

# Roles of Climate Change and Environmental Sustainability

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**Abstract** Climate change is widely acknowledged as a major global challenge with serious environmental, economic, and social repercussions. Iraq is ranked as the world's fifth greatest vulnerable country. The country is facing serious challenges, such as rising temperatures, decreasing rainfall, alkalinity, and the latest dust storms. Given this, combating climate change is an urgent and profound task for Iraq, a complex and difficult mission that will span several generations. To confront the challenge of climate change, a comprehensive climate change mitigation and adaptation framework covering as many climate-related topics as possible and connecting as many interested parties as possible across Iraq is required. It is critical to weather patterns topics such as climate-induced impact assessment, environmental vulnerability, and adaptability and sequels, climate change. Our objective use remote sensing and GIS are to mitigation and adaptation strategies to hold the sustainable weather and an improved understanding of climate, climate-related impacts, and remedies.



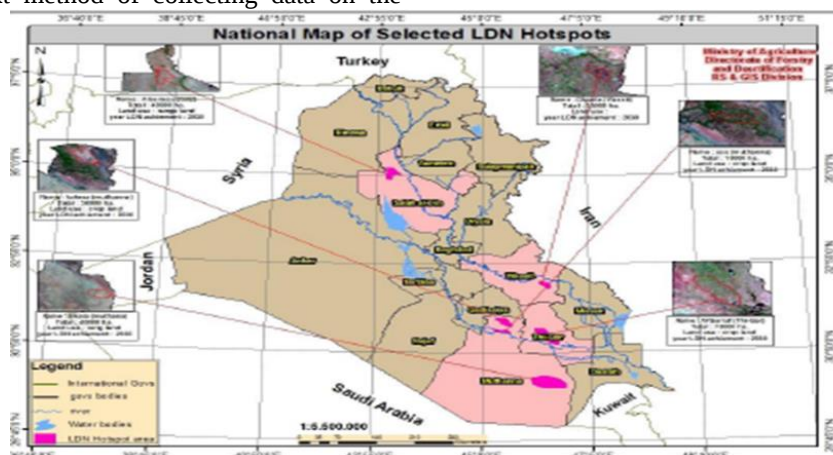
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**Keywords:** Climate change; Indicators for Sustainable Development; urban transformation; built environment; Climate Change Overview: Impacts, Mitigation, ; Adaptation in Iraq.

## 1. INTRODUCTION

The climates in Iraq have always been and will continue to change. Understanding and forecasting climate change are difficult in the midst of the Climate change is causing severe weather instabilities and global warming. Understanding the dynamic influence of climate perturbations in these spheres, both in real time and the synoptic level (for adjustment), is thus suitable in Iraq, necessitate a multidisciplinary attitude a combo of data collection and analytical methods capable of processing data rate comparable to or quicker than the processes cause and manifest climate change Climate change has made comprehensive use of remote sensing (RS) and geographic information systems (GIS) analysis and adjustment. There are number definitions available, RS is defined in this context method of collecting data on the

character traits of the Iraqi surface are measured using a device (sensor) that is not in contact with the objects being measured, as well as information processing (see Figure 1). GIS refers to information about Iraq's surface, including the regions directly beneath it and, thus, the subsurface, rivers, and atmosphere. RS allows for acquiring prestigious datasets, whereas GIS allows for the display, overlaying, incorporating, and analyzing of data from other sources. To maintain sustainable development, we must retain and increase the area of green land, provide lakes and distribute them over areas through the establishment of dams, and use remote sensing technology to recognize water stores, rising temperatures, and so on [1].



**Figure 1.** location of the very hot spots in Iraq, the other less hot[2].

## 2. REMOTE SENSING (RS) AND GIS CLIMATE CHANGE.

The huge collection of past and present RS imagery allows for the analysis of spatiotemporal patterns of environmental elements as well as the impact of human activities. RS is a vital tool for obtaining climate information at both the local and synoptic levels in order to assess climate change. In order to combine dispersed field measurements and remotely sensed data, GIS plays a critical role in monitoring systems and modeling. As climate logical and meteorological phenomena are innately spatially variable, GIS represents a useful solution for managing vast spatial climate datasets for a variety of applications. Living with climate change is referred to as adaptation It is a natural or planned response to climate change that minimizes negative effects while maximizing any benefits[2]. Climate change adaptation strategies include loss bearing, loss sharing, climate change threat modification, effect prevention, and changes land use or activity, alter of location, advancement of research on better methods of adjustment and behavioral change Given the range of adaptation options, it more logical to opt for prevention rather than cure. RS and GIS tools can aid in the capture and analysis of data procedure relevant data in order to take appropriate actions in advance of climate change events. This study examines studies on the use of RS and GIS in environment and change analysis, with a focus on.

