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Monitoring and evaluation with the change detection of the dryness in Marshes regions south of Iraq to enhance the urban environment of the area

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Abstract
The rise in global temperatures poses a threat to life, as it threatens the occurrence of natural disasters such as drought and desertification in various parts of the world. The problem of drought has exacerbated this year for many reasons, the most important of which is the lack of rain, and the lack of water coming to the affected countries, including Iraq.
The construction of dams in Turkey, Iran and Syria at the gates of the *Tigris* and Euphrates rivers over many years, causing reduced water flow in both rivers, which contributed to desertification and drought throughout Iraq.
This research aims to monitor desertification, determine the areas of sand dunes, identify the types of sand dunes, and measure their movement in different regions of Iraq, depending on remote sensing techniques and geographic information systems.

Keywords: Monitoring, Evaluation, Dryness, Marshes regions, Remote Sensing, GIS

1. Introduction

The rise in the Earth's temperature is dangerous to all life on Earth, and it causes natural disasters, humidification, and desertification in other regions, including Iraq (Emadaldeen *et al.*, 2024; Abdul Jabbar, 2010) [1, 2]. The problem of drought this year is considered for many reasons, the most important of which is due to rain and the decrease in water coming to Iraq, and the phenomenon of desertification has become a third in general life. For people in the least aspects, starting with the decline of green areas, in addition to the impact of the phenomenon of dust storms and impact impacts. (Al-Ansari, 2013; Al-Handal *et al.*, 2015) [3, 4].
Their agreement included the problem of drought in Iraq and the phenomenon of desertification there. The problem of stagnation is increasing significantly this year for many reasons, most notably the small quantities that Turkey exports from the water of the *Tigris* and Euphrates rivers due to the system of monitoring the percentage of a large number of dams on the two rivers' banks over many years. (Aoki *et al.*, 2010; Chebud *et al.*, 2012; Dehni *et al.*, 2012) [5, 6, 7].
Wasting our water and throwing it into the Gulf requires a serious stance, and the idea of constructing dams on the Shatt al-Arab, for example, is an idea that I work more than care about, because this dam is in a state of completion (Gh, 2014; Kennedy *et al.*, 2009) [8, 9]. It will save water and return it to the lands of Iraq and will contribute to reviving millions of hectares of arable land (Kerekes *et al.*, 2007; Khattab *et al.*, 2014) [10, 11]. It is a proposed project that we demand and call for its activation. And his desire to make its presence known, especially since neighboring countries have been interested, for more than two decades, in constructing dams. The Ataturk Dam in Turkey, the Grand Karaj Dam in Iran, and the Raqqa Dam in Syria all contributed to reviving agriculture in those countries, but at the expense of Iraq (Koch, 2011) [12]. The phenomenon of desertification and drought has drawn political attention, scientific studies, and a position Government official (Lillesand *et al.*, 2014; Lu *et al.*, 2011) [13, 14].
They did this by working in this field from the Iraqi Ministry of Environment, Geographic Information Systems Department, to put within priority the issue of desertification in Iraq, delaying it to the people of the element, and to create the necessary reincarnation in order to save Iraq from the great disaster that looms on the horizon (Marcello *et al.*, 2013) [15]. Samples were taken from different areas of the regions. The southern and western parts of the south in order to establish the project. These areas in the region represent (the marshes in southern Iraq, Lake Razaza from the central region, Al-Uqaila from the western region, and Sahn from southwestern Iraq (Martin *et al.*, 2008; Mather *et al.*, 2009) [16, 17]
The selection of areas was chosen precisely and to the point of meaning by the experts and masters of the project. For example, the marshes area of the South was chosen, and thus a result was issued in the marshes of Abu Zark, Al-Baghdadiya, and the marshes of Al-Chibayish, and the extent of the development that occurred in coverage rich in benefits over the past two decades, and Lake Al-Razzaza was chosen to study the surface level (Mather *et al.*, 2011; Mawahib *et al.*, 2010) [18, 19, 20]. The water in the lake, but the areas of

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the Western Lake and even southwestern Iraq in particular were chosen to study the types of computerized soils and the level of the plate in the ground, and the types of sand dunes in those areas were also determined (Moghaddam *et al.*, 2010; MoWR *et al.*, 2007; Ministry of Water Resources *et al.*, 2007) [21, 22, 23].

The undirected classification formula was adopted as the primary formula for the project study in the ERDAS IMAGINE 9.1 program to produce preliminary images in (.img) format of the study areas supported by the areas of phenomena that these areas included.

It is worth noting that the Arc GIS program was used to produce these classified images in the form of thematic maps. The current study aims to use remote sensing techniques and geographic information systems to identify areas where sand dunes are located and measure their movement based on satellite visual data.

The preliminary results showed the variation in the movement of sand dunes in western Iraq and the change in the nature of the marshes area in southern Iraq. The results also showed the retreat occurring in Lake Razaza in the central region and how it is exposed to sand drift and sand encroachment on it, which requires taking the direction and speed of movement of sand dunes into consideration when planning urban expansion. And the future industrial sector within Iraqi territory.

