inclusion, as it focused on criteria related to biological diversity, as the component supports 1% of the biogeographic numbers of several species. It also supports some endangered species, a habit for species of plants and animals, and its importance as an important food source for fish and spawning. In addition to being considered a unique, rare, or typical example of a natural wetland pattern (UNEP, 2006).

The Study area is located between longitudes 47°21′30.1″E – 47°52′34″E and latitudes 31°17′12.8″N – 31°47′31.8″N. The area of the marsh inside Iraqi territory during the flood season is about (2350) km^2, and it recedes in the hot season and under water scarcity conditions to reach (650) km², and it will have restricted just to the marshes of (Umm Al-Naaj, Al-Edhaim, and Al-Jackah), the depth ranges between (3-4.5) m. These marshes fed by water sources mostly originate from outside of the Iraqi territories via Al-Teeb and Al-Doerij rivers, where these two rivers dispose into the Al-Sanaf Marsh, then, eventually, water drains into the Al-Huwaizah Marsh (Al-Sakini, 2009).

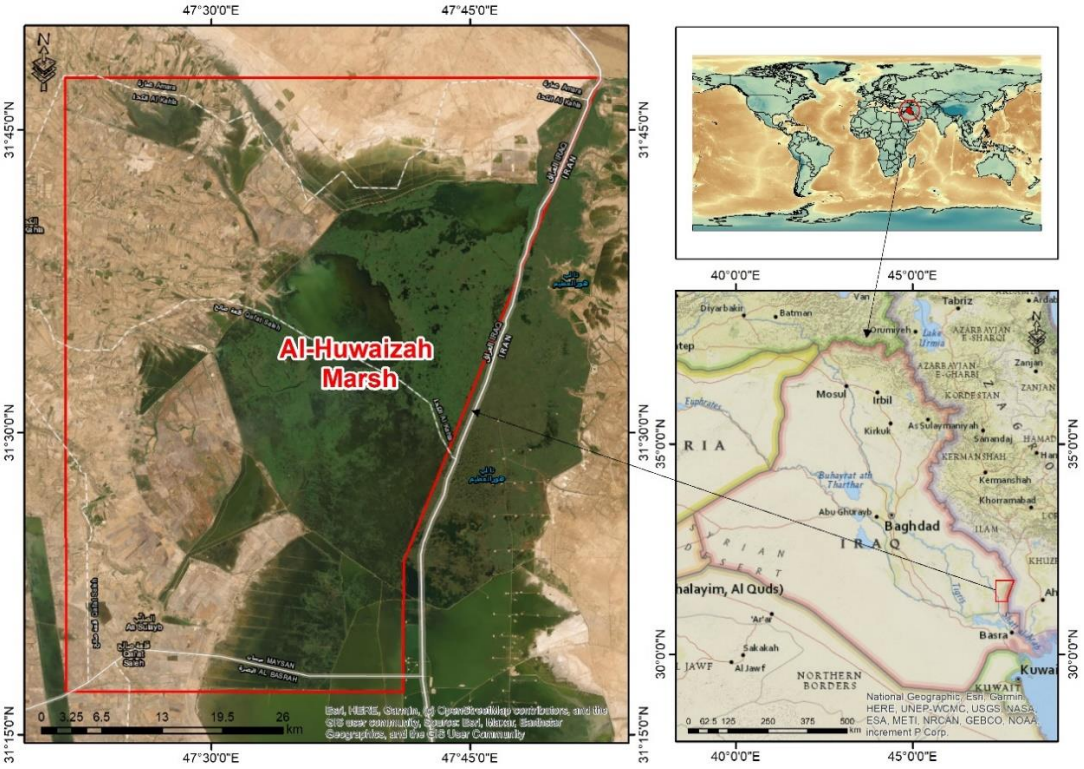

Figure 1. *Site of Al-Huwaizah marsh in Misan Governorate, Iraq.*

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The slope of the study area is directed from northwest to southeast, however, it represents part of the terrain of the newly formed Iraqi alluvial plain, where Iraq's topography in general is flat to low. This gradual decline has enabled the Tigris and Euphrates Rivers oriented in this direction. The land gradually rises towards the north and north-east, reaching a height of (10 m) above sea level, at this point tends to decline in the direction of the south and south-west, reaching a level of (5 m) above sea level (Fig.2). During flood months, the marsh extends to wider areas, at a height of 1 meter above sea level, to become sabkhas when its waters dry up in summer (Al-Sakini, 2009). The northern part of the Al-Huwaizah Marsh is characterized by the presence of distinct deep depressions, the largest of which are the pools of Umm Al-Na'aj and Al-Edhaim.