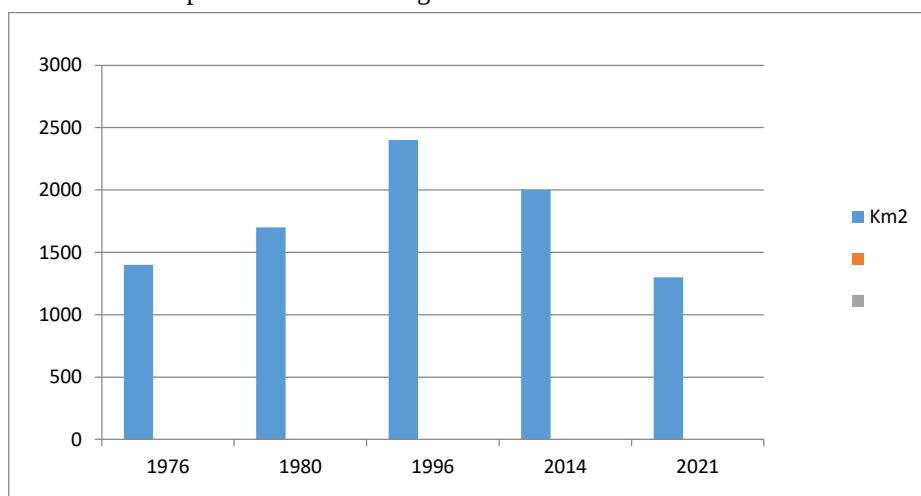
## 3. ROLE CLIMATE CHANGE EVENTS.

Living with climate change is referred to as adaptation. It is a planned or automatic Reaction to climate change that reduces negative consequences while maximizing any benefits Threat modification, effect prevention, change in land-use or activity, location change, research into better alternatives, behavior modification are all examples of climate change

adaptation techniques. Given the variety of adaptation options, it is more logical to choose mitigation over cure. RS and GIS applications can aid in the collection and processing of relevant data in order to take appropriate actions in advance occurrences of climate change This research looks at studies that use RS and GIS to analyze climate change with a focus on CO2 sinks and the path of climate impacts [2].

## 4. MONITORING OF VEGETATION CHANGE

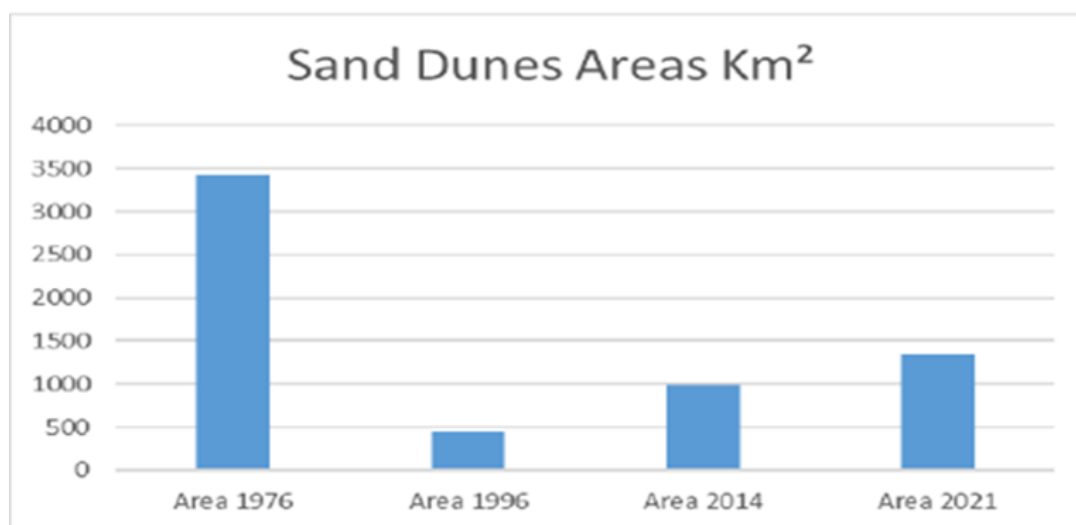
It provides a variety of ecosystem services, such as food and shelter for wildlife, it aids in controlling Iraq's climate. However, vegetation is becoming increasingly threatened, owing primarily to anthropogenic and climatic influences, and may already be irreparably damaged. Understanding vegetation spatial pattern is a major intellectual challenge, The most widely used approaches for providing scientific evidence of vegetation change are RS and GIS tools. Climate change has gotten a lot of attention in recent years. On a quest for new, unprecedented ideas to combat climate change, the community has been inspired by the urgent need to find green solutions to existing problems in the country's infrastructure. GIS database from 1976 to 1996, vegetation increased by more than 160 percent, while sand dunes decreased by about 12 percent, indicating that a treatment strategy was in place. This period increased the green areas, where western Mosul cultivation increased, as well as western Iraq, as well as central, southern, and northern Iraq, which to temperature mitigation and adaptation strategies However, In 2021, vegetation brought back to roughly the same area, and sand dunes expanded from 438 Km2 in 1996 to around 990 Km2 in 2014, and then to more than 1300 Km2 in 2021. Figures (2), (3), and (4) show how greenery grows and the reduction of sand dunes, including both.