3. Work methodology

Remote sensing techniques and geographic information systems were utilized to produce maps containing basic classifications for the areas studied during the period (1990-2006), as well as to derive maps of the locations of the sand dunes, their general direction, their area, and the speed of their movement by identifying the changes that occurred in their location. We used maps and satellite visuals (Landsat 7 TM, Aster, Google Earth) with a spatial resolution of (57*57) and (30*30), which were obtained by the Geographic Information Systems Center in the Iraqi Ministry of Environment / Baghdad (Al-Waziriya) and using specialized programs. (ERDAS IMAGINE 9.1) and (Arc Info, Arc View) programs produced sand movement maps and calculated changes in the lands that were studied.

2. Study area

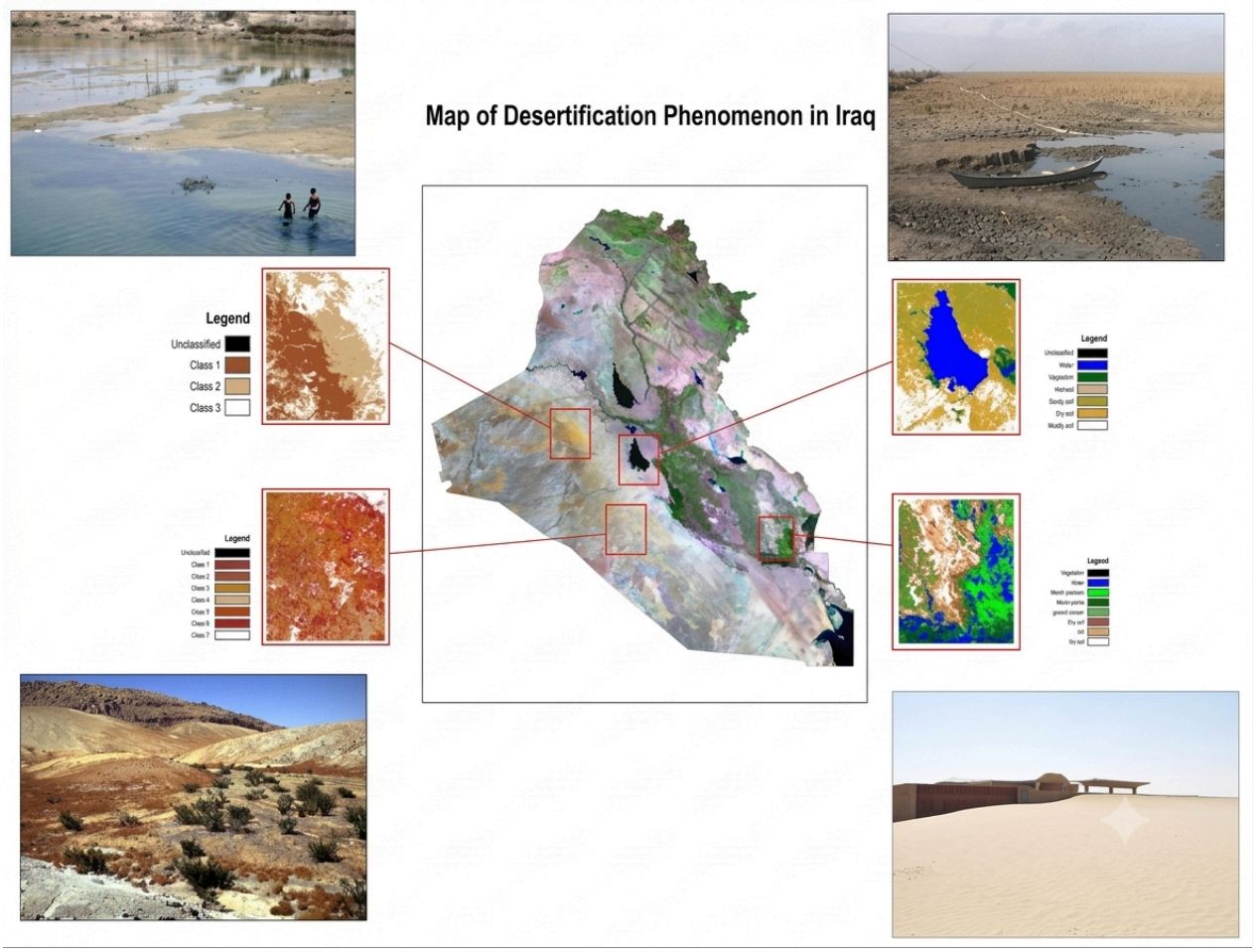


Figure 1. Map of Desertification Phenomenon in Iraq

4. Technical method of analysis

First: Analysis of satellite visuals

1. Geometric correction of the image: In this study, the method of correction with a corrected satellite image (Image to Image) was used, and this process was taken into account when taking the ground control points (GCP) so that they were well distributed over the image.
2. Resampling process: Because the correction process may disturb the size of the cells, some of them increase and others decrease than what is supposed, so the resampling is done to unify the size of the cells and return them to the original size. This has been reset for all images to remove cases of displacement. Nearest Neighbor method because it preserves linear features and cell values.
3. Defining the study area (Subset): Four areas were taken, as mentioned previously, for specific purposes and with lines of longitude and latitude.

