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Representation and mapping analysis of changes in land cover in the Kalar district using digital processing

Aram Hassan Mohammed

Social Sciences Department - College of Basic Education
Garmian University

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Corresponding Author

aram.hassan@garmian.edu.krd

Abstract:

Tourism plays an important role in economic, social and cultural life in countries in the world. Indicators and statistics published by the World Travel Tourism Council (WTTC) show that tourism has become the largest economic factor in the world and the fastest growing and benefits from tourism countries are interested in highlighting its historical and cultural heritage, and its features. Unique environmental and aesthetic, which develops its ability to market its distinct tourist site. Accordingly, we decided in this research to rely on : analyses of data and their application in the tourism field through the designation of all tourist areas in Iraqi Kurdistan region depending on geographic information systems data, which is at the core of the research work in spatial analysis of tourist phenomena in spatial analysis have a spatial space and a specific distribution and spread, and the goal of this type of analysis is to find relationships and model for spatial phenomena.

The importance of research in the field of benefiting from the application of Geographic Information Systems (GIS) technologies in the tourism sector because it is the best program that collects, organizes, analyses, displays and coordinates this information on its magnitude in a system that allows its recall with easy acceptable speed, and we find that it has become An essential tool applied in analysis and as a presentation on tourist and archaeological sites and resources in the form of geographical maps that contribute to providing information and data that support tourism planning.

Summary:

This research deals with the representation and mapping analysis and the extent of change of land uses and land cover in the study area by observing that cover with pictures and maps during(2000-2021),and determining the type and amount of change in the condition and area of vegetation coverage and The uses of the land and the analysis of the causes of that change, by employing the data of the automatic processing of the satellite visuals in extracting the area of vegetation coverage for different years(2000-2021) in the study area, and the data of the satellite visuals is the main source for this research, which was processed automatically through a set of mathematical programs, including (Arc map^{10,7}),and ERDAS IMAGINE 2014).

The time-successive satellite visualizations are taken for the same area give a clear analysis of the extent of the change in the land use and land cover in the study area. The United Conditions Geological Survey(USGS)system is adopted to classify maps produced for land use and land cover. And as a result of changes in environmental and agricultural activity as a result of the construction of housing units and urban expansion. The changes occurring in the classes of land use and land cover during the time period from 2000 to 2021 were analysed using the directed classification system and the urban difference index calculations by using two programs (Arc map^{10,7}) and ERDAS IMAGINE2014).

The study concluded that showing the extent of the significant decline that occurred in the change of land use and land cover in the study area. The results of this study showed that the mapping representation and the use of time-series visuals increase the possibility of integration with the systems that use geographic information systems to obtain information and monitor environmental changes and agricultural activities with high accuracy as they can be relied on, in preparing reports and research for various purposes.

Introduction

The use of remote sensing techniques and geographic information systems is one of the best techniques used in studying the changes taking place in the representation and analysis of maps of land uses and land cover because it provides the vast amount of information that can be dealt with in analysis, interpretation and classification within a short period and with clear accuracy which is the basic building block Create databases of information that can be updated over time .⁽¹⁾

It defines the uses of the land as a description of how the land is used in terms of being agricultural, residential, industrial, or otherwise. As for the ground cover, it is a description of the natural condition or the natural cover of the land when activities by humans such as natural pastures and rock and river streams are not practiced .⁽²⁾

The study area was categorized and analyzed in terms of the uses of the Earth and the ground cover by