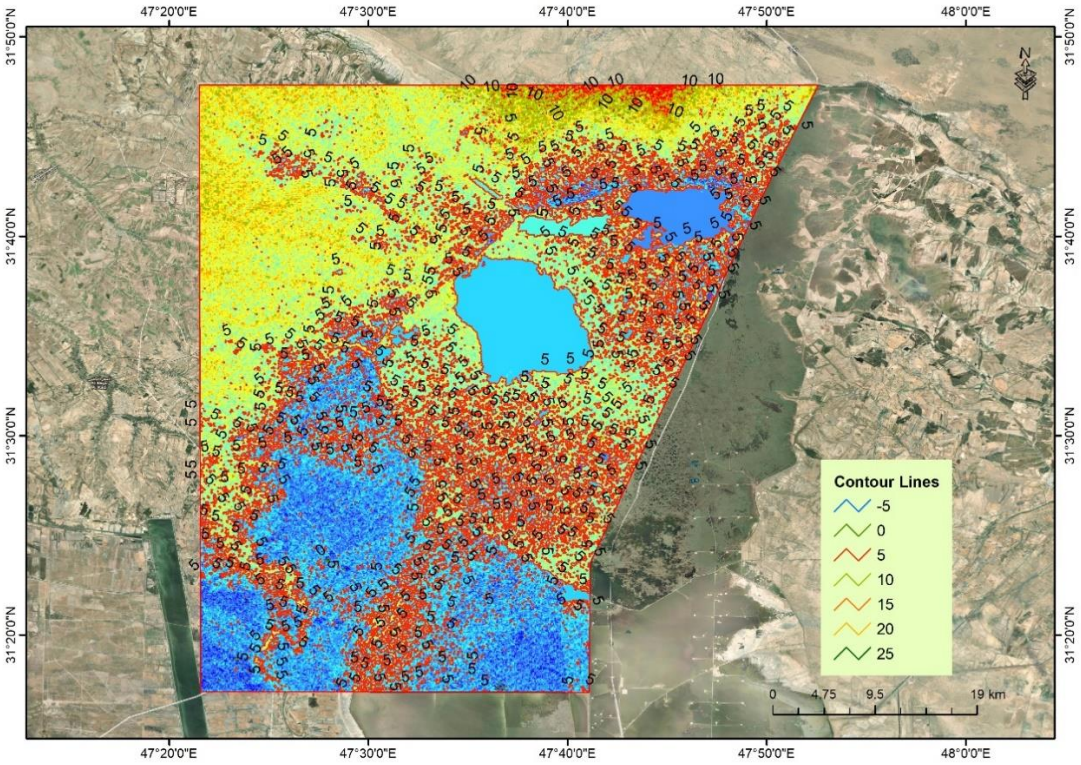

Figure 2. *Contour lines of Al-Huwaizah marsh.*

Geologically, the study area is completely covered with Quaternary sediments. These sediments are mainly transformed by the river at different periods furthermore partly by wind-transformed sediments. Geological surveys of the sedimentary plain have shown that the sediments of the Quaternary period reach a depth of (120) meters below the earth's surface, near the axis of the sedimentary basin southwest of the city of Al-Amarah (Al-Jiburi, 2005). The surface runoff deposits represent the far parts of the alluvial fan that cover the northeastern corner of the study area (Al-Salih & Al-Kubaisi, 2016). The surface layers of these sediments date back to the Holocene era, knowing that these sediments started early since the Pleistocene era because they are related to the deposition of the alluvial fan and accompanying the river sedimentation system of the foothills area (Fig.3). These deposits generally consist of sand, silt, and clay (Sabah Y. Yacoub, 2010). The sediments of lakes, swamps, or marshes are the predominant lake sediments in the region, in addition to the inland

marshes. These sediments are characterized by having a fine texture with dark colors due to their mixed with decomposed organic matter (mostly plant origins). The main source of water and sediments is the flooding seasons, river load, and torrents that generates from the foothills, particularly Al-Teeb and Al-Duwairej Rivers (Almutury & Al-Asadi, 2008).

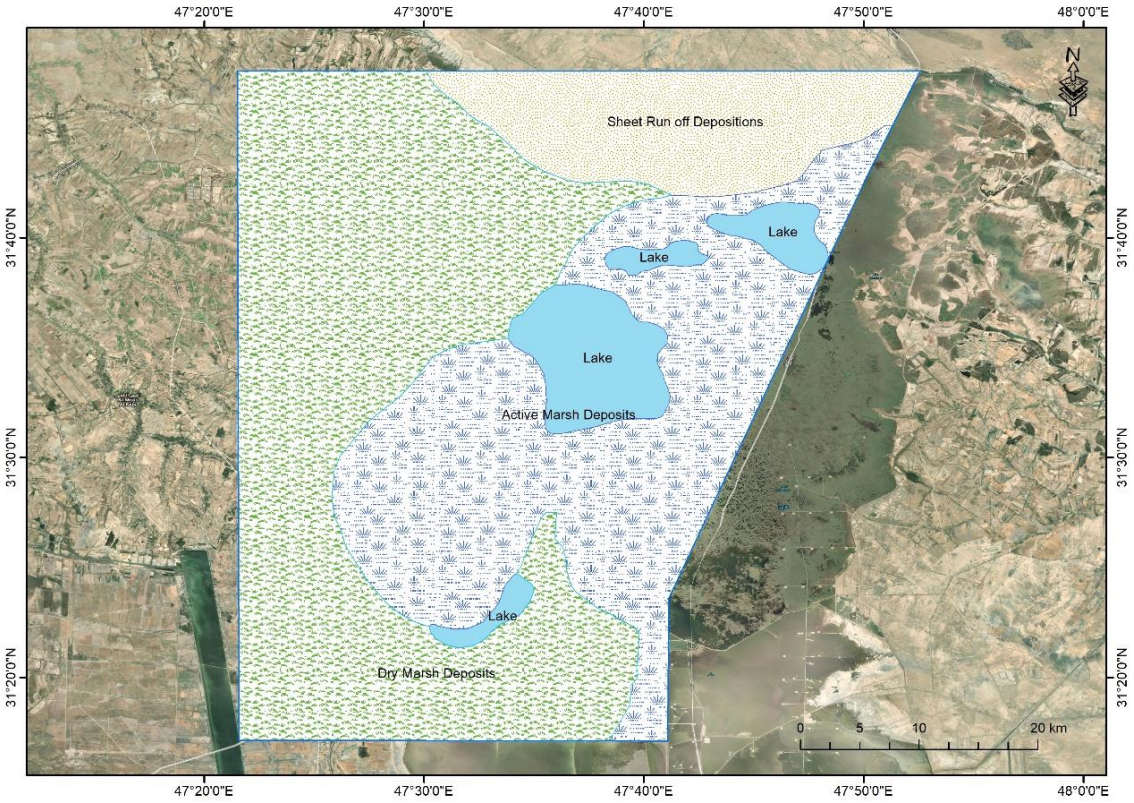

Figure 3. *Geological structure of Al-Huwaizah Marsh.*

Al-Huwaizah Marsh area is a part of Iraq's general climate specifically the sedimentary plain region, where wide ranges of temperature variations occur on the daily or seasonal level. However, the temperature rises in the hot summer season of the year, which is usually associated with low rates of rainfall, these conditions mostly lead to an increase in evaporation rates, reflecting on the reduction of the volume of water input supplied to main water bodies, leaving many marshes totally or partly dried leading to reduction of the total areas of flooded marshes (Maaroof & Kareem, 2023; Qassim, 2014). Temperatures play a major role in changing the environment of the flooded marshes between the hot season, in which the temperatures rise to more than (40) C°, while in cold seasons it decreases to (11) C°, which is accompanied by rainfall as the main source of surface water feeding of the marshes (Table 1).

The falling rains in the study area are followed the Mediterranean rain system, which is called periodic rains. The precipitation is restricted in the cold season of the year at very few monthly rates, precipitation ranges during the cold season ranges between (10-40) mm. The prevailing winds in the study area are northwest, compared to the rest of the other directions, which decrease to low rates,

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with almost limited impact on the region. Wind speed increases during the months of the hot season (June, July, August) to be ranged between (4-6) m/s, while this speed decreases in the winter months (December, January, February) to be ranged between (3-5) m/s.

Table 1. Climatic elements according to the data of the Al-Amarah climatic station for the period (1980-2009).

Months	temperature (°C)	Rainfall (mm)	wind (m/s)
January	16.2	34.5	2.5
February	19.5	22.6	2.7
March	24.2	31.7	2.7
April	30.9	13.3	3.4
May	40.7	2.1	4.5
June	45.7	–	5.4
July	47.2	–	5.4
August	45.2	–	4.7
September	42.1	–	3.7
October	35.2	5.7	3.1
November	25.7	14.5	2.8
December	20.1	19.7	2.7
Average	32.7	11.8	3.6

The soils of the study area are characterized by the dominance of sediments transported by the waters of the Tigris River from the Turkish and Syrian territories towards the Iraqi side, mostly characterized by its fine-textured soils (silt clay). The level of the groundwater is almost near the earth's surface. On the other hand, some swampy soils are seen covered with flood waters, where in the hot summer months, this water evaporates, leaving the soil covered with white salts above soils characterized by poor water drainage (Rasheed, 2008) (Fig. 4).