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4. Classification stage: The classification process was carried out by sorting each element in the satellite image according to its spectral reflectance, then. Each element was given a single spectral fingerprint in an area to be classified and different from the rest of the elements. This process resulted in a thematic map in which the geographical locations of the components of the Earth's surface are shown (land use maps). In this study, images of the study area were classified, as explained later. Classification areas, the method of spreading sand dunes, and the change in the physical and chemical properties of the soil.
5. Calculating the changes in areas occurring in different regions and in different years by setting a table of land changes in the study area and for the period. (1990-2006).
6. Developing some proposals for the purpose of protecting the environment from the dangers of sand drift in different regions of Iraq.

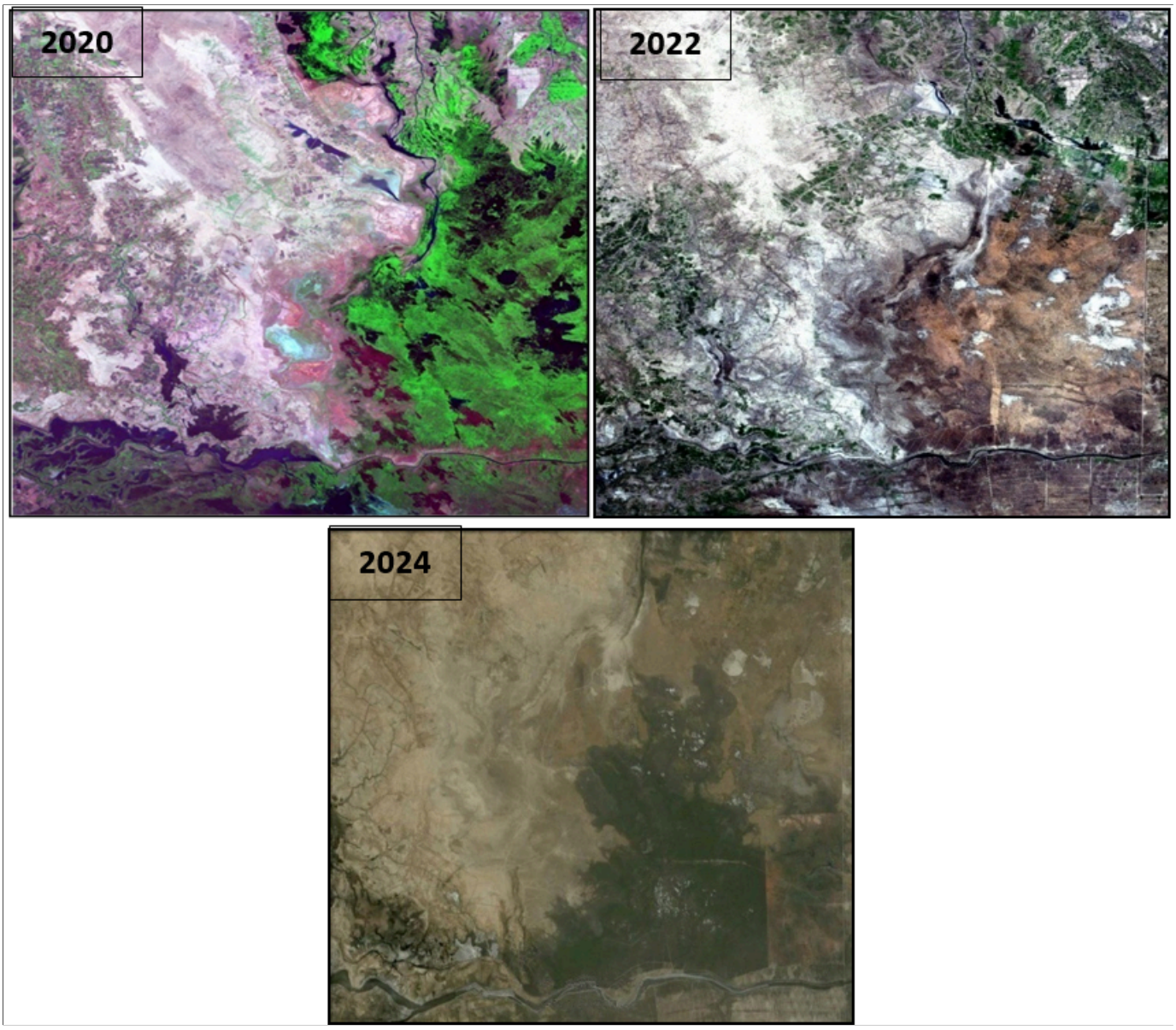
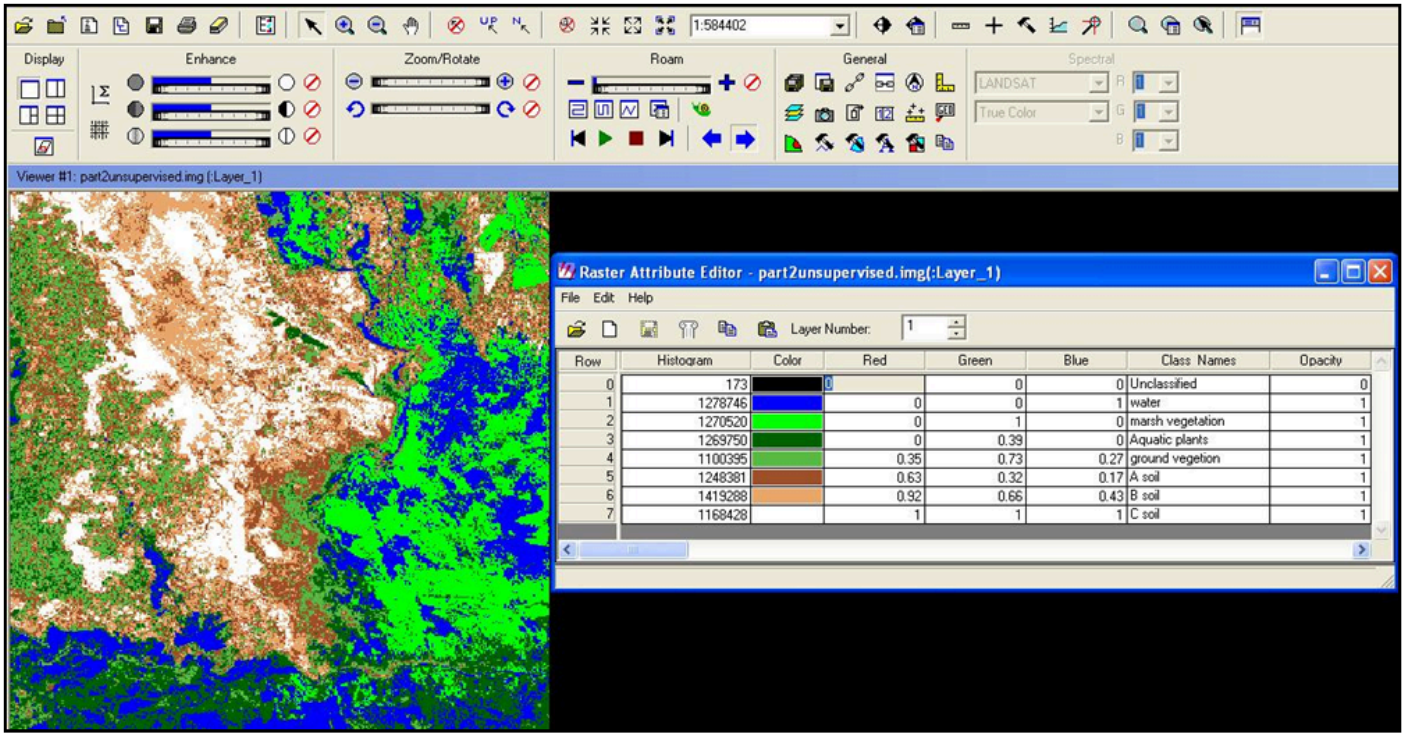