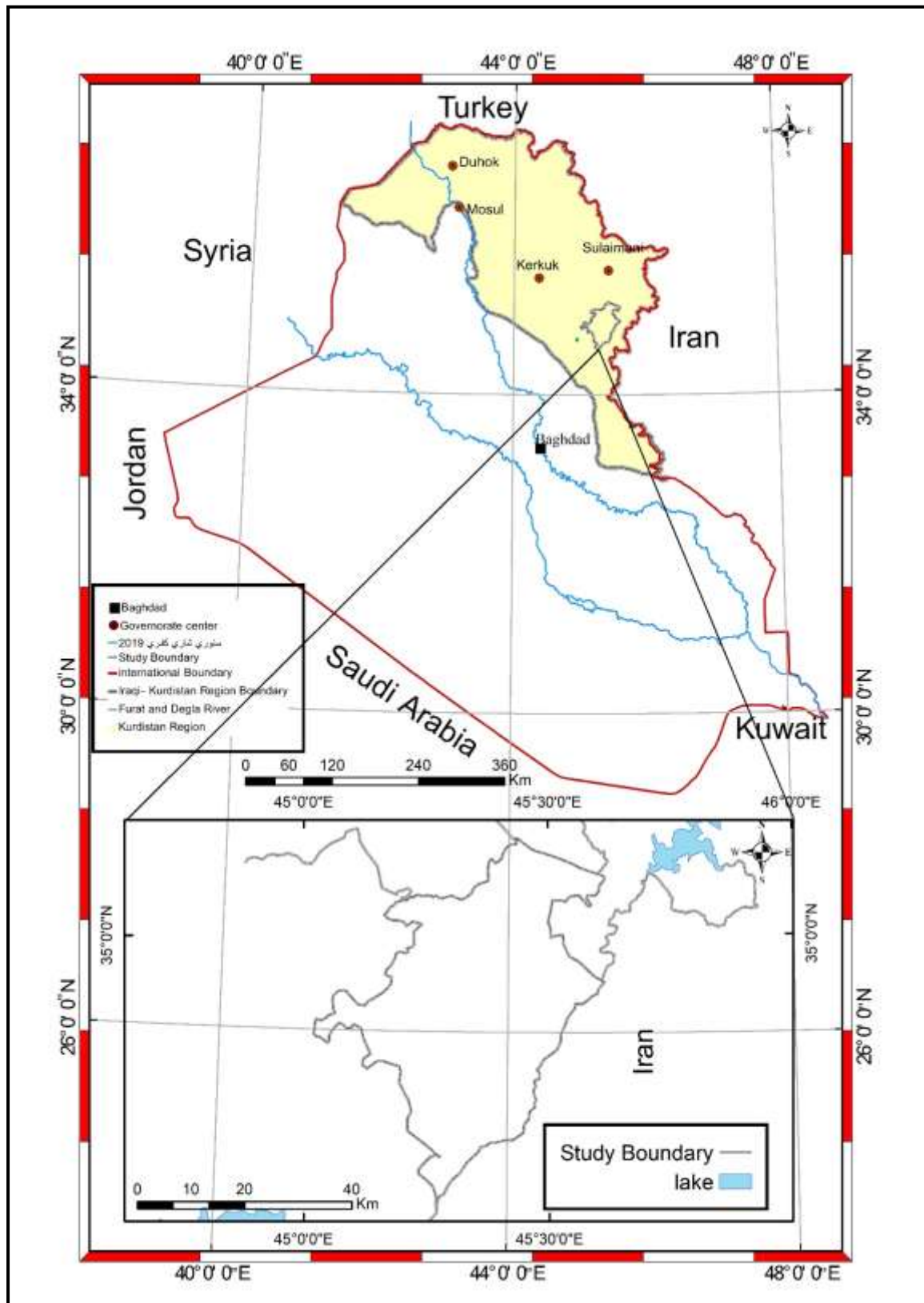
relying on time-series satellite visuals for the years(2000,2008,2021) two programs (Arc map^{10,5} and ERDAS IMAGINE 2014) were used to interpret, analyze and prepare special statistical tables that show The area and ratio of each species and the places of distribution of the species in the region where the reliance on the USGS system grew in the objective classification or map classification.⁽³⁾

Study area location

The study area is located in the northeast of Iraq, specifically in the southeast of the Sulaymaniyah Governorate center, which is about (160 km) away from it, and it is located between the two longitude (45, 36', 34[°]) and (45, 06', 55[°]) East and two latitudes (34, 55[°] , 32[°]) and (35 ,19[°], 09[°]) to the North,⁽⁴⁾ as the area of the study area reached (1695 km²) (Map 1).⁽⁴⁾

The time limits for the research are the period between (2000 until2021).

Map No (1)
Location of the study area by the Kalar and Iraq administration



Source: Prepared by the researcher based on:

- 1- Using two programs (Arc map^{10.5}) and (Erdas imagin 2014).
- 2- Ministry of Water Resources, General Directorate of Survey, Iraq Administrative Map, scale (1/250000), for the year 2021.
- 3- Ministry of Planning, Sulaymaniyah Statistics Directorate, Sulaymaniyah Administrative Map and Garmian Administration, Geographic Information Systems Department, 2021.

The data used in the study

Three space visuals were used during a successive time series taken by the satellite (Landsat TM), which covers the study area) .2000,2008 and 2021)

Research objective

The aim of this study is to represent and map analysis and to find the changes in land use and land cover that have occurred in the study area for the period (2000-2021) as a result of environmental factors represented by the elements of climate, agricultural factors and human intervention that the region witnessed during this period and as follows:

Arc map^{10,7} (ERDAS IMAGINE 2014) land-use analysis and land cover analysis.

Calculating the percentages of changes in the area of the study area as a result of climate changes and environmental and agricultural activity as a result of the construction of housing units and urban expansion, while finding accurate classification of the produced maps.

Explain the role of contemporary geographic techniques in assessing the condition of land use and land cover in the study area.

Research Methodology

In order to obtain the recent and necessary data to evaluate and classify the uses of land and land cover, for Kalar district during the period from (2000 to 2021) and represented it in maps. The quantitative analysis method was adopted through the use of (NDVI) evidence relying on the law that was mentioned by (Belwar,1990), to follow up on the changes that occurred in the subject of the research in the study area, and in order to reach the goal of the research, we followed the following scientific steps:

Research problem:

The research problem gets rid of formulating the following negotiations:

- 1- Is it possible to build cartographic models using digital processing of the changes in land use and land cover in the Kalar district?
- 2- What is the current condition of land uses and land cover in the Kalar district?
- 3- Which is the most influential factor in highlighting the changes taking place in the land use and land cover in the Kalar district?
- 4- To what extent are the changes in the use of land and land cover balanced with the constituents of the geographical environment in the Kalar district?

