**Int. j. adv. multidisc. res. stud.** 2023; 3(2):1201-1206

**Received:** 11-03-2023
**Accepted:** 21-04-2023

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

# Detection of Land Cover Change in the Sea of Najaf / Iraq for the Period (2005-2022) using Remote Sensing Techniques

[1] **Enas Riyadh Wdaah,** [2] **Abbas F Nori**
[1, 2] Department of Physics, Faculty of Science, University of Kufa, Najaf, Iraq

Corresponding Author: **Abbas F Nori**

**Abstract**
The study targeted the sea al-Najaf region, because of its geographical value, being an important water resource, as it acts as a large water reservoir, contributes to agriculture, and an important resting point for migratory birds, and has an important role in improving the climate in the region, and there are fish in it, also its Seasonal torrents gathering. Several remote sensing techniques and GIS have been used to track the effects of land cover changes. Knowing and understanding the amount, direction, and causes of land cover changes is critical to planning sustainable management of natural resources. Used ERDAS IMAGINE 2015 to do the supervised classification using maximum probability. Adopting the period from 2005 to 2022 as a period for a study in the study area. Water bodies, agricultural lands, barren lands, and clay soils were determined by multispectral satellite data (Landsat 5 TM images, Landsat 8 / OLI images, and Landsat 9 / OLI images). The results showed an increase for Water Bodies and Barren Land during the approved period by about 33.229% and 1.197% respectively, while a decrease in both agricultural lands and Clay soil was about 8.218% and 26.208%, respectively.

**Keywords:** Remote Sensing, Land Cover, Satellite Data, Satellite Image, Multispectral Image

## 1. Introduction

In order to track changes in the land, water resources, plants, and other natural resources, remote sensing technologies are a crucial tool. As a result, these data provide information that can be used in conjunction with other methods to comprehend how desertification, rising water levels and area, and increasing water areas all affect the riches of plants and animals as well as the economy and population [1]. The interpretation and analysis of land cover changes and the dynamic transformation of land use are the most crucial considerations that must be made when creating regional and urban planning policies and strategies at different levels [2]. One of the most crucial ways to learn about how to manage and develop resources is through the study of land cover. Given how quickly the population is growing, this issue is quite essential [3]. In addition, it is important to take into account ecological, political, and economic variables while researching how land uses are changing [4]. The ecosystem in arid regions is one of the most commonly affected by natural and human changes, and it faces significant obstacles in the area of sustainable development. It is subject to environmental degradation, soil degradation, and biodiversity under the influence of social, economic, and political pressure [5]. In comparison to conventional methods, remote sensing technologies and geographic information systems have made it possible to study the dynamics of land use and cover, the factors influencing their change, the nature of their distribution, and the relationships between them with greater accuracy and at a lower cost [6]. Because Najaf is a significant religious center, many residents of Iraq's governorates-particularly the central and southern governorates-have migrated there in search of family stability and job opportunities. However, the province of Najaf is currently dealing with a complex pattern of urban expansion and agricultural activities to counter the increase in population [7]. The region of sea Al-Najaf is one of the most interesting environments, where all scientific studies and researchers referred that it plays an active role in the growth of Al-Najaf city [8]. The current study aims to use remote sensing (RS) techniques to follow up the changes that occurred in the surface areas of four categories, namely (water bodies, agricultural lands, barren lands and clay soils), by comparing satellite images for the years 2005-2022, which is the implementation of operations Spectral classification on satellite images and detection of changes between every two consecutive years.

## 2. Literature Review

Several studies have been undertaken in the Najaf province, particularly in the sea al-Najaf region, utilizing remote sensing techniques represented by the spectral classification of satellite pictures with the aim of detecting changes in the land cover across various times and as follows:

Regarding (Nawal Khalaf Ghazal and Ali Kazem Hussein's) study, it was carried out in the province of the Al-sedimentary Najaf Plain, which was divided into three districts: Al-Haydria Sub District, Al-Kufa District Center with Al-Abbassiya Sub District, Al-Huriya Sub District, and Al-Manatheradistrict Center with Al-Heera Sub District. Maximum Likelihood by using Landsat 8 satellite image of 2015 Superv Six categories in all was discovered and categorized for each of these districts in this study [8].