Figure 2. Satellite images for marshes area south of Iraq (2020-2022-2024)

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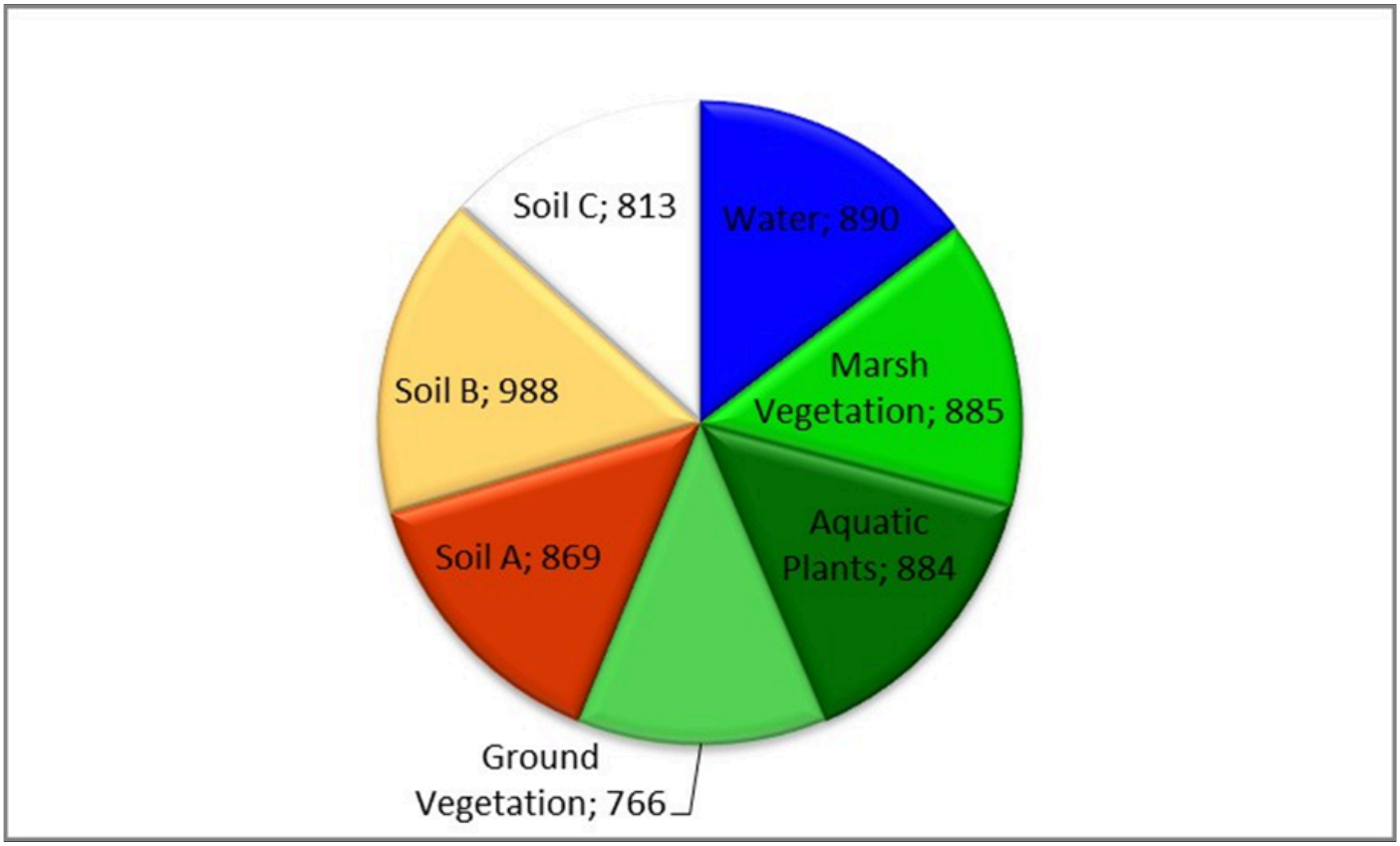


Figure 3. Area classification of marshes area south of Iraq (2020)

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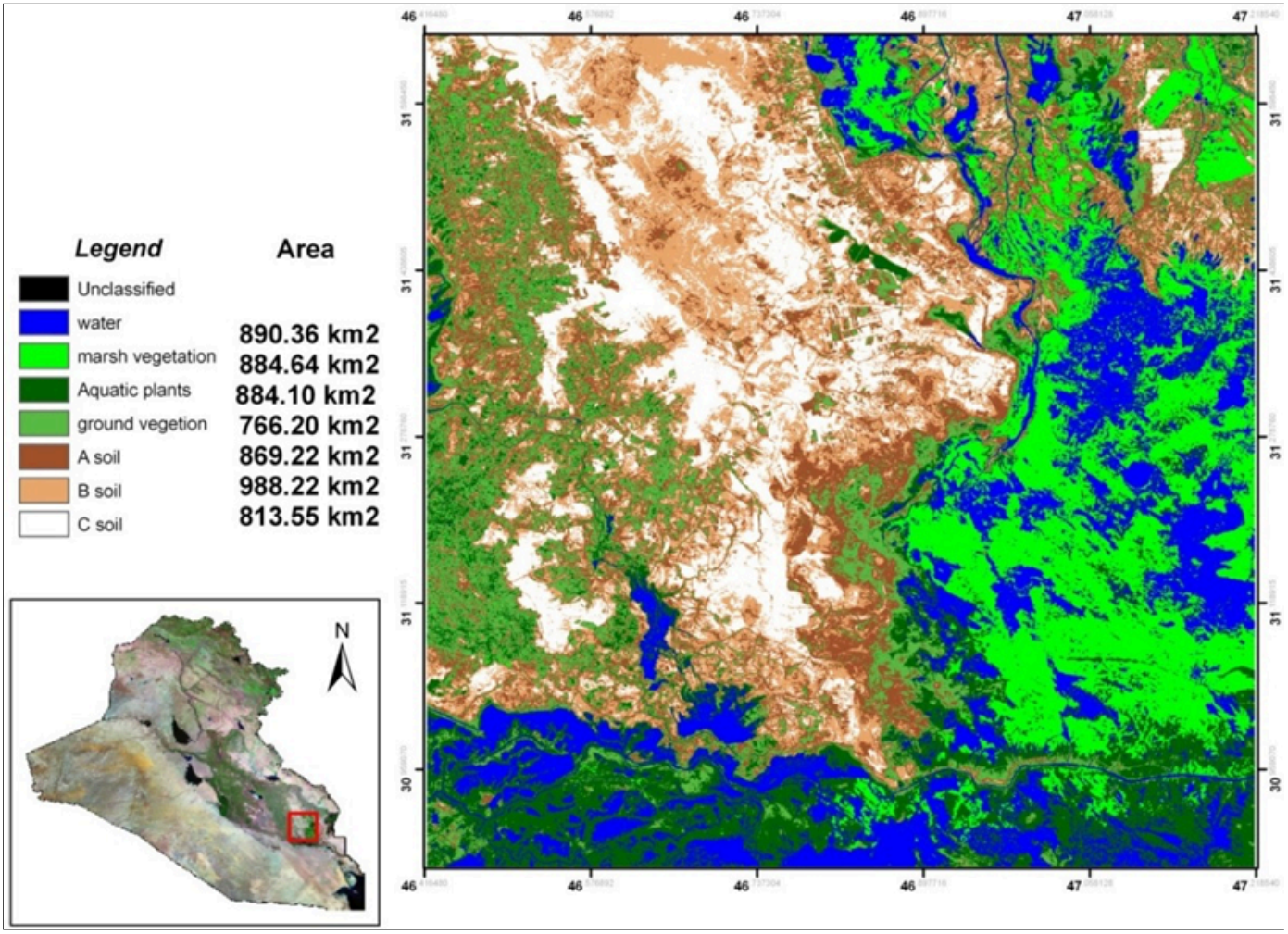