Research hypothesis:

The research hypothesis was based on the following:

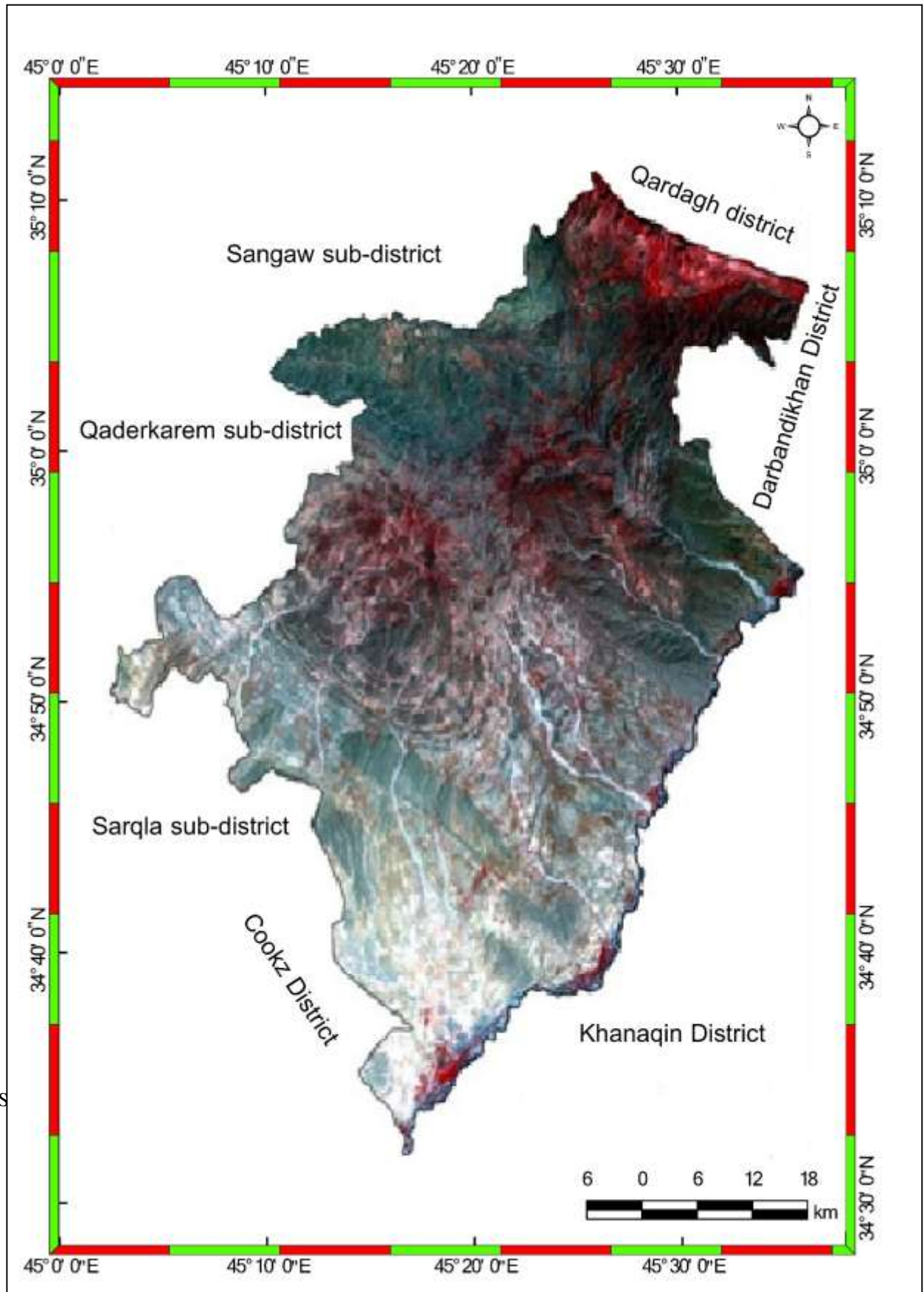
- 1 – We can build cartographic models by using digital processing of changes in land use and land cover in Kalar the district.
- 2- The reality of land use and land cover in Kalar the district is according to the classification directed to seven classes.
- 3- The population growth factors and the climate component are represented by the drought characteristics are among the most important factors in the areas of the types of uses in the judiciary.
- 4- The reality of the condition of land uses in the study area and its changes are not balanced with the prevailing geographical constituents thereof are not diluted.