Amany A Kh., and Mustafa Abdul Jalil assessed in their study, Jalil evaluated the changes in land use and land cover within the city of Najaf. The changes in LULC of the region between the years 1986 and 2016 have been looked into by using the specialized software package Remote Sensing and GIS. Furthermore, there has been a discernible increase in populated regions and agricultural fields at the price of a decline in the areas of arid lands [9].

Last but not least, the pertinent research done in the Middle Euphrates region, specifically the research done by (Imzahim, Abdul Razzak, and Alaa). This research was done to keep track of the Middle Euphrates region's agricultural drought from 1988 to 2018. We employed multispectral Landsat TM, ETM+, and OLI photos. The photos were taken in the plant growth months of 1988, 1993, 2000, 2005, 2010, and 2018.was adopted using ERDAS Imagine 2015, ENVI 3.2, and ArcGIS 10.5 were used to process and analyze the data in order to implement computerized drought monitoring. According to the findings, from 1988 to 2018, there were between and areas that had no drought. The results revealed that the percentage of no drought area ranged between (7%) and (17%) during the period from 1988 to 2018 [10].

## 3. Basic Theoretical Concepts

Land cover change is a crucial element in current methods for keeping track of environmental changes and managing natural resources [11]. Planners interested in land cover change benefit greatly from spectral classification of satellites imagery. The multi-spectral satellite image serves as the primary input for the digital process of spectral classification of satellite images, and the output is an objective map depicting changes in land cover. In general, the use of statistical techniques with varying degrees of mathematical complexity is the basis of the spectrum classification process. No matter how effective, accurate, or sophisticated the statistical algorithms used in the classification process, there will always be some degree of error in the positional map generated by the classification [12]. In spectral remote sensing, the light emitted, reflected, and transmitted from particles, objects, and surfaces is measured. The information that is impacted by ambient factors (most notably lighting conditions) and the sensor measurement methods should be modified, nevertheless [13]. Electromagnetic energy is usually classified in remote sensing applications according to its location in the electromagnetic spectrum. X-rays are at the lower end of the spectrum (longer wavelengths), while other communications wavelengths are at the higher end (television and radio). Radio and television broadcasts have wavelengths that can be measured in meters. The blue, green, and red wavelength bands make up the three basic divisions of visible light [14].

## 4. Methodology

### 4.1 Information About the Study Area

The research area has an area of (Sea al-Najaf) (1016.11 $km^2$) and is located in the province of Najaf / Iraq. The geographical coordinates of this area are longitude (31 ° 40'00' 'N - 32 ° 10'00" N), latitude (44 ° 00'00"E - 44°30'00"E). One of Iraq's wetlands, Sea al-Najaf, is located two kilometers distant from the center of Najaf city, in a region known as the Middle Euphrates to the west of the Euphrates River, and the site of Sea al-Najaf (Fig 1). It is located south of the sedimentary plateau's border, among marshes and orchards. The Western Desert's periphery can be found north and west of Sea al-Najaf, which stretches west and south towards Saudi Arabia's desert. The shape of the area clearly indicates Sea al-Najaf's location between two distinct ecological zones (wetlands and desert), as well as abundant biodiversity. In addition to local groundwater, water springs and oasis in the northwest are the sources of the water that hydrate the waterbody and the lower marshes, Additionally, the western side of the Sea receives surface waters from the watercourses that periodically transport water from the upland desert to the west following any significant rainfall.