**Figure 2.** Vegetation Blue areas Km2 in Iraq

| Km2  | Yeas |   |
|------|------|---|
| 1400 | 1976 | 2 |
| 1700 | 1980 | 3 |
| 2400 | 1996 | 4 |
| 2000 | 2014 | 5 |
| 1300 | 2021 | 6 |

**Figure 3.** Database of the Vegetation areas Km2 in Iraq



**Figure 4.** Sand dunes areas in Iraq [4].

## 5. WATER RESOURCES MANAGEMENT IN IRAQ.

Iraq, as a country located in the Fertile Crescent with abundant water resources, has the region's longest and most proud history of agriculture and irrigation. In the 1980s, it had a well-developed drip irrigation. Sadly, due to the decades of devastation that Iraq has experienced, the market of water resources in Iraq is now in a critical state (see Figure 5). Aside from the fact that irrigation consumes vast amounts of water, the dam building in the upper reaches Tigris and Euphrates has resulted in a drop in water levels. Saline water seeps into the soil, and poor drainage management contributes to soil salinity. Climate change is having a negative impact on the quality of life of river and groundwater. As a result, available

water and healthy lands are diminishing. To maintain sustainable development, implement the following mitigation and adaptation strategies:

- Ensure the safety of existing water resource amenities and strengthen operation and maintenance functions for efficient water use.
- Utilize efficient water distribution by monitoring water use.
- Raise public awareness about the importance of conserving water resources and introduce new water-saving techniques to the agricultural sector.
- Subsurface dam construction.
- Create small dams on valleys.