Discussion and analysis:

First: digital data processing

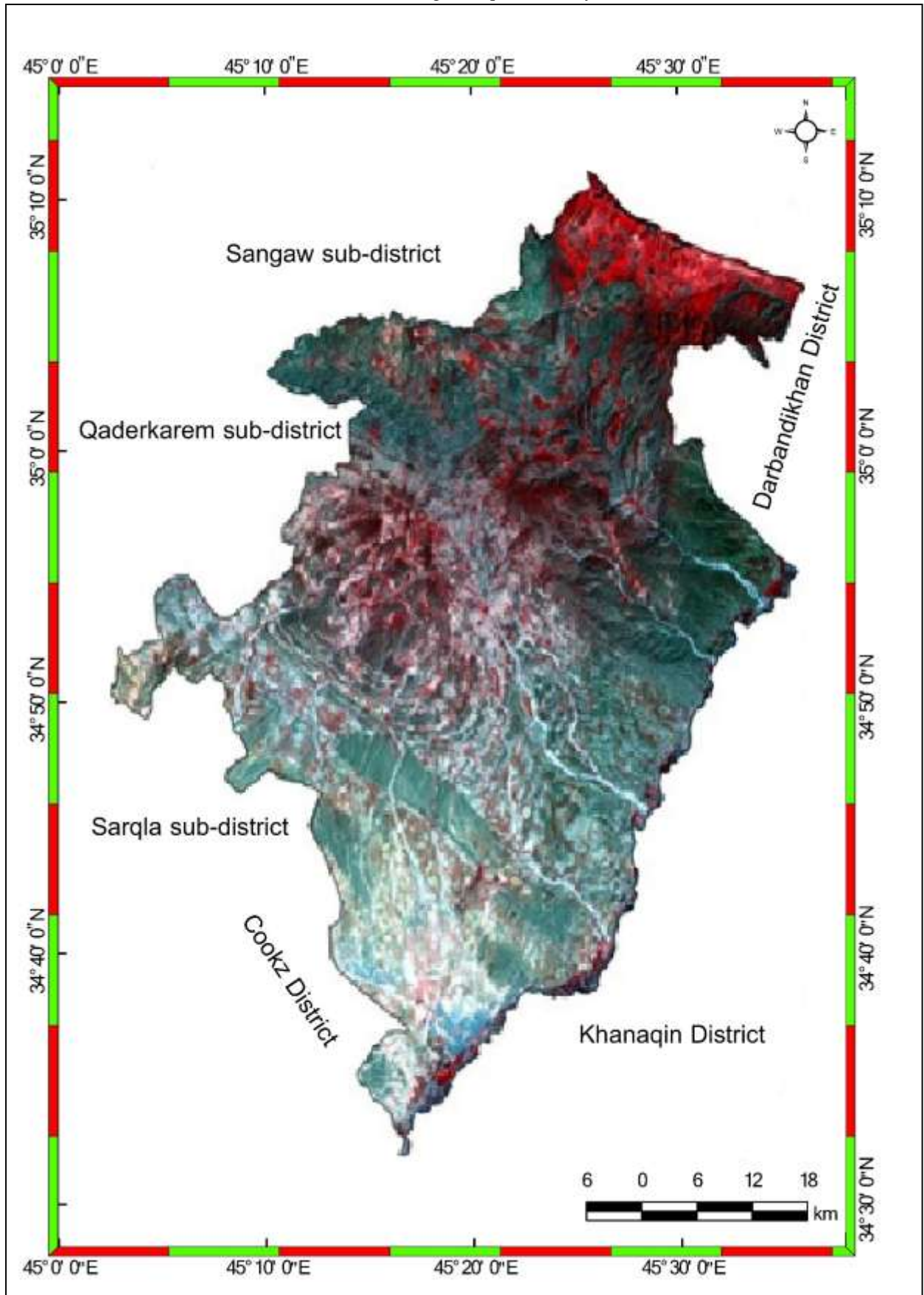
The optimization process was applied to the space visuals, Spectral Enhancement, in order to highlight the contrast between the types of the visual, in order to facilitate the distinction between the types of representation of maps, the uses of the land and the land cover in the study area. Gray levels between the varieties through the Edge Enhancement process using the Histogram Equalization method based on the Radiometric Enhancement plugin in the ERDAS IMAGINE 2014 program, where a section of the classes was separated from each other by clarifying the boundary between the Gray levels of the varieties, where the water bodies and geological structures were easily separated (Map 2, 3 and 4).

Map No (2).
Visuals used after Histogram Equalization digital processing (years2000).