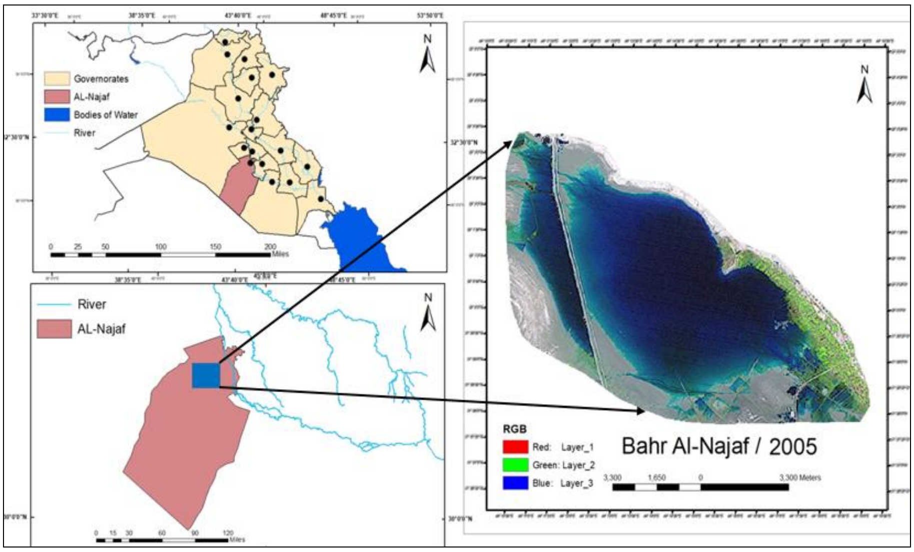


**Fig 1:** The research area's location is in Sea Al-Najaf and the adjacent environs

### 4.2 Satellite Data
Images from Landsat 5, Landsat 8, and Landsat 9, which are equipped with sensors TM and OLI, were used in this study. Information obtained from the USGS site. According to Table 1, the bands used are (3, 4, 5) from Landsat 5 and (4, 5, 6) from Landsat 8 and 9. Fig 2 show the color composite images of the study area.

**Table 1:** Details on the Landsat pictures utilized in the study

| Date of Imagery | Sensor | Spatial Resolution of Reflective Bands (meters) | Number of Bands | Format |
|---|---|---|---|---|
| 14/3/2005 | Landsat 5 /TM | 30 | 7 | Geo TIFF |
| 21/8/2005 | Landsat 5 /TM | 30 | 7 | Geo TIFF |
| 8/3/2010 | Landsat 5 /TM | 30 | 7 | Geo TIFF |
| 18/8/2010 | Landsat 5 /TM | 30 | 7 | Geo TIFF |
| 23/3/2016 | Landsat 8 /OLI | 30 | 11 | Geo TIFF |
| 19/8/2016 | Landsat 8 /OLI | 30 | 11 | Geo TIFF |
| 29/3/2022 | Landsat 9/OLI | 30 | 11 | Geo TIFF |
| 12/8/2022 | Landsat 9/OLI | 30 | 11 | Geo TIFF |