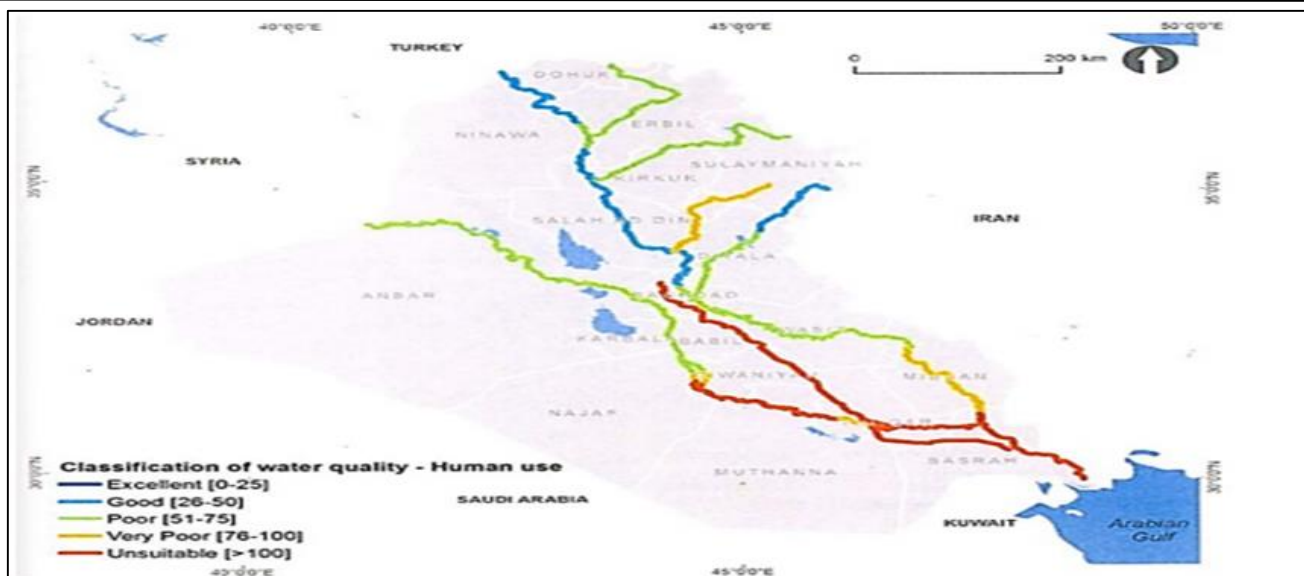


Figure 5. Rivers and tributaries contain a high proportion of water and gusts.

### 5.1 Climate Change Marshlands Area.

Changes in the local weather area contributing influencing factor in Marshlands growth Regardless of the Marshlands' role in temperature, humidity, and sandstorm regulation. Variability and severity of rainfall in other parts of Iraq, as well as Turkey and Iran, are affecting water security in the

Marshlands and limiting economic opportunities growth. Latest the drought, as well as the area's agrarian and oil production, have put a strain on the vulnerable marsh communities. Climate change leadership should thus aim to strengthen the Marshlands' climate regulatory processes and encourage these stakeholders' adaptation abilities (see Figures 7 and 8).



Figure 6. Marshlands land cover, 1973(Source: UNEP)