Figure 4. Full satellite image of marshes area classifications south of Iraq (2020)

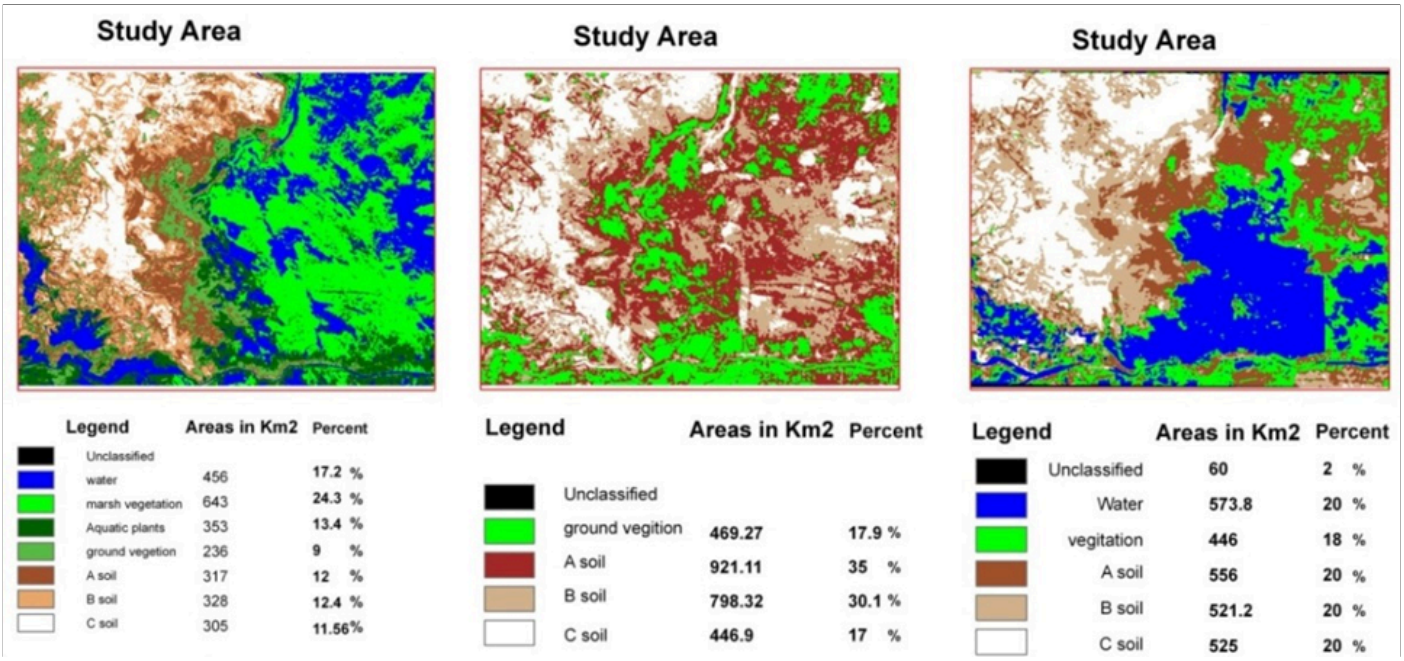


Figure 5. A map is showing the various classifications, percentages, and the change dictations of the marshes region overall the years (2020, 2022 and 2024)

5. The problem of desertification in Iraq

Iraq faces the largest environmental problem in its history, represented by severe desertification, which endangers its food security. Many natural and human factors in making it have dire environmental, economic, social and cultural consequences, most notably the loss of land producing and moving sand dunes and severe sand and dust storms and their resulting consequences: increased air pollution (Phua *et al.*, 2012; Potes *et al.*, 2012) [24, 25]. This study attempts to identify the development of the problem, analyzes its causes and consequences, and proposes a number of solutions to process it (Pour *et al.*, 2015; Pu *et al.*, 2011) [26, 27].