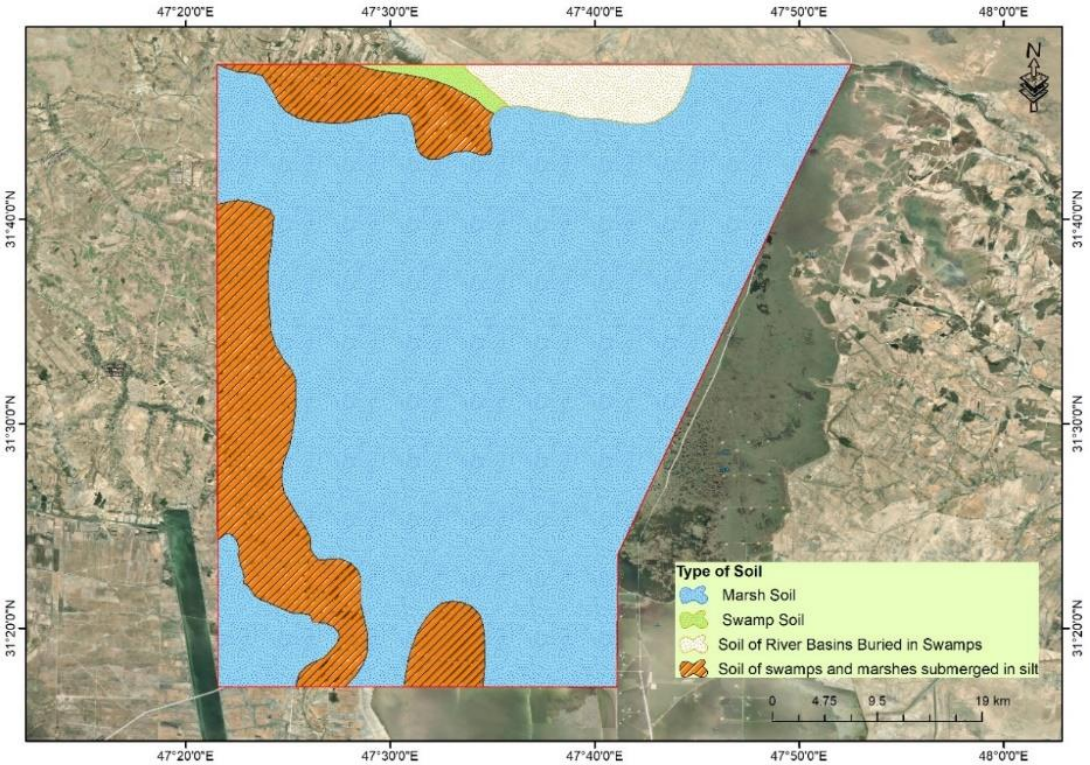

Figure 4. *Soil types in Al-Huwaizah marsh.*

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4. Results and Discussion:

4.1. Hydrological System:

Al-Huwaizah marsh is a natural depression that fills with water during floods. Its area varies according to the quantities of provided water (Bedair et al., 2006). In times of intense floods, the levels of Al-Huwaizah marsh rise leading it to merge with the adjacent marshes, causing the Tigris River to disappear along with its banks. When the water levels gradually decrease and are naturally oriented to the south, the Tigris River and neighboring highlands appear again. In the dry season, the area of Al-Huwaizah marsh shrinks, keeping the water remaining only in the low areas which are just Al-Edhaim and Umm Al-Na`aj (Hussain & Grabe, 2009). These pools are connected by waterways devoid of vegetation, which penetrate pass-through the areas which include reeds, papyrus, and waterweed, these pools are called the permanent marsh (Almaarofi, 2015).

Hydrological and climatic factors play a major role in changing Al-Huwaizah marsh, whether on the level of long or short seasonal periods. During the winter and spring seasons, the amount of water supplied to the marsh increases, and its area expands according to the size of the incoming discharge. In the summer and autumn seasons, the marsh shrinks due to the lack of water supply, or during periods of water scarcity, according to this the area of the marsh and its water level will change (Al-Saady & Abdullah, 2014).

Al-Huwaizah marsh includes many sub-marshes, the most important of which are (Al-Edhaim, Umm Al-Na`aj, Al-Sanaf, and Al-Jakka). Al-Huwaizah Marsh is supplied from the Iraqi (western) side by the waters of the Tigris River through three main streams namely Al-Musharrah, Al-Kahla, and Al-Majjariya, where their water does not reach the marshes except during the flood season (Maaroof, 2017). On the other hand, the Iranian (eastern) side is supplying the water to the marshes from some rivers and valleys generates by the Iranian mountains, which are Al-Karkheh, Al-Duwairej, and Al-Teeb rivers, these streams flow the water into Al-Sanaf Marsh, which in turn ends in Al-Huwaizah Marsh (Fig. 4). A portion of the waters of Al-Huwaizah Marsh is discharged to the Tigris River through more than 12 streams, the most important are (Kassara and Al-Routa) with a discharge rate of 97 m^3/s (Al-Salih & Al-Kubaisi, 2016).

The average salinity of Al-Huwaizah Marsh is 2.5 $Ds.m^{-1}$. The average depth of Al-Huwaizah Marsh was 3 m, this level varied between the flood and dry seasons, reaching 3–4 and 1–2 meters, respectively. The amount of water recharge for Al-Huwaizah Marsh decreased from 10.7 km^3 in 1979 to 4.28 km^3 in 2005, which negatively affected the area, depth, and water quality of this marsh (Al-Saboonchi et al., 2011; Qassim, 2008). The decrease in the amount of water supplied by Al-Huwaizah Marsh led to a shrink in its area on the Iraqi side to 1700 km^3 in 2007, by 71%, which caused a decrease in water depths to 1-2 m, and an increase in the salinity rate to 3 $Ds.m^{-1}$. Al-Huwaizah Marsh lowers the risk of flooding disasters in the Tigris River, in the flood season, huge amounts of water flow from the Tigris River into the Marsh, and in the dry season, the marshes' water returns to the Tigris River (Mays, 2018).

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Figure 5. *Hydrological system of Al-Huwaizah marsh.*

4.1.1. Rivers flowing into Al-Huwaizah marsh:

4.1.1.1. Al-Karkheh River: It originates from Iran and discharge into Al-Huwaizah Marsh. It passes through Al-Hamidiyeh, which is located approximately 60 km away from its mouth. The water of this river is divided into several branches within the marsh, its discharge rate in Al-Hamidiyah is (204 m^3 / s) and the annual supply rate for this river is (6.43 billion m^3) annually (Ghobadi et al., 2015).