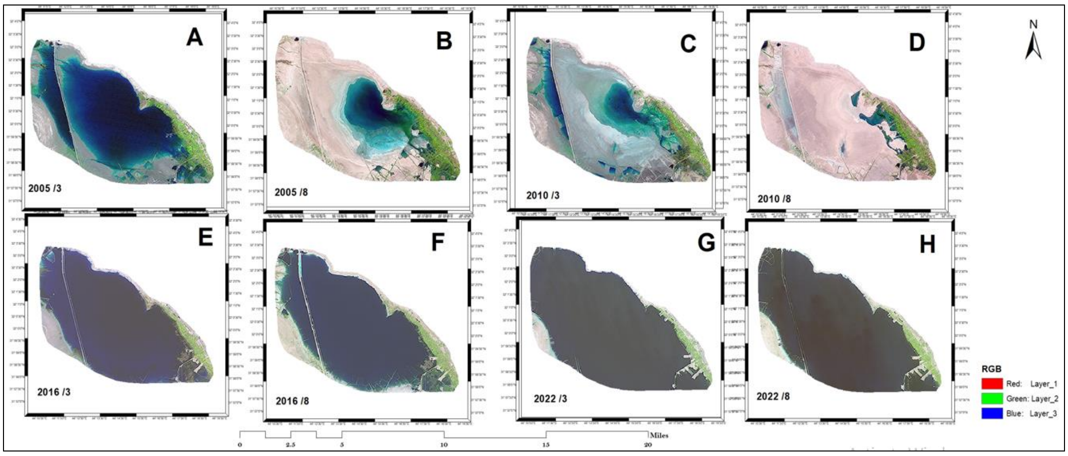


**Fig 2:** Satellite images after cutting the study area

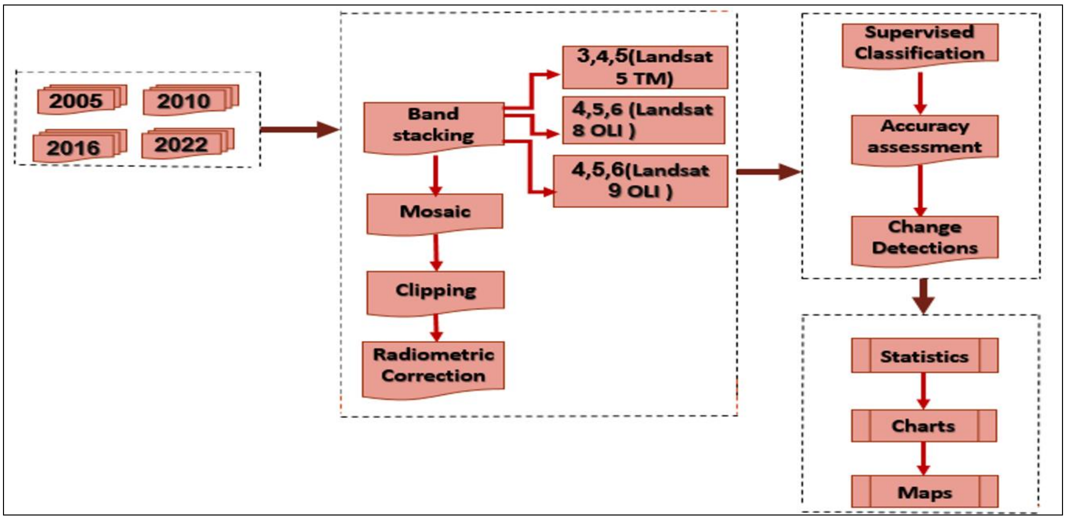


**Fig 3:** A Flowchart Depicting the Methodology Taken to Classify Land Cover

### 4.3 Research Methods
In the (Fig 3) is an illustration of the current study's main processing stages.

For the work steps, after downloading the selected satellite images (2005, 2010, 2016, 2022) and using the supervised classification based on the maximum likelihood algorithm of the ERDAS EMAGEN 2015 program for four categories (water bodies, agricultural lands, arid lands and, clay soil) for a specific area (1016.11 km$^2$) and, selected image classification, mapping and detection change between every two consecutive years during the approved period.

## 5. Results and Discussion
### 5.1 Land Cover Mapping
Mapping the land cover will aid in the study of changes in our ecosystem and environment. In order to make sure that all resources are utilized, local governments must create these planning models. To protect the environment, we may implement measures and policies. For the aim of comprehending the map of Sea al-Najaf and the spatiotemporal conditions, the analysis of the resulting land cover is shown in (Fig 4) below.

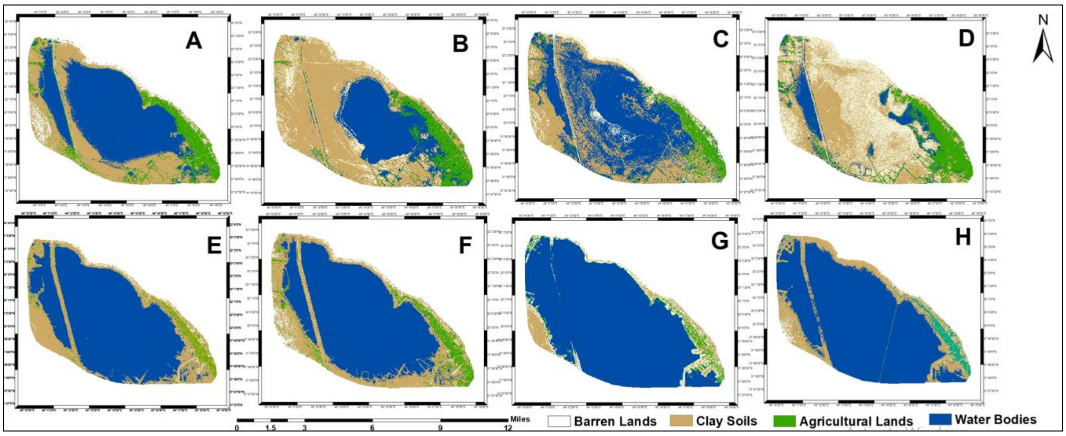


**Fig 4:** Shows the land cover classification for the years 2005, 2010 and the Landsat 5 TM satellite, 2016 for the Landsat 8 satellite and 2022 for the Landsat 9 OLI satellite for Sea Al-Najaf