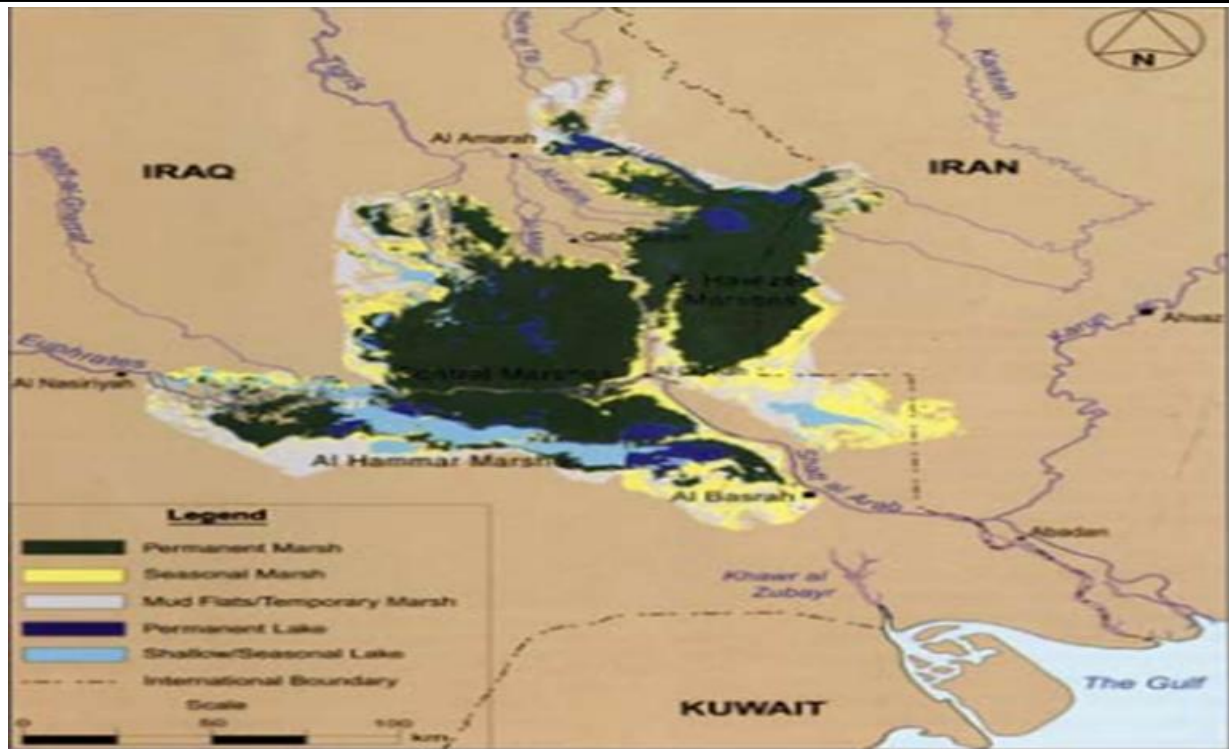


Figure 7. Marshlands land cover, 2000(Source: UNEP)

The water in the Swamplands is becoming less safe to drink and is no longer suitable for farming or other uses. Its qualities have changed primarily as a result of changes in the quality and flow of the waterways upriver. As it flows south into the Marshlands, the Tigris and Euphrates River system deteriorates. Water has recently become polluted with increased salinity, causing pH values to change (see Figures 9&10). The reduction in area as well as the pressures placed the marsh environment's general fitness has suffered as a

result of the marsh's reliance on water resources. The diversity of species and the number of remaining populations have declined. This has an impact on the status of hundreds of migratory bird species, threatening the sources of livelihood of those who depend on marsh fish stocks; and endangering a number of species found only in marshes to mitigation and adaptation strategies to maintain sustainable development.

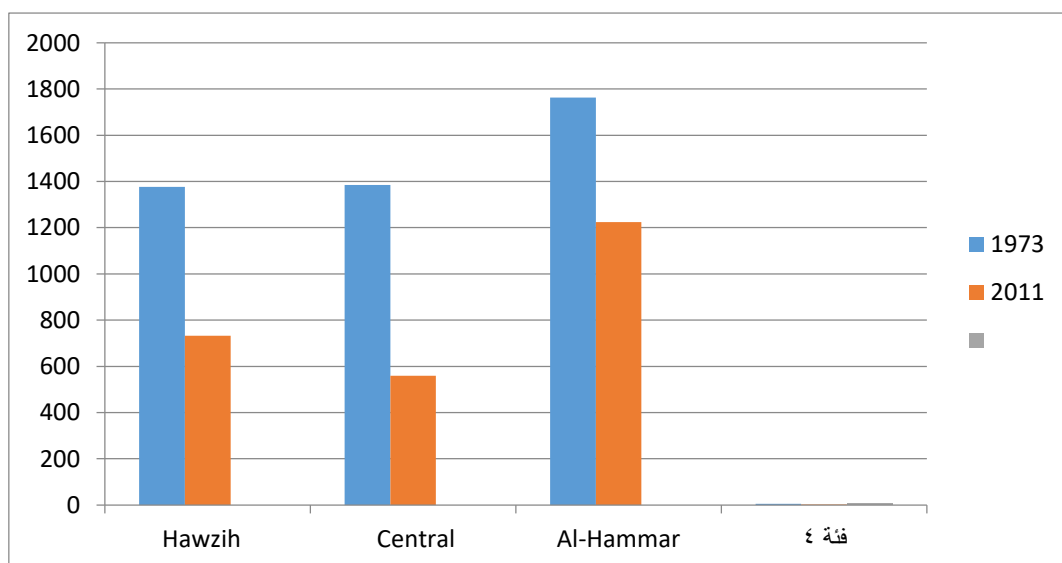


Figure 9. Source: Water Resources Minister, Core for the Revival of Iraqi Marshes, February 2011.

| C    | B    | A         |   |
|------|------|-----------|---|
| 2011 | 1973 | Marsh     | 1 |
| 733  | 1377 | Hawzih    | 2 |
| 559  | 1385 | Central   | 3 |
| 1224 | 1763 | Al-Hammar | 4 |

Figure 9. Database of Revival of the Iraqi Marshes. A is Years and B are areas of Marshes in Km2.