4.1.1.2. Al-Duwairej River: This river originates from inside Iranian territory to enter the Iraqi border at Al-Fakkah outpost. This river flows until it empties into Al-Sanaf marsh at a point about (11 miles) away from the mouth of Al-Teeb River, and its discharge peak is (100 m^3/s).

4.1.1.3. Al-Teeb River: This river originates from the Iranian lands located to the east of the districts of Badra and Jassan, the river enters the Iraqi lands at a point located east of Al-Teeb police station, which is located about (31 miles) north of the city of Al-Amarah (Maaroof & Kareem, 2022). It flows south in a deep valley until it ends in the Al-Sanaf marsh (Rahi et al., 2019).

4.1.1.4. Al-Kahla River: It branches from the left side of the Tigris River, with a length of (30) km to the center of Al-Kahla district. This river branches into three main streams: Al-Ma`il, with a length of 24 km, and Umm Al-Tus, with a length of 23 km, as for the third, is called Al-Ahsiji, which has a length of 21 km. The mouths of these streams end in the Al-Huwaizah Marsh at Al-Suda Bridge, and there are no dams or regulators on the course of this river (Al-Kenzawi et al., 2011).

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4.1.1.5. <u>Al-Musharah River</u>: It branches from the left side of the Tigris River in the center of the Misan Governorate. Its length is 47 km, and it heads in its course toward the east. At a distance of 13 km, the Umm Al-Batout River branches from the right bank. Al-Masharah River continues its course until a distance of 37 km from the branch of the Umm Al-Battout River, after it branches into the Al-Maleh and Al-Ama Rivers then flows towards the southeast and ends in the Al-Huwaizah Marsh (Hatem, 2016).

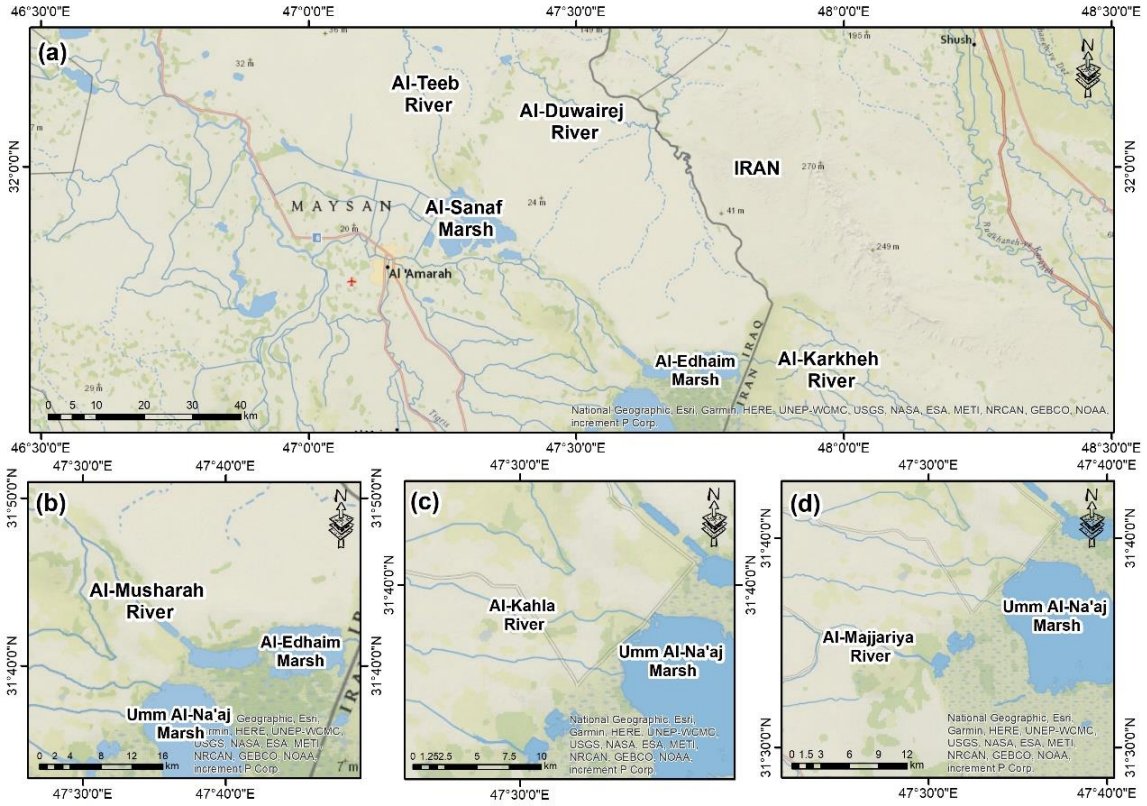

Figure 6. *Rivers flowing into Al-Huwaizah marsh.*

4.1.2. Parts of Al-Huwaizah marsh:

4.1.2.1. <u>Al-Edhaim Marsh</u>: This marsh considers the beginning of Al-Huwaizah Marsh, which is located in the district of Al-Mushrah, and represented one of the largest marshes in the area. about 70 km away from the center of Misan Governorate, it is connected to the Umm Al-Na`aj marsh through the Al-Suda marsh. This marsh is supplied with water from inside the Iranian territory by the rivers (Al-Karkheh, Umm Al-Dairy, and Al-Nisan) (Al-Ansari, 2013).

4.1.2.2. <u>Umm Al-Na`aj Marsh</u>: It has an area of 15 km^2, about 20 km southeast of Amarah city. It is located in the northwestern part of Al-Huwaizah Marsh. This marsh is supplied with overflow water from Al-Kahala River and the tributaries of the Tigris River (Alwan & Aziz, 2021).

4.1.2.3. <u>Al-Sanaf Marsh</u>: It is located to the north of Al-Huwaizah Marsh, and is supplied with water from Al-Teeb and Al-Duwairej rivers. It reaches Al-Huwaizah Marsh at the eastern end, to supply it

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with water during flood periods. The average depth of this marsh is around 3 m, with a 50 km length, and a 5 km width (Makki et al., 2019).

4.1.2.4. <u>Al-Jakka Marsh</u>: It is located in the east of Al-Amarah city, between Al-Musharah and Al-Kahla rivers. The total area of this marsh is 83.31 km^2, it is considered shallow compared to Al-Huwaizah Marsh, where its depth ranges between (20-175 cm), its length is (20.312 km), and its width ranges between (2-5.7 km). Most of its parts are free of papyrus and reed plants (Mays, 2018).