**5.2 Analysis of Land Cover Changes**

The land cover was classified into four categories in the study area, (1) water bodies (2) agricultural lands (3) barren lands (4) clay soils, in (Table 2) the data indicates that in the 2005 image, (509.48 km$^2$) water bodies, (126.02 km$^2$) agricultural land, (50.98 km$^2$) barren land, and (329.63 km$^2$) clay soil.

As for the 2010 picture, the area of water bodies reached (511.32 km$^2$), and its area increased by (1.84 km$^2$) due to the rise in the level of the Najaf Sea during this period. As for the agricultural land, its area reached (76.86 km$^2$), which indicates a decrease in its area of (49.16 km$^2$), while the arid land amounted to (71.89 km$^2$), with an increase in its area of (26.41 km$^2$). The area of clay soils was (356.04 km$^2$). With an increase in the area by (26.41 km$^2$) as shown in (Fig 5).

That is, changes in the area between (2005-2010) show that water bodies, arid lands, and clay soils have an increase of (0.181%), (4.837%), and (2.058%), respectively, while agricultural lands have a decrease of (2.598%).

As for the 2016 image, the area of water bodies reached (709.47 km$^2$), and its area increased to (198.15 km$^2$) due to the precipitation during this period. As for the agricultural land, its area reached (45.6 km$^2$), which indicates a decrease in its area by (31.26 km$^2$), while the arid lands amounted to (18 km$^2$), with a decrease of (53.89 km$^2$), while clay soil to (243.04 km$^2$), with a decrease in the area by (113 km$^2$).

That is, the rates of change in areas between the years (2010-2016) are the increase in water bodies by (19.502%) and a decrease for each of agricultural lands, barren lands, and clay soils by (-3.078%), (5.303%), (11.121%), respectively.

In the 2022 image, the area of water bodies reached (847.13 km$^2$), and its area increased to (137.66 km 2) due to the state's irrigation of the Najaf Sea during this period. As for the agricultural land, its area reached (42.52 km$^2$), which indicates a decrease in its area by (3.08 km$^2$), while the arid land amounted to (63.15 km$^2$), with an increase of (45.15 km$^2$), while the clay soil (63.31 km$^2$) with a reduced area of (179.73 km$^2$).

As for the rates of change between the years 2016-2022, it is an increase for both water bodies and arid lands, with rates of (13.546%) and (4.442%), respectively. As for a decrease in the area for agricultural land and soil, the percentage is (0.303%) and (17.685%), respectively.

As for the study period (2005-2022), the area of water bodies increased by (33.229%). As for agricultural land, decreased by (8.218%), while the dry land area increased by (1.197%). While the clay soil decreased by (26.208).

**Table 2:** Area change of the land cover in Sea al-Najaf and the area around it over the period (2005-2022)

| Years / Class | 2005 Area in (km$^2$) | % Area (%) | 2010 Area in (km$^2$) | % Area (%) | Change in % 2005-2010 | 2016 Area in (km$^2$) | % Area (%) | Change in % 2010-2016 | 2022 Area in (km$^2$) | % Area (%) | Change in % 2016-2022 | Change in % 2005-2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Bodies | 509.48 | 50.14 | 511.32 | 50.321 | 0.181 | 709.47 | 69.823 | 19.502 | 847.13 | 83.369 | 13.546 | 33.229 |
| Agriculture Land | 126.02 | 12.402 | 76.86 | 7.565 | -4.837 | 45.6 | 4.487 | -3.078 | 42.52 | 4.184 | -0.303 | -8.218 |
| Barren Land | 50.98 | 5.017 | 71.89 | 7.075 | 2.058 | 18 | 1.772 | -5.303 | 63.15 | 6.214 | 4.442 | 1.197 |
| Clay soil | 329.63 | 32.441 | 356.04 | 35.039 | 2.598 | 243.04 | 23.918 | -11.121 | 63.31 | 6.233 | -17.685 | -26.208 |
| Total Area | 1060.11 | 100% | 1060.11 | 100% | 0 | 1060.11 | 100% | 0 | 1060.11 | 100% | 0 | 0 |