## 5.2 Groundwater in Iraq.

Recharging, the geomorphologic Iraq had been evaluated as it contributes to deciding the groundwater aquifers, as well as a review of the main aquifer's hydro geologic division A review of groundwater table and depths, regional trends in flow, variability in specific quality (particularly salinity), and suitability for use, multifunctional use had been performed throughout Iraqi land. The hydraulic characteristics of groundwater aquifers, as well as the quality flow of groundwater, have resulted in a severe shortfall of drinking water for millions of Iraqis. Water resources are in short supply. Since then, Iraq has gone from being a major wheat exporter to one of the world's largest importers. Water resources have been significantly wasted as a result of traditional and unbalanced irrigation and drainage systems. There is an urgent need to compile all published information and findings on groundwater resources in Iraq into a single reference, which will help to create a more integrated

database. Presently data resources total 70.86 billion m3/year, including surface water entering Iraq, surface water created within Iraq, and renewable groundwater, while current agricultural, industrial, and municipal consumption, as well as evaporation from reservoirs, marshes, and surrounding runoff to the Shatt Al-Arab, total 72.12 billion m3/year. According to NASA, Iraq has a 5 billion cubic meter renewable groundwater reservoir available in multiple layers of Iraqi lands, though "the strategic groundwater volume is not specified." Strategies for reducing and adapting to ensure long-term development.

- Increasing green space by empirically exploiting groundwater, which causes a change in temperature in the area and thus contributes to reduced water use.
- Implement stringent controls for well drilling.
- The use of to be replaced by modern irrigation facilities such as sprinkler and drip systems traditional watering, which wastes a lot of water.

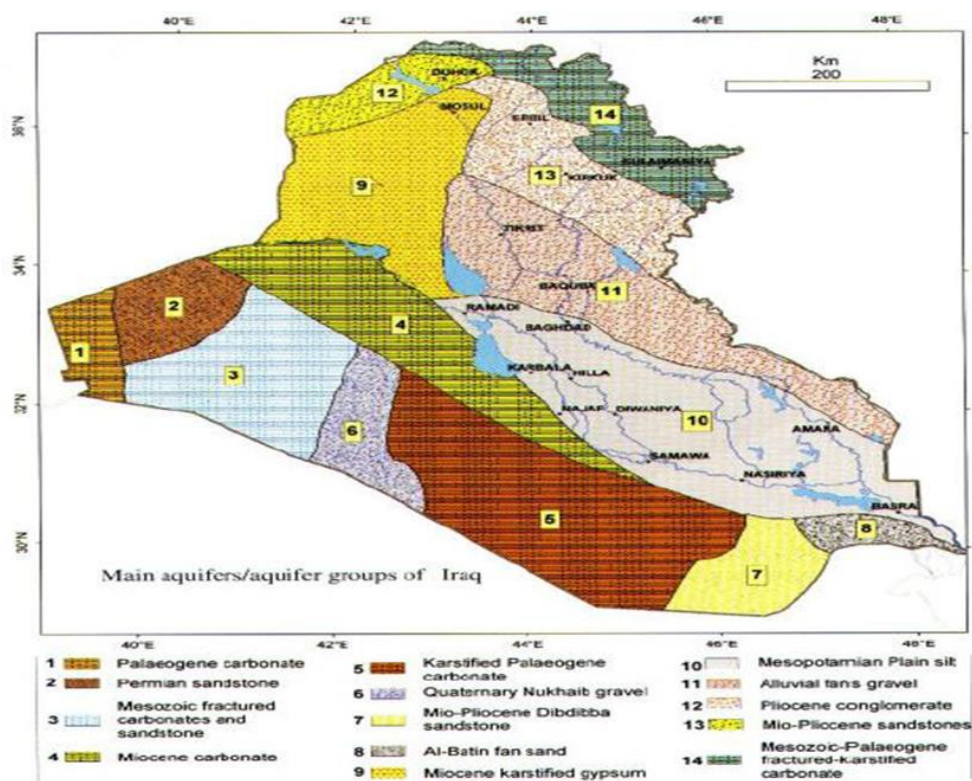
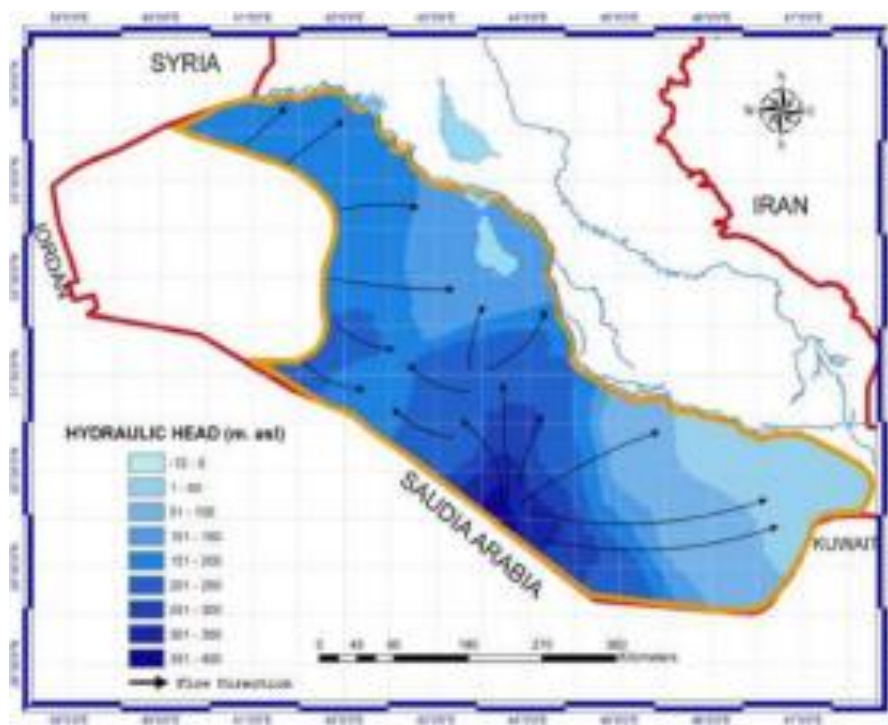