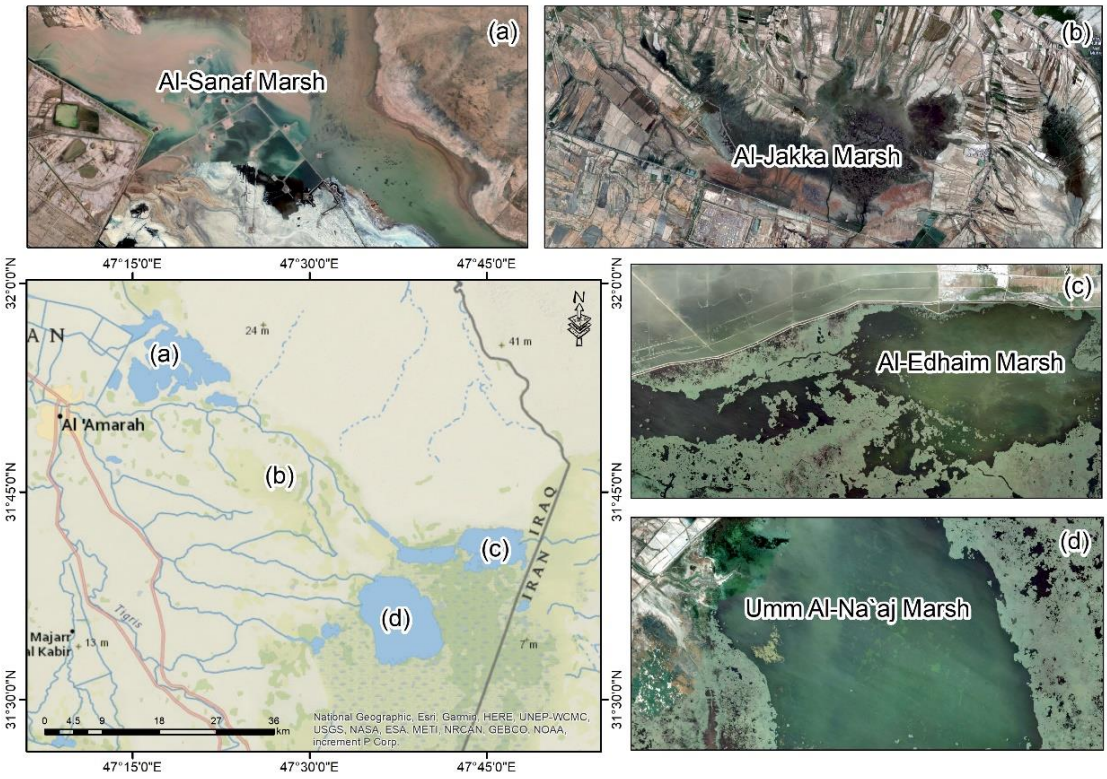

Figure 7. *Parts of Al-Huwaizah marsh.*

4.2. Ecosystem of Al-Huwaizah Marsh:

Al-Huwaizah Marsh is one of the distinctive ecosystems in southern Iraq. It is also a unique ecosystem compared to wetlands in the world. Where water flows from the neighboring mountainous areas, from the Iranian side, and gradually descends through a network of valleys and rivers toward this basin (Zahraa et al., 2018). This water loaded with silt and dissolved salts flows very quickly. When the water speed decreases, it dumps its load in the flat areas of the marshes. This water is constantly undergoing change and renewal through a continuous flow that contains large amounts of sediment and organic matter (Hashesh & Ahmed, 2018). Al-Huwaizah Marsh is characterized by warm climatic conditions and relative humidity, which created a suitable environment for the growth of many plants that have adapted to grow in abundance, the most famous of which are (reeds and papyrus). These plants contributed to the creation of environmental conditions suitable for the

settlement of large numbers of other organisms, such as birds, fish, mammals, and others (A. AHMED & S. HASHESH, 2022).

4.2.1. Birds: Al-Huwaizah marsh is one of the most suitable wetlands in the world for the settlement and migration of birds. The region ranks fourth out of 11 in the world. Birds in the study area are classified into migratory and indigenous birds (Muhsin & Kadhim, 2017). In the spring season of each year, there are various groups of birds migrating from Russia and Europe to Al-Huwaizah marsh (Abed, 2007). The main reason for the migration of these birds is the favorable climate and the abundance of water and food (Al-Sheikhly & Al-Azawi, 2019). These groups of birds remain in the area for about 7 months, and end their migration in Mays. In addition to migratory birds, Al-Huwaizah marsh includes many endemic birds that have adapted to the elements of the environment and have been able to find stable environments for them in coexistence with the ecosystem (Salim et al., 2009). The most important types of birds (migratory and endemic) in Al-Huwaizah Marsh are shown in Figure 8.

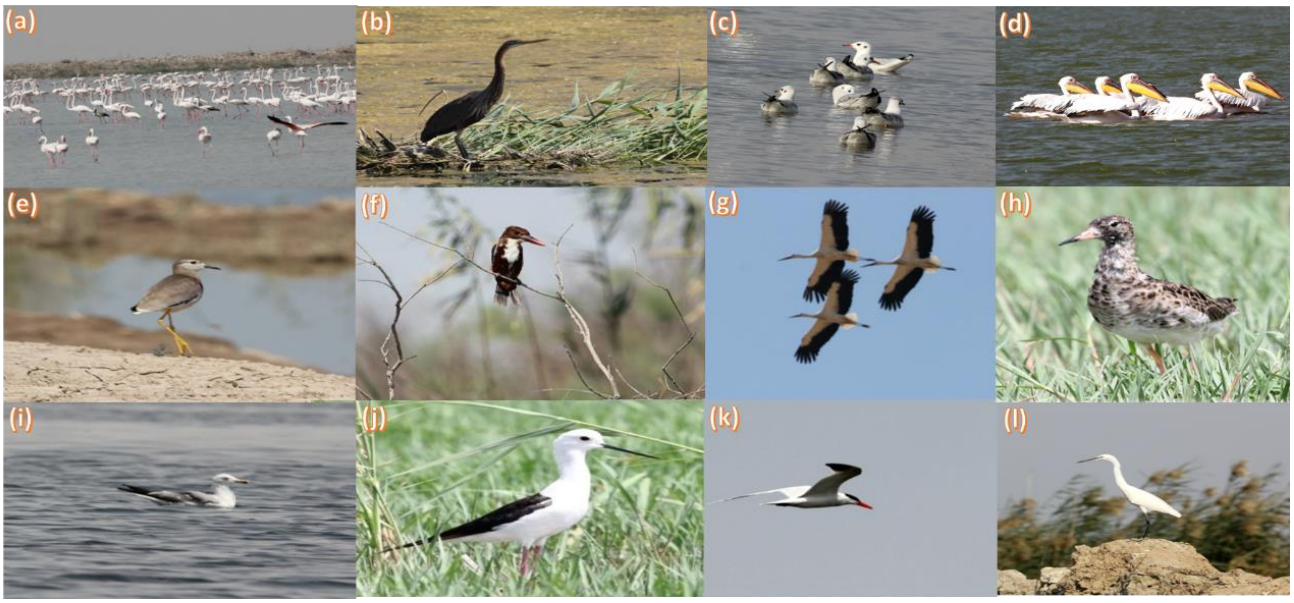

Figure 8. *The most important types of birds (migratory and endemic) in Al-Huwaizah Marsh: (a) Phoenicopterus ruber, (b) Ardea purpurea, (c) Larus genei, (d) Pelecanus onocrotalus, (e) Chettusia leucura, (f) Halcyon smyrnensis, (g) Ciconia, (h) Philomachus pugnax, (i) Larus armenicus, (j) Himantopus, (k) Sterna caspia, (l) Egretta alba.*