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Table 2: Comparison for moving of the sand dunes and classify of changes areas in marshes region

Color Classify	Classifications	Area (Km) 2020	Area (Km) 2020	Change Area
	Water	890.36	-	-
	Marsh vegetation	884.64	-	-
	Aquatic plants	884.10	-	-
	Ground vegetation	766.20	1429.01	662.81
	A soil	869.22	2027.25	1158.03
	B soil	988.22	1289.52	301.3
	C soil	813.55	1289.52	475.97

There are many definitions of desertification, but the most recent definition was approved in 1994 within the United Nations Convention to Combat Desertification states: "Desertification means the degradation of land in arid and semi-arid areas and in dry and sub-humid areas, which results from various factors, including climate change and human activities (Quilbé *et al.*, 2007; Rokni *et al.*, 2014) [28, 29]."

In fact, desertification is a destructive process or the destruction of the Earth's vital energy, which can eventually lead to desert-like conditions, which is a manifestation of the widespread deterioration of ecosystems, which leads to a decline in the Earth's vital energy represented by plant and animal production, and then influence the support of human existence.

6. Development of desertification

It may seem easy to distinguish decertified lands, but in reality it is difficult to identify and describe them using simple terms.

Accurate diagnosis requires identifying a large number of factors, and even after that, the problem remains complicated due to different factors: opinions regarding the relative importance of the various factors that are accelerating the phenomenon of desertification in Iraq, and the proportion of lands exposed to it is estimated. It exceeds 92% of the total area. Since 1981, this percentage has increased, especially due to military operations, which destroyed both the soil and plants and had other harmful negative consequences on the environment.

Desertification can be classified according to its intensity and the lands affected by it.

7. Causes of desertification

Since desertification is a complex and interrelated environmental, economic and social problem, so a number of natural factors intertwine and intertwine, and humanity can create it. Regarding the first factors, we find repeated droughts in Iraq in recent decades. For example, rainfall amounts were 30% above average, and water levels in the main rivers fell by more than 50% in 1999. This resulted in a decline in the production of agricultural crops that depend on rain by 70% and losses in the production of wheat and barley by 37% and 63% in the central and southern regions, respectively.

The problem becomes more complicated if we know that the climate desert prevails in 70% of the land, especially in the alluvial plain and the western plateau, where annual rainfall varies between 50-200 mm. Salinization is the main factor in desertification, which has reached a very serious degree. In fact, the spread salts were found in the Mesopotamian Plain after being cultivated during successive generations, as historical sources indicate that the history of irrigation of agricultural lands in this plain dates back more than six thousand years.

Hence the opinion that says, the transfer of centers ancient civilizations from the south to the center and the north were caused by the spread of salts in the soil and the decline in their production, and it becomes clear that the spread of salts is due to geomorphological, hydrological, climatic factors, water and soil properties, and to the worker. The human problem is represented by the lack of use of appropriate irrigation methods, which means the absence of water techniques and scientific methods used in agriculture, despite much talk over the years about interest in agriculture.

8. Distribution of sand dunes

Regarding the distribution of sand dunes at the governorate level, there are dunes in Babylon adjacent to the general estuary, and in Salah al-Din, north and south of Baiji, Tikrit-Kirkuk. In Al-Qadisiyah, there are small dunes that move depending on the wind speed, and in the Al-Budair area-Nafar-Afak. In Diyala, the dunes are relatively high, and in Muqdadiya they are longitudinal, crescent-shaped, or fan-shaped.

And in Anbar, the soil is swept away by the wind due to lack of vegetation cover and drought, and sand dunes form throughout the Western Desert, moving and affecting on the highway to Jordan and Syria. And in Dhi Qar, there is shifting sand in the area between the general estuary, the borders of Diwaniyah and Al-Budair district. In Basra, the southern desert is sandy land where wells are drilled.

And in Wasit, there is the sand in Numaniyah has an area of 91 km^2, and Al-Muwafiqiyah-Sheikh has an area of 13 km^2. In Nineveh, the company is 4 km away, in Al-Baret, 3 km away, and in Nasiriyah, the dunes creep into these areas and reach the street leading to the Hatra district and the airport, with a length of 45 km. It is located in Karbala, the dunes are within 32 degrees of latitude from the northwest and southwest sides.

In Muthanna, the area of the dunes is 65,000 dunums in the Warka district, 25,000 dunums in the Najmi district, and 12,000 dunums in the Basiya district, and there are dunes, fixed area of 1000 dunums in Al Hilal district.

As for the economic results, they are represented by what the United Nations specified in its survey of the state of the environment in the world for the period 1972-1992, where it was stated: "Land degradation and desertification affect the ability of countries to produce food, and thus entail a reduction in capabilities regional and global food production, and they also cause food deficits in threatened areas, with the associated consequences effects on food reserves and food trade in the world."

Since desertification involves the destruction and decrease of plant life, there are many plant and animal groups, and it is one of the main reasons for the loss of biodiversity in arid and semi-arid regions arid land, which reduces food production opportunities, and these conclusions apply to Iraq.