Figure 4.1 The Major groundwater aquifers in Iraq [4]



**Figure 4.2** Groundwater flow inside the Umm Rodham groundwater flow formation in the Southern and Eastern Deserts [ 4]

## 6. DROUGHT AND DESERTIFICATION

Weather is defined as a condition in which Average rainfall is below average, monthly/seasonal rainfall is below average, and river flow and ground water availability are below average. Land degradation refers to the decline in biological or economic productivity of soil in arid and semiarid areas caused by land degradation caused by human activities and climate variations. stated that satellites provide continuous and synoptic observations over large areas, with the advantage of much better resolution imagery that can be used for long-term relief management and detailed dry spells and dry lands monitoring Advances in RS technology and GIS aid monitoring in real time Data from the NOAA Advanced Very High-Resolution Radiometer was submitted for drought and flooding early warning and disaster monitoring. (AVHRR), Landsat, SPOT, and Radar Sat are functionally used to assess the impact of drought on crop production. Drought can now be detected and demarcated 4-6 weeks earlier than previously, and its impact on grain production can be diagnosed far in advance of harvest, which is the most critical need for global food security and barter, define and assess adaptation and mitigation strategies They used both qualitative and quantitative approaches, collecting information through questionnaires, observations, and interviews. The tools were used to gather information on extreme weather events, climatic trends, and adaptation. Changing climate has significantly harmed livelihoods and food security, according to the findings. To maintain

sustainable development, mitigation and adaptation strategies must be implemented. Restore natural vegetation in rangelands by working to establish To prevent overgrazing, desert oases and water wells, as well as pastures in grazing areas, and the use of drought-tolerant plants in conjunction with contemporary irrigation methods, are being used. Several water harvesting projects have also been established to improve water management and reduce run-off (especially during droughts and low rainfall).