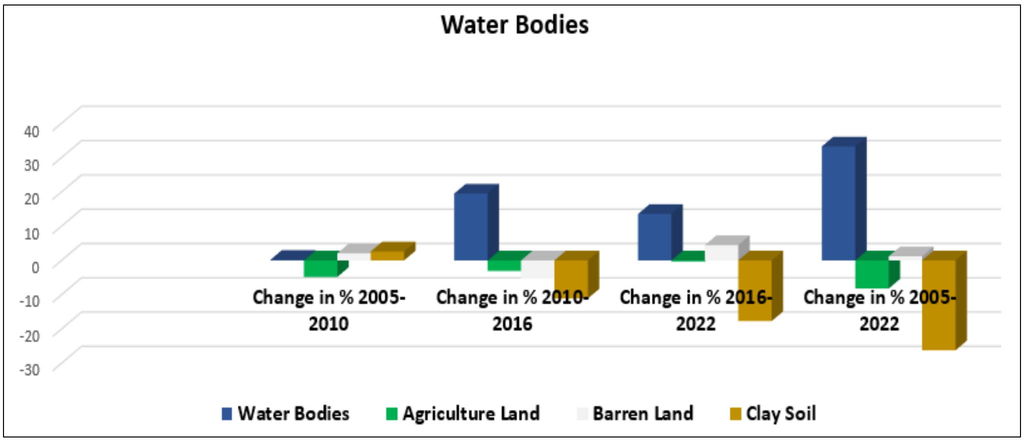


**Fig 5:** Changes in the land cover during the period (2005) to (2022) for the Najaf Sea and its surroundings

**Table 3:** Shows Drought areas percentage of the Najaf Sea during the period (2005-2022)

| class | 2005/ March | 2005 /August | Drought Ration/2005(March)2005 (August) | 2010 / March | 2010 /August | Drought Ration/2010 (March)-2010(August) | 2016 / March | 2016/August | Drought Ration/2016(March)-2016(August) | 2022 / March | 2022/August | Drought Ration/2022(March)-2022(August) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Bodies | 509.48 | 296.14 | 41.80% | 511.32 | 107.43 | 79.27% | 709.47 | 638.38 | 13.90% | 847.13 | 773.65 | 14.40% |

In (Table 3) and (Fig 6), it shows the percentage of drought in the sea of Najaf between March and August of each year during the study period (2005-2022).

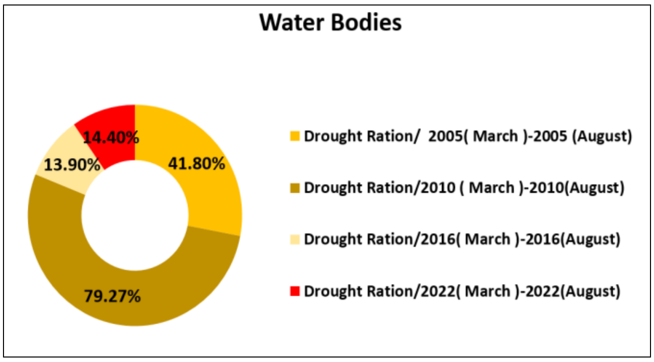


**Fig 6:** displays the Drought Ration for each year between the months of March and August during the research period

## 6. Conclusions

This study explains the detection of changes in the land cover of the Najaf Sea / in Najaf Governorate, which is one of the governorates known for its religious importance on the one hand and its cultural importance on the other hand. On the other hand, during the recent period. The results of the research showed the prosperity of the province significantly. The fact of the changes whether positive or negative was explained. The area was classified into four categories (water bodies, agricultural lands, barren lands, and clay soils). It has been demonstrated that remote sensing and geospatial methods have a critical role in determining appropriate and valuable data for this study, using a supervised classification algorithm of maximum probability, accuracy, Simplicity, and effectiveness in terrestrial changes during the period (2005 - 2022), for a period of seventeen years using satellite images Landsat 5, Landsat 8 and Landsat 9 for years (2005, 2010, 2016 and 2022).