The agricultural land lost annually as a result of salinization, erosion and soil degradation is large when compared to the area total cultivated land.

9. Results of desertification

We will analyze the most prominent environmental, economic and social consequences of desertification. For the first, human use of natural resources is consumption, and therefore the type and intensity of use either lead to environmental degradation or maintain its balance. This is represented in the deterioration of plant and animal life, the deterioration of soil and pastures, and the shrinkage of agricultural lands or those that can be reclaimed. The shortage of water and the deterioration of its quality, especially its high salinity, are all due to improper and excessive use for these resources.

Desertified lands or those in the process of desertification result in a decrease in the productivity of environmental or agricultural systems, whether natural pastures, forests or cultivated lands. Ultimately, environmental degradation can be a major factor in change climate. Sand

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dunes are among the most dangerous consequences of desertification because of their negative effects on all vital aspects of life.

Dust and sand storms are a harmful feature, and their main manifestation is the spread of sand dunes, often in areas the central and southern regions are moved by the wind. These storms pollute the environment and affect human health and agricultural production. And it is ruined physiological processes of plants, especially pollination and flowering. Sand storms blow from sand fields in the central regions and the south. They have increased in recent years, and the problems have become worse since the imposition of economic sanctions in 1990.

Poor soil and water management and harsh climatic factors have extensively altered the agricultural lands of the alluvial plain to barren and waterlogged soil covered with sand resulting from air erosion and sand dunes. Where the limit ranged, the highest amount of dust falling in 2006 ranged between 9 in Anbar and 168 (g/m^2/month) in Basra, and the limit ranged between the lowest is between 1.2 in Salah al-Din and 60 (g/m^2/month) in Maysan.

It can be said that most of the dust storms originate in Iraq, which is represented by the western plateaus and the island. The lands left in the alluvial plain are 80% of the area of Iraq located south of latitude 35 degrees in the north. It is a source of dust from dust storms, while some of the dust comes from the desert of the Levant and the Arabian Peninsula and the Sinai Peninsula.

10. Combat desertification

Despite the awareness of the seriousness of desertification, the means to combat it have not yet lived up to the level of the threat it poses at various levels: environmental, economic, social, cultural, political and security. Therefore, it has become necessary to give it a prominent place in development plans. Combating it requires developing plans that include direct goals of halting its progress and reclaiming desertified lands. Others include reviving soil fertility and maintaining it in areas prone to desertification.

This requires evaluation and review of plans continuously to avoid what is not valid, with a long-term view, rational management of environmental resources at all levels, and cooperation, regional and international, taking into account the lack of quick solutions to this problem. This becomes more important if we know that 33.4% of the population of Iraq in 2007 still lived in the countryside, according to the estimate of the Central Bureau of Statistics, and were directly dependent or indirectly on agriculture, and since humans are primarily responsible for desertification, their work can stop desertification.

Stopping it essentially requires restoring the balance between humans and the Earth—between population size, available resources and the environment—through better use of resources, which can help relieve pressure and restore balance, as population growth represents the main factor in the population-resources-development-environment equation. This factor must be taken into account when planning long distances Al-Mada for development, control of desertification and other aspects of environmental conservation.

Any realistic efforts to stop desertification assume that it takes in an integrated manner the problems of development and providing the basic needs of the population, as it has long been recognized that poverty is one of the main threats to the environment. Therefore, the slogan that we must raise is “development without environmental destruction.”

Environmental scanning is the necessary introduction to any plans aimed at combating desertification. Since desertification suffers from a lack of reliable information, although there is evidence at the local level about its spread, there is a lack of data about its extent, deterioration and rate of change at the national level. Without this, it is difficult to justify spending a lot of money on combating desertification.

To improve our understanding requires better observation and more detailed cross-disciplinary research into social processes and the environment that constitutes desertification, and stronger support for this trend from the scientific community, which contributes to this development trend. Meteorological stations use advanced devices and equipment and benefit from satellite services for monitoring desertification, which some Arab countries have begun to benefit from.

11. Results and recommendations

1- The movement of sand dunes has increased since 1990 - 2006, and most of the expansion was from the western direction.

And from the southwest to the east, depending on the movement of the wind direction.

2- From what was revealed through satellite images and maps that were created through remote sensing technology

Geographic information systems showed changes in the study area and explained the incursion of sand dunes into areas

Between the two rivers.

3- The emergence of new types of soil within a short period of time. The reason is attributed to climate changes in Iraq.

12. Recommendations

1- Review and determine land use plans and implement the proposed policy matrix.

2- Coordination and cooperation between government agencies directly related to sand drift.

3- Include environmental impact assessment studies for future industrial and residential projects.

4- Collecting and multiplying seeds of local plants capable of withstanding the desert climate characteristics.

5- The spread of vegetation and its monitoring in Iraq in general and in the study areas in particular.

Researchers believe that the issue of desertification in Iraq is a major future problem if it does not come together. Efforts to reduce the aggravation of the problem also influence decision-makers for the purpose of coordination with ministries related to this topic.

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