## 7. DISCUSSION

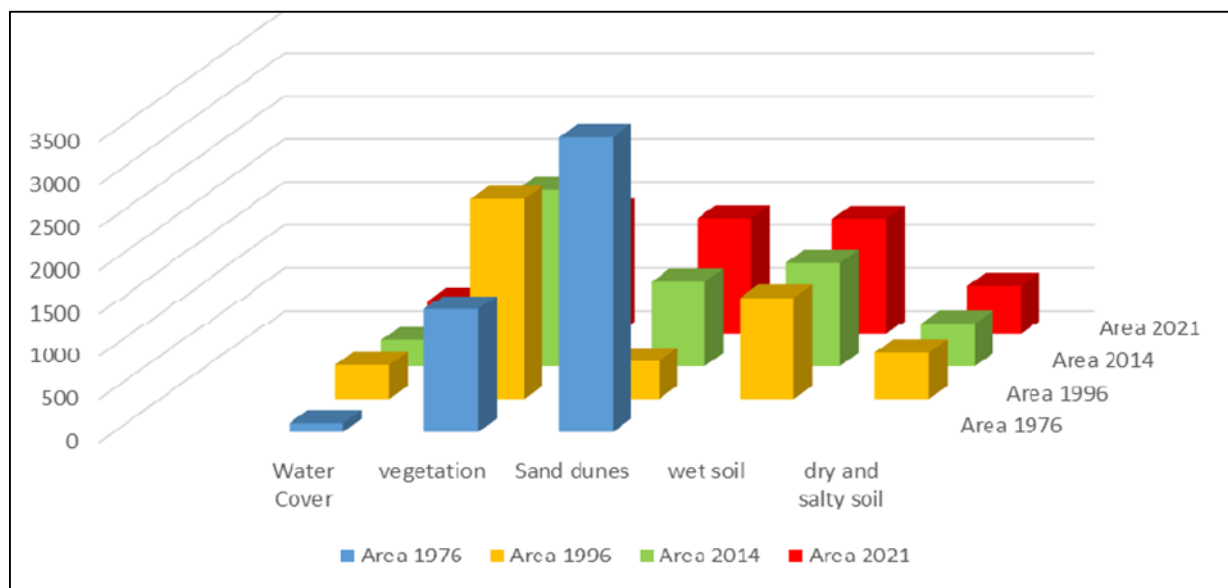
(see Figures 11&12)

1. Remote sensing and GIS applications must be available in Iraq. The most recent environmental issues in Iraq. Understanding of how to use remote sensing data in all scenario modeling. Case studies demonstrate the roles of RC and GIS in solving Iraq's environmental issues.
2. The effect of climate change on water resources is mitigated by modern irrigation methods. Increasing awareness of the importance of water conservation helps to mitigate the effects of climate change on water resources.
3. Reactions to climate change mitigation measures are described in descriptive statistics. Conservation measures for assets of water as the first water-saving mitigation measure, raising awareness about the

importance of justifying water usage lessens the impact of climate change on water resources, while agriculture is Iraq's largest consumer of water.

4. In order to achieve ecological responsibility, the must-save region faces significant resource management and conservation issues, particularly in the management of water and energy resources, as well as in drought and degradation. The potential for achieving environmental sustainability is hampered by land and other environmental occurrences.

5. Steps needed Modernize agriculture at the local and national levels. Convert some of the current agricultural areas into marshes. Secure agreements with neighboring countries to meet rising water demands.
6. The issues confronting the groundwater sector, as well as the development of recommendations for optimal investment and development of water sources in each region.



**Figure 11.** Present and comparison for all items in the four stations [3].

**Table 1.** Database Present and comparison for all items in the Four stations [3].

| Date<br>Class Name | Area in<br>Km <sup>2</sup><br>1976 | Area in<br>Km <sup>2</sup><br>1996 | Area in<br>Km <sup>2</sup><br>2014 | Area in<br>Km <sup>2</sup><br>2021 |
|--------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| Water Cover        | 100.201                            | 393.518                            | 305.965                            | 391.357                            |
| Vegetation         | 1435.552                           | 2329.413                           | 2055.254                           | 1426.331                           |
| Sand dunes         | 3429.151                           | 438.355                            | 989.6355                           | 1342.398                           |
| wet soil           | /                                  | 1189.371                           | 1201.431                           | 1336.087                           |
| dry and salty soil | /                                  | 538.0699                           | 505.905                            | 562.225                            |

## 8. CONCLUSION

The following conclusions can be drawn from the paper:

- 1) Climate change is accelerating, with Iraq among the fastest-warming regions. The country is experiencing an ascending pattern of temperature rise, which is preceded by a decreasing rate of rainfall.
- 2) We wanted to use mitigation and adaptation strategies to maintain long-term development in Iraq, such as changing weather patterns.
- 3) Management using GIS and methods for remote sensing Climate change to collect data in the past or what will happen in the future to mitigation and mitigation options in all situations.

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