4.2.2. fish: The marshes of southern Iraq, including the Al-Huwaizah Marshe, are characterized by being a suitable environment for the living and breeding of various types of fish. Especially if we know that fish is the main source of living for the people who inhabit the marshes (Al-Zaidy et al., 2019). There are large populations of migratory fishes coming from the Arabian Gulf that enter Al-Huwaizah marsh in March and April of each year. These fish come swimming against the water current of the Shatt Al-Arab and the Tigris Rivers. These fish reproduce in their habitats to repeat the life cycle on an annual basis (Partow, 2001).

The field study indicates that the types of fish found in Al-Huwaizah Marsh are somewhat similar to the fish found in the rest of the other marshes in southern Iraq. This similarity in fish species is due to the convergence in water quality, in terms of physical and chemical characteristics and nutrients in the water. In terms of the number of fish and their weight, it was noticed that Al-Huwaizah Marsh was superior to the rest of the other marshes, which indicates the existence of a suitable environment for the growth and reproduction of fish (Al-Thahaibawi et al., 2019). The most famous of these fish are shown in Figure 9.

Figure 9. *The most important types of fish in Al-Huwaizah Marsh: (a) Barbus sharpeyi, (b) Tilapia zilli, (c) Ctenopharyngodon Idella, (d) Sea groupers, (e) Aspius vorax, (f) Silurus triostegus, (g) Heteropneustus fossilis.*

4.2.3. Mammals: Al-Huwaizah Marsh is an ideal environment for the breeding of several types of mammals, which have reached more than 60 species registered in the area (Munro & Touron, 1997). The great diversity of high plant productivity supports the diversity of mammals in Al-Huwaizah Marshes, providing water, food, and shelter. Among the mammal species endemic to the region shown in Figure 10.

Figure 10. *Among the mammal species endemic to Al-Huwaizah Marsh: (a) Sus scrofa, (b) Canis aureus, (c) Vulpes rueppelli, (d) Herpestes auropunctatus, (e) Lepus, (e) Bubalus bubalis.*

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4.2.4. Plants: Al-Huwaizah Marsh includes a large group of plants. Climate, water resources, and soil quality played an important role in determining the type and density of vegetation cover, as the plants in the study area are desert plants that have adapted to this type of climate (Hassan et al., 2011). Among the most significant plants in the study area (reed and papyrus), are the most significant and largest types of plants and the most widespread. These plants are used as a basic material for housing construction in the marshlands, and the demand for them is increasing from outside the places of their production, also, it is more spread in the pool of Umm Al-Naaj (Jabbar et al., 2010). As for the Golan plant, it spreads almost at the edges of the temporary marshes, as shallow water depths at the time of the flood reach between (1.5-2) m (Fig. 11).

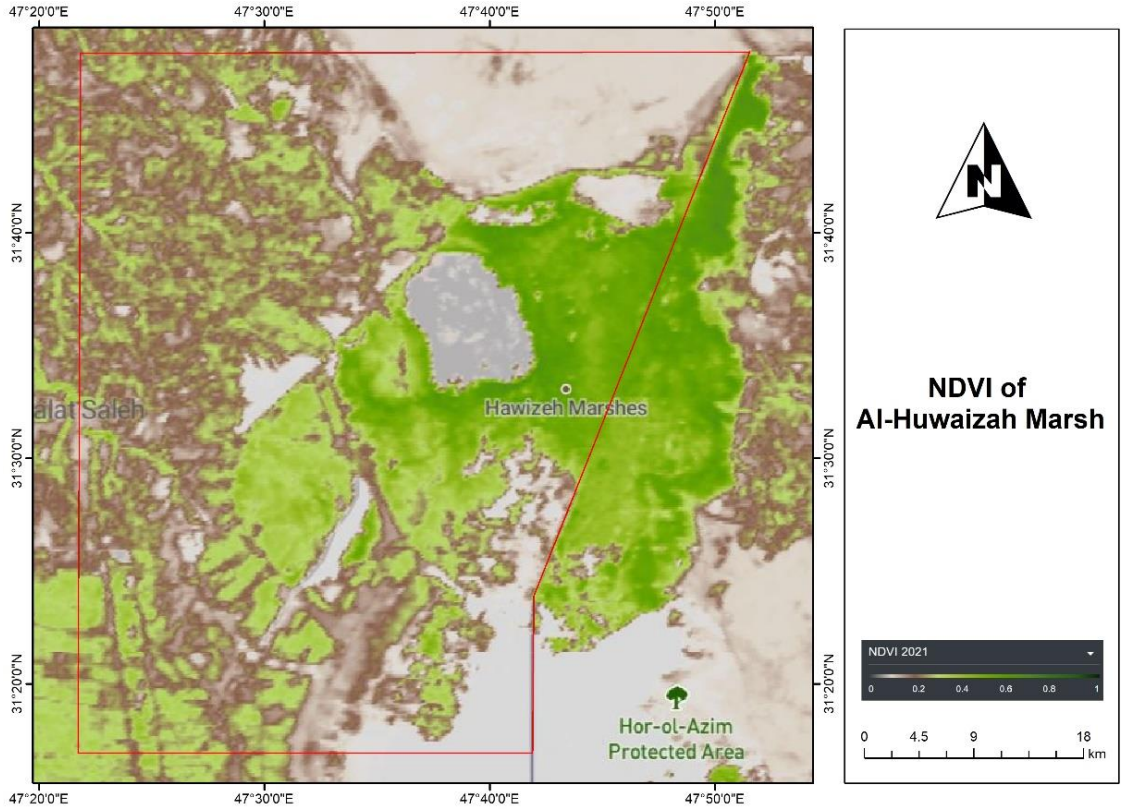

Figure 11. *NDVI of Al-Huwaizah Marsh for 2021.*

These plants are generally divided into three groups, which can be described as follows:

4.2.4.1. Emergent Plants: Part of the vegetative system of this plant is under the surface of the water, and the rest is above the surface of the water. These plants are large and upright, such as *(Phragmites australus, Typha domingensis, and Schoenoplectus litoralis)*.