- The results showed an increase in water bodies as a result of increased rainfall in addition to the state's irrigation of the Najaf Sea during the period of the research years (50.14%), (50.321%), (69.823%) and (83.369%) during (2005-2010-2016 2022), respectively.
- As for the agricultural lands, there was an increase and a decrease, and their percentages were (12.402%), (7.564%), (4.487%) and (4.184%) for the year (2005-2010-2016-2022), respectively, these changes are due to the neglect of agriculture.
- As for the arid lands, they were affected by the increase and decrease of each of the agricultural lands, the clay soil that turns into barren land, according to the climate of Najaf governorate, that is, during (2005-2010-2016-2022), and its percentages were (5.017%), (7.075%), (1.772%) and (6.214%), respectively.
- As for the clay soil, it usually consists of a lack of water, that is, it is adjacent to the Sea of Najaf and is affected by changes in the Sea of Najaf. They were (32.441%), (35.039%), (23.918%) and (6.233%), respectively.

## 7. References

1. Kadhum SN, Alsudani ES. Monitoring the Land Covers Around Al- Razaza Lake/ Iraq Based Upon Multi-Temporal Analysis Technique, Al-Mustansiriyah Journal of Science. 2021; 32(2):18-24.
2. Sewnet A. Land use/cover change at Infraz watershed by using GIS and remote sensing techniques,

northwestern Ethiopia, International Journal of River Basin Management. 2016; 14(2):133-142.
3. Xie H. Towards sustainable land use in China: A collection of empirical studies, Sustainability (Switzerland). 2017; 9(11). Doi: 10.3390/su9112129
4. Shalaby A, Tateishi R. Remote sensing and GIS for mapping and monitoring land cover and land-use changes in the Northwestern coastal zone of Egypt," Applied Geography. 2007; 27(1):28-41. Doi: 10.1016/j.apgeog.2006.09.004
5. Bonan GB. Land use and land-cover change, in Ecological Climatology, 2013, 432-469.
6. Hietel E, Waldhardt R, Otte A. Analysing land-cover changes in relation to environmental variables in Hesse, Germany, Landscape Ecology. 2004; 19(5):473-489.
7. United Nations and NGO coordination committee for Iraq; "Najaf Governorate," Report, 2015 December, 45-45.
8. Al-Zurfi SKL, Shabaa SH, Tsear AA. Assessment of physicochemical parameters and some of heavy metals in Bahr al-Najaf-Iraq, Plant Archives. 2019; 19(1):936-940.
9. Amany AK, Ebraheem MA. Comparative Analysis of land use and urban growth modeling using geomatics technology (city of Najaf-Iraq), in IOP Conference Series: Materials Science and Engineering. 2020; 881(1). Doi: 10.1088/1757-899X/881/1/012023
10. Alwan I, Ziboon AR, Khalaf A. Monitoring of Agricultural Drought in the Middle Euphrates Area, IraqUsing Landsat Dataset, Engineering and Technology Journal. 2019; 37(7A):222-226.
11. Twisa S, Buchroithner MF. Land-use and land-cover (LULC) change detection in Wami river basin, Tanzania, Land. 2019; 8(9).
12. Al-Helaly MH, Alwan IA, Al-Hameedawi AN. Land covers monitoring for Bahar-Al-Najaf (Iraq) based on sentinel-2 imagery, in Journal of Physics: Conference Series. 2021; 1973(1). Doi: 10.1088/1742-6596/1973/1/012189
13. Estoque RC. A review of the sustainability concept and the state of SDG monitoring using remote sensing, Remote Sensing. 2020; 12(11).
14. Martensson U. Introduction to Remote Sensing and Geographical Information Systems, Department of Physical Geography and Ecosystems Sciences, 2011, 55.