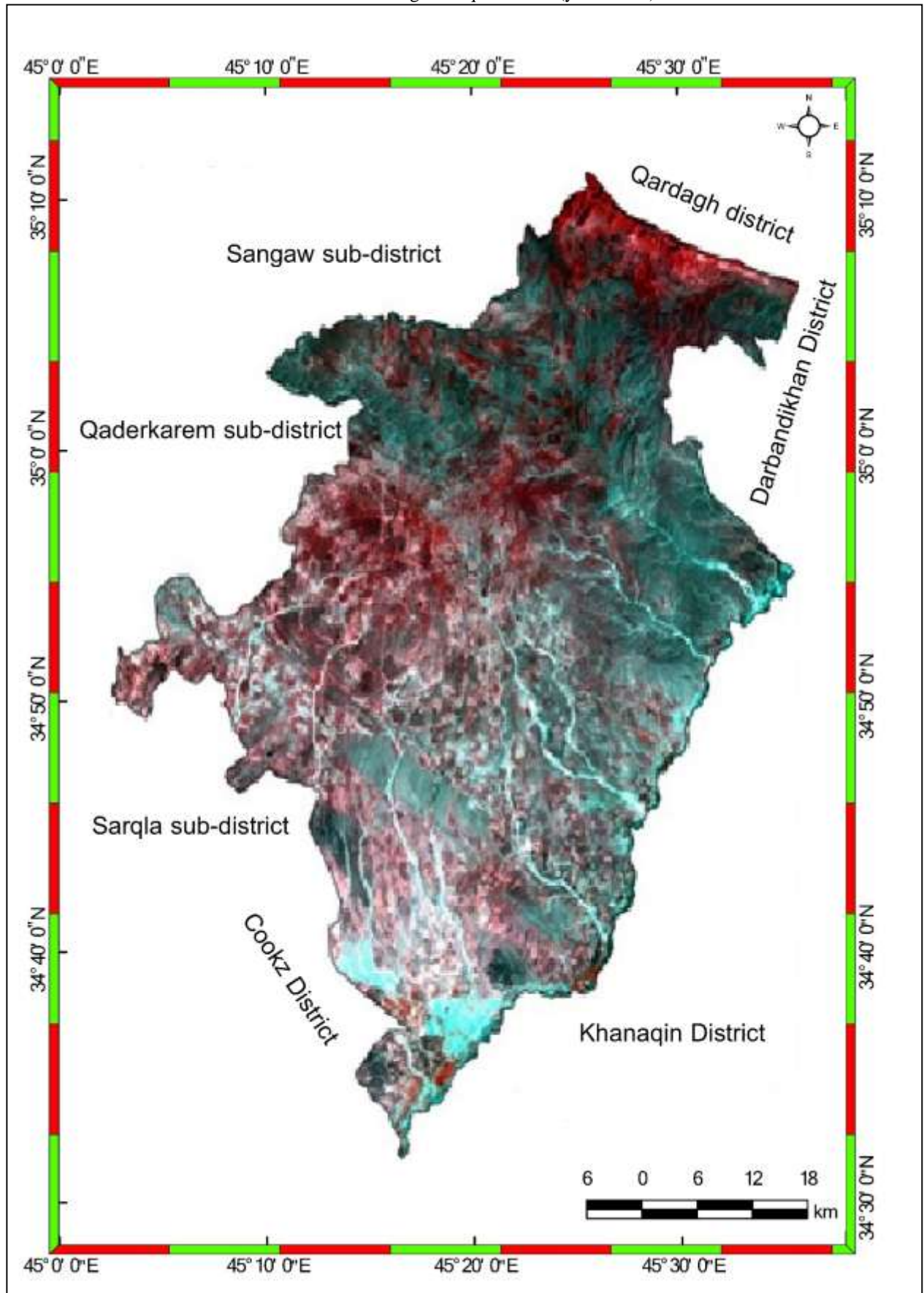
Equalization method.

Map No (3).
The visuals used after the histogram equalization (years 2008)



Source: prepared by the researcher based on the ERDAS IMAGINE2014 program, using Histogram Equalization method.

Map No(4)
Visuals Used After Histogram Equalization (years 2021)