4.2.4.2. Floating Plants: This type of plant has leaves floating above the surface of the water, and has roots embedded in the bottom. Examples are *(Salvinia natans, and Lemna polyrhiza)*.

4.2.4.3. Submerged Plants: These plants have extended roots in the mud, and part of them are loose. Examples are *(Myriophyllum spicatum and Najus sp)* (Fig. 11).

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Figure 12. *Types of plants at Al-Huwaizah Marsh: (a) Phragmites australis, (b) Typha domingensis, (c) Potamogeton lusens, (d) Lemna polyrhiza, (e) Salvinia natans, (f) Schoenoplectus litoralis, (g) Najus sp, (h) Ceratophyllum demersum, (i) Hydrilla.*

Conclusion:

The elements of the natural environment (geographical location, slope, geological structure, climate, soil) of Al-Huwaizah Marsh had a direct role in the geographical distribution of living organisms. A natural depression called Al-Huwaizah Marsh collects water during floods. The amount of water that enters it determines its area. When there are significant floods, the Tigris River and its banks vanish, and Al-Huwaizah Marsh levels rise and merge with the other marshes. The four most significant waterbodies in Al-Huwaizah Marsh are Al-Edhaim, Umm Al-Na'aj, Al-Sanaf, and Al-Jakka. Water from the Tigris River enters Al-Huwaizah Marsh from the Iraqi (western) side by the streams of Al-Musharrah, Al-Kahla, and Al-Majjariya, but only during the flood season. One of the wetlands in the globe, where birds can settle and migrate, is the Al-Huwaizah marsh. Out of 11, the region comes in fourth place globally. In the study area, there are two types of birds: migratory birds and endemic species. Al-Huwaizah Marshes are distinguished by providing an ideal environment for different species of fish to live and reproduce. Especially considering that the inhabitants of the marshes rely heavily on fish for their food. Al-Huwaizah Marshes' diverse and productive plant life sustains the abundance of mammals by offering them refuge, food, and water.

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References

A. AHMED, B., & S. HASHESH, T. (2022). USING SATELLITE IMAGES CLASSIFICATION TO ESTIMATE WATER LEVEL IN THE SOUTHERN MARSHLANDS AFTER THE FLOODS WAVE. *MINAR International Journal of Applied Sciences and Technology*, *4*(4). https://doi.org/10.47832/2717-8234.13.18

Abdul Jabbar, M., Al-Ma'amar, A., & Shehab, A. (2010). CHANGE DETECTIONS IN MARSH AREAS, SOUTH IRAQ, USING REMOTE SENSING AND GIS APPLICATIONS. *Iraqi Bulletin of Geology and Mining*, *6*(2), 17–39.

Abed, J. M. (2007). Status of Water Birds in Restored Southern Iraqi Marshes. *Marsh Bulletin*, *2*(1), 64–79. www.pdffactory.com

Al-Ansari, N. (2020). Can We Restore the Marches in Iraq (Garden of Eden)? *Engineering*, *12*(07), 466–486. https://doi.org/10.4236/eng.2020.127033

Al-Ansari, N. A. (2013). Management of Water Resources in Iraq: Perspectives and Prognoses. *Engineering*, *05*(08), 667–684. https://doi.org/10.4236/eng.2013.58080

Al-Jiburi, H. (2005). *Hydrogeological and Hydrochemical Study of Al-Amara Quadrangle*. State Company of Geological Survey and Mining.

Al-Kenzawi, M. A. H., Al-Haidary, M. J. S., Talib, A. H., & Karomi, M. F. (2011). Environmental Study of Some Water Characteristics at Um-Al-Naaj Marsh, South of Iraq. *Baghdad Science Journal*, *8*(1), 531–538.

Almaarofi, S. (2015). *Ecological Assessment of Re-flooded Mesopotamian Marshes (Iraq)* [Thesis]. University of Waterloo.

Al-Musawi, M., & Maaroof, B. (2019). Geographical analysis of the ecological tourism components of Al Hammar marshes in southern Iraq. *Misan Journal of Academic Studies*, *18*(37), 1–13.

Almutury, W. G., & Al-Asadi, M. M. (2008). Tectonostratigraphic History of Mesopotamian Passive Margin during Mesozoic and Cenozoic, South Iraq. *Kirkuk University Journal for Scientific Studies*, *3*(1), 31–50.

Al-Nussairi, H., & Hassan, K. (2020). Study and evaluation the Marshes and surrounding areas in south of Iraq. *E3S Web of Conferences*, *150*(20 20). https://doi.org/10.1051/e3sconf/202015003011

Al-Saady, I., & Abdullah, E. (2014). Water Quality of Tigris River within Missan Governorate eastern part of the Mesopotamia Plain–Iraq. *Journal of University of Babylon*, *22*(9), 2489–2502.

Al-Saboonchi, A., Mohamed, A.-R. M., Alobaidy, A. H. M. J., Abid, H. S., & Maulood, B. K. (2011). On the Current and Restoration Conditions of the Southern Iraqi Marshes: Application of the CCME WQI on East Hammar Marsh. *Journal of Environmental Protection*, *02*(03), 316–322. https://doi.org/10.4236/jep.2011.23035

Al-Sakini, A. (2009). *Environment Changes of Southern Iraq Marshlands and its Geographical Impacts*. University of Baghdad.

Al-Salih, S., & Al-Kubaisi, Q. (2016). HYDROCHEMICAL ASSESSMENT OF WATER RESOURCES IN AL-TEEB AREA, NE MAISSAN GOVERNORATE, SOUTH IRAQ. *Iraqi Bulletin of Geology and Mining*, *12*(2), 1–12.

Al-Sheikhly, O. F., & Al-Azawi, A. J. (2019). The diurnal birds of prey (raptors) in the Mesopotamian marshes of southern Iraq with notes on their conservation status. *Bulletin of the Iraq Natural History Museum*, *15*(4), 381–402. https://doi.org/10.26842/binhm.7.2019.15.4.0381

Al-Thahaibawi, B. M. H., Younis, K. H., & Al-Mayaly, I. K. A. (2019). Fish Assemblage Structure in Al-Huwaizah marsh southern of Iraq after inscribed on the World Heritage List. *Iraqi Journal of Science*, *60*(7), 1430–1441. https://doi.org/10.24996/ijs.2019.60.7.3

Alwan, I. A., & Aziz, N. A. (2021). An accuracy analysis comparison of supervised classification methods for mapping land cover using sentinel 2 images in the al-hawizeh marsh area, southern iraq. *Geomatics and Environmental Engineering*, *15*(1), 5–21. https://doi.org/10.7494/geom.2021.15.1.5

Al-Zaidy, K. J. L., Parisi, G., Ali Abed, S., & Salim, M. A. (2019). Classification of the Key Functional Diversity of the Marshes of Southern Iraq Marshes. *Journal of Physics: Conference Series*, *1294*(7). https://doi.org/10.1088/1742-6596/1294/7/072021