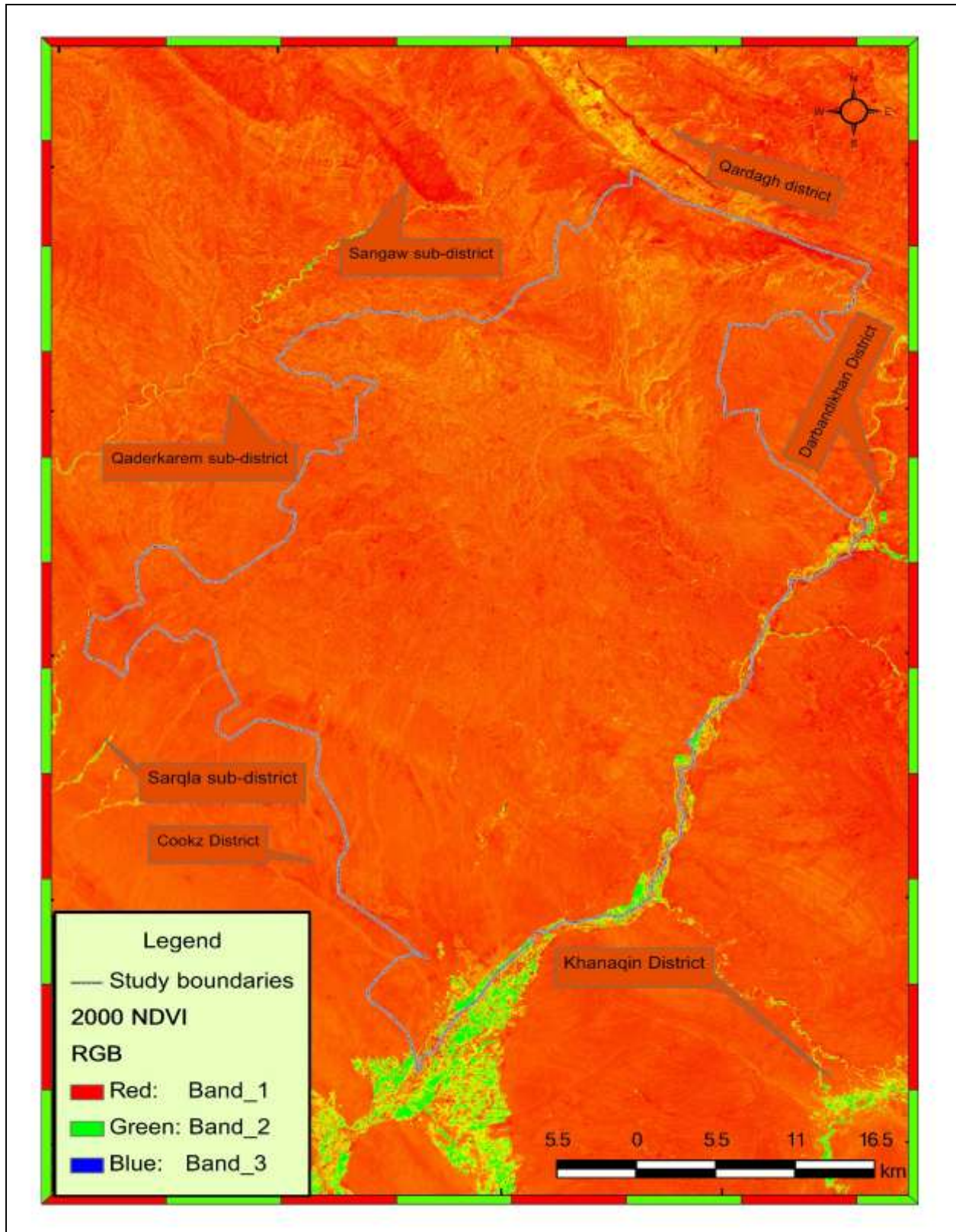


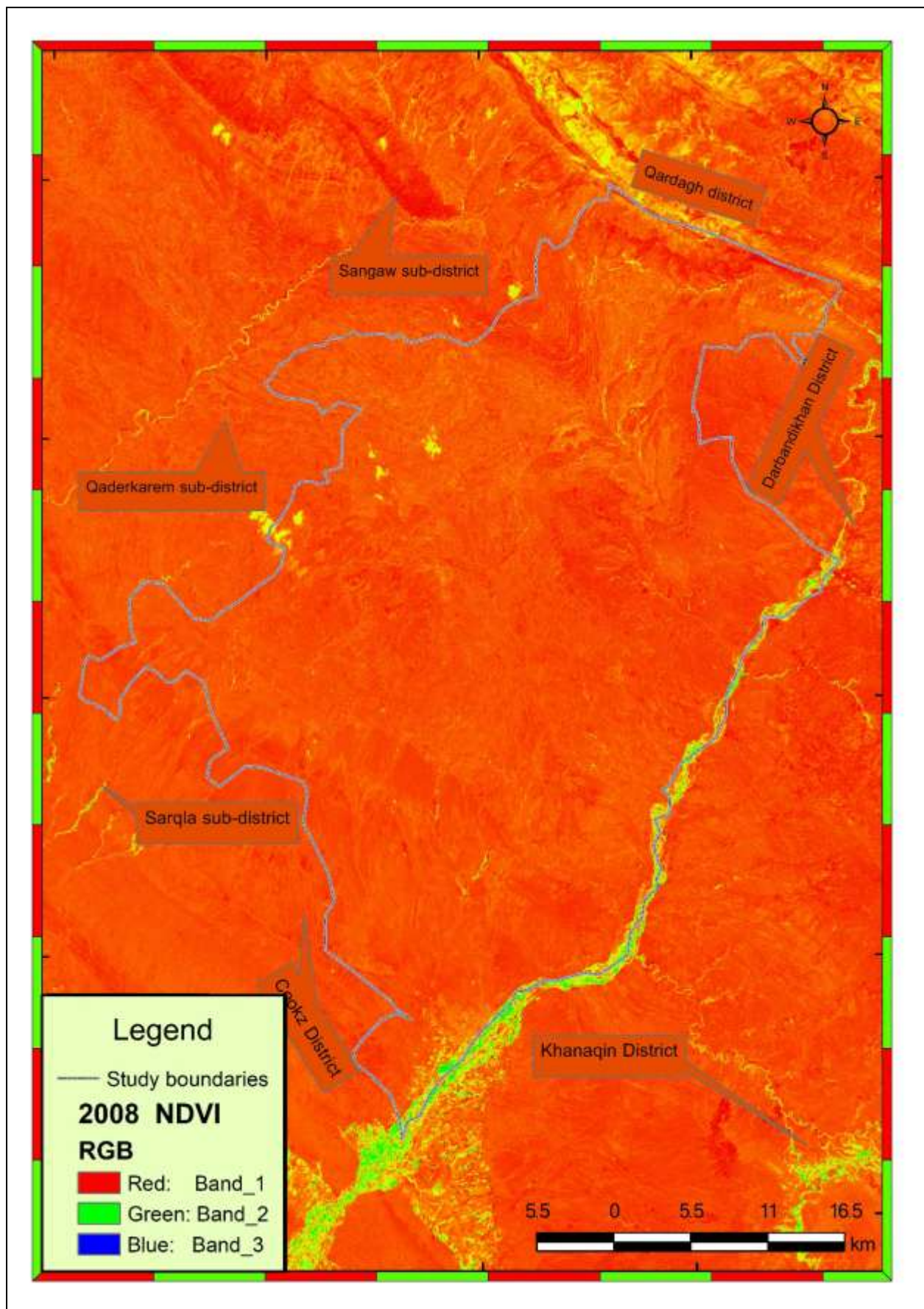
Where:
NDVI = vegetative variation index
TMb4 = fourth spectral beam

TMb3 = third spectral beam

Its value ranges from (-1 to +1). As a result of calculating the value of NDVI for all the visuals, the values from (-1 to zero) represent the non-vegetative features such as the abandoned lands, urban lands and water, while the values that are (greater than zero to +1) are the vegetation cover in the study area. (Map 7,6,5) NDVI maps represent the study area. In order to calculate the effectiveness of the vegetation cover and the changes occurring for the period (2000-2021), the values of NDVI were categorized using the Density Slicing method and through ERDAS IMAGINE 2014 program to the plants that represent the density of the vegetation (Map 7,6,5).

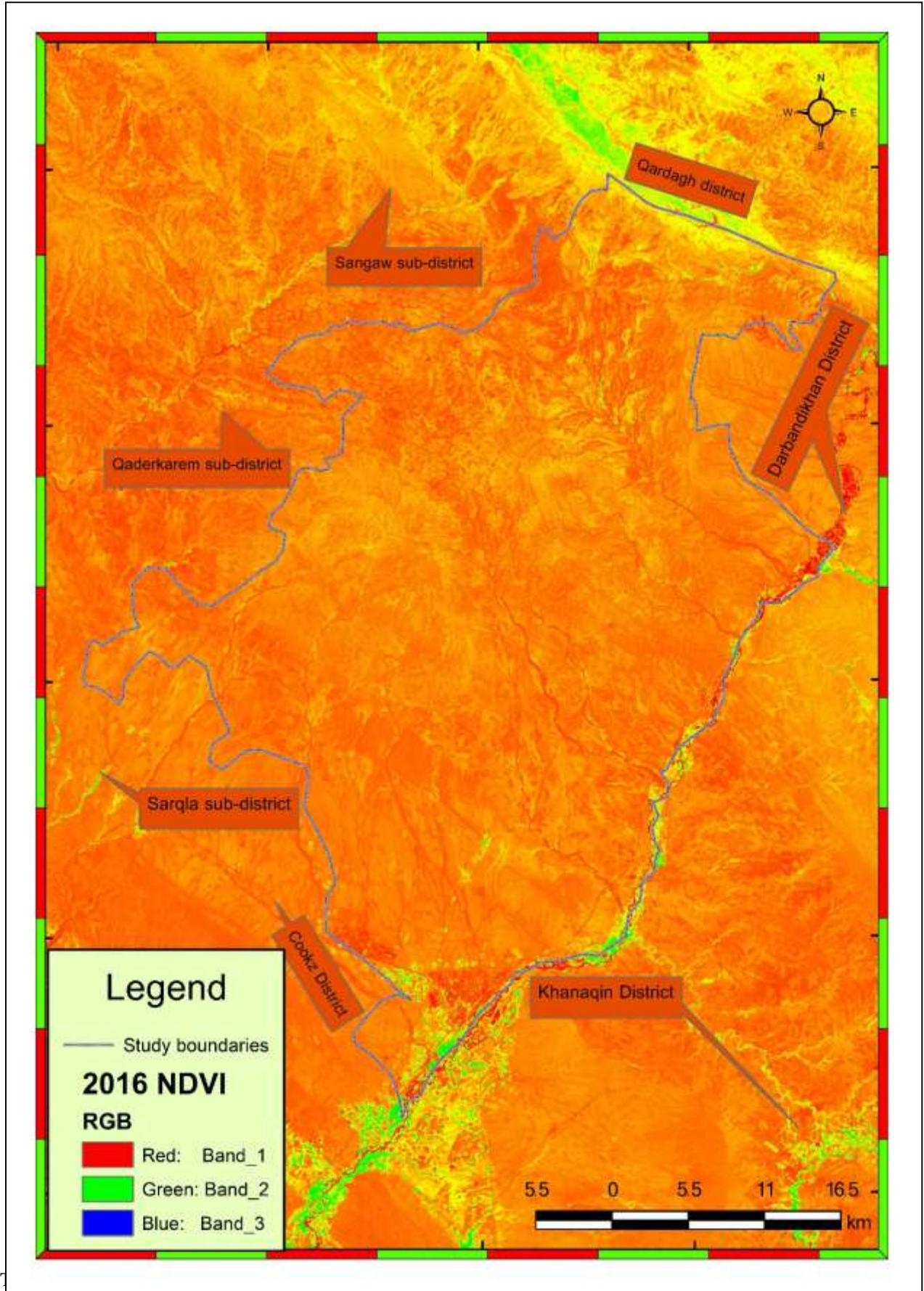
Map No (5)
Classification of NDVI values for the study area for the (year 2000)