Bedair, H. M., Al Saad, H. T., & Salman, N. A. (2006). Iraq's Southern Marshes Something Special To Be Conserved; A Case Study. *Marsh Bulletin*, *2*(1), 99–126. www.pdffactory.com

Gan, J. (2004). Wetland Ecosystems for Treatment of Stormwater in an Urban Environment. In *Wetlands Ecosystems in Asia*. https://doi.org/10.1016/b978-044451691-6/50024-7

Ghobadi, Y., Pradhan, B., Sayyad, G. A., Kabiri, K., & Falamarzi, Y. (2015). Simulation of hydrological processes and effects of engineering projects on the Karkheh River Basin and its wetland using SWAT2009. *Quaternary International*, *374*, 144–153. https://doi.org/10.1016/J.QUAINT.2015.02.034

Hashesh, T. S., & Ahmed, B. A. (2018). Using GIS and remote sensing to study water quality changes and spectral analysis for Al-hawizah marshes, South of Iraq. *Iraqi Journal of Science*, *59*(3). https://doi.org/10.24996/IJS.2018.59.3C.20

Hason, M. M., Abbood, I. S., & Odaa, S. aldeen. (2020). Land cover reflectance of Iraqi marshlands based on visible spectral multiband of satellite imagery. *Results in Engineering*, *8*. https://doi.org/10.1016/j.rineng.2020.100167

Hassan, F. M., Al-Kubaisi, A. A., Talib, A. H., Taylor, W. D., & Abdulah, D. S. (2011). Phytoplankton primary production in southern Iraqi marshes after restoration. *Baghdad Science Journal*, *8*(1), 519–530.

Hatem, A. (2016). *GEOMORPHOLOGICAL CHARACTERISTICS OF THE COURSE OF RIVERS AL-KAHLA AND AL-ASHERAH IN MAYSAN PROVINCE AND ITS IMPACT ON HUMAN ACTI*. University of Baghdad.

Hussain, N. A., & Grabe, S. A. (2009). A Review of the Water Quality of the Mesopotamian (Southern Iraq) Marshes Prior to the Massive Desiccation of the Early 1990s. *Marsh Bulletin*, *4*(2), 98–120. www.pdffactory.com

Jabbar, M. F. A., Al-ma, A. F., & Shehab, A. T. (2010). Change Detections in Marsh Areas, South Iraq, Using Remote Sensing and GIS Applications. *Iraqi Bulletin of Geology and Mining*, *6*(2), 17–39.

Maaroof, B. F. (2017). Geomorphological characteristics of the East Tigris region between Al-Shihabi and Al-Huwaizah Marsh in southeastern Iraq. *Journal of Misan Researches*, *13*(26), 366–390.

Maaroof, B. F. (2022a). GEOMORPHOMETRIC ASSESSMENT OF THE RIVER DRAINAGE NETWORK AT AL-SHAKAK BASIN (IRAQ). *Journal of the Geographical Institute Jovan Cvijic SASA*, *72*(1), 1–13. https://doi.org/10.2298/IJGI2201001M

Maaroof, B. F. (2022b). Geomorphometric Assessment of the Terrain Characteristics of Al-Sharhani Drainage Basin, Eastern of Misan Governorate, Iraq. *Journal of Babylon Center for Humanities Studies*, *12*(3), 39–62.

Maaroof, B. F., & Kareem, H. H. (2022). Geomorphometric Analysis of Al -Teeb River Meanders Between Al-Sharhani Basin and Al-Sanaf Marsh, Eastern of Misan Governorate, Iraq. *Misan Journal of Academic Studies*, *21*(42), 430. https://doi.org/10.54633/2333-021-042-033

Maaroof, B. F., & Kareem, H. H. (2023). Geomorphological Analysis of Chemical Weathering Features in Al-Band Hills Area, Eastern of Misan Governorate, Iraq. *Iraqi National Journal of Earth Science*, *23*(1), 67–84. https://doi.org/10.33899/earth.2023.137382.1034

Makki, J. S., Abood, A. R., & AL-Umar, M. H. (2019). Restoration of Al-Sanaf Marsh under various operation conditions. *Journal of Ecological Engineering*, *20*(11). https://doi.org/10.12911/22998993/113038

Mays, A. (2018). *THE ASSESSMENT OF ENVIRONMENTAL CHANGE AND SUSTAINABLE DEVELOPMENT USING GIS ON SOUTHERN IRAQ MARSHES* [Thesis]. UUNIVERSITYOF BUCHAREST.

Muhsin, I. J., & Kadhim, M. J. (2017). Monitoring of south Iraq marshes using classification and change detection techniques. *Iraqi Journal of Physics*, *15*(33), 78–86.

Munro, D. C., & Touron, H. (1997). The estimation of marshland degradation in southern Iraq using multitemporal landsat TM images. *International Journal of Remote Sensing*, *18*(7). https://doi.org/10.1080/014311697218304

Partow, H. (2001). *The Mesopotamian marshlands: demise of an ecosystem*. UNEP.

Qassim, I. (2008). *THE GENERAL YDROGEOLOGICAL AND GEOMORPHOLOGICAL CONDITIONS OF THE EASTERN PARTS OF MISSAN GOVERNORATE* [Ph.D.]. University of Baghdad.

Qassim, I. (2014). *The Effect of Climatic Water Budget on The Investment of Water Resources in the Governorate of Mayssan*. University of Baghdad.

Rahi, K. A., Al-Madhhachi, A. S. T., & Al-Hussaini, S. N. (2019). Assessment of surface water resources of eastern Iraq. *Hydrology*, *6*(3). https://doi.org/10.3390/HYDROLOGY6030057

Rasheed, M. (2008). *GEOMORPHOLOGICAL AND SEDIMENTLOGICAL INVESTIGATION OF HUR Al-HUWAIZEH AND ADJACENT AREAS* [Thesis]. University of Baghdad.

Sabah Y. Yacoub. (2010). Geomorphology of the Mesopotamian Plain: A Critical Review. *Journal of Earth Sciences and Geotechnical Engineering*, *10*(4), 1–25.

Salim, M., Porter, R., & Rubec, C. (2009). A summary of birds recorded in the marshes of southern Iraq, 2005-2008. *BioRisk*, *3*(1), 205–219. https://doi.org/10.3897/biorisk.3.14

UNEP. (2006). *Iraqi Marshlands Observation System UNEP Technical Report*. https://postconflict.unep.ch/publications/UNEP_IMOS.pdf

Zahraa, E. H., Hasan, R. H., & Aziz, N. A. (2018). Detecting the Changes of AL-Hawizeh Marshland and Surrounding Areas Using GIS and Remote Sensing Techniques. *Association of Arab Universities Journal of Engineering Sciences*, *25*(1). https://www.researchgate.net/publication/323287491

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