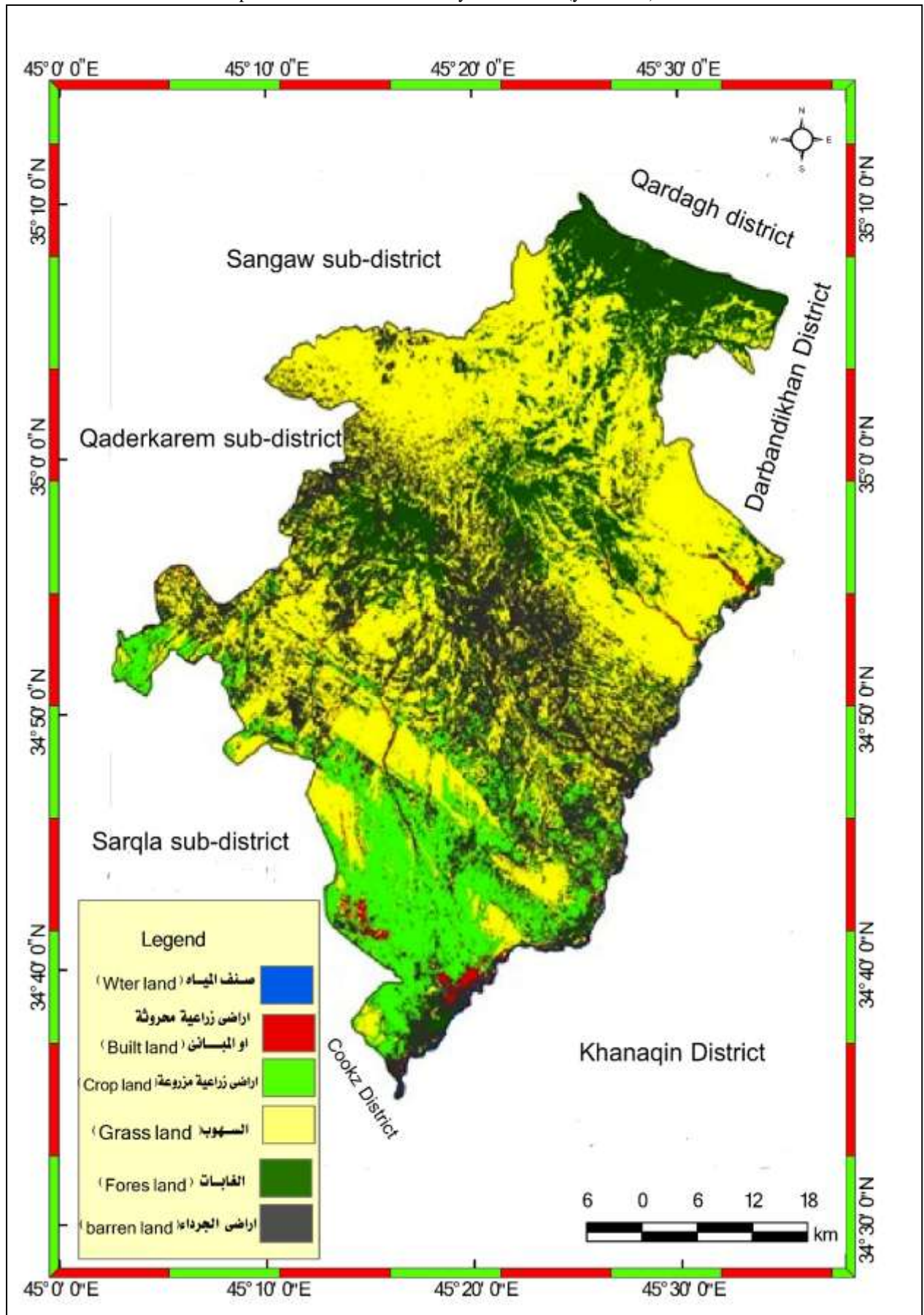
Slicing method.

Map No (7)
Classification of NDVI Values for Study Area for the (Year 2021)



1-
2-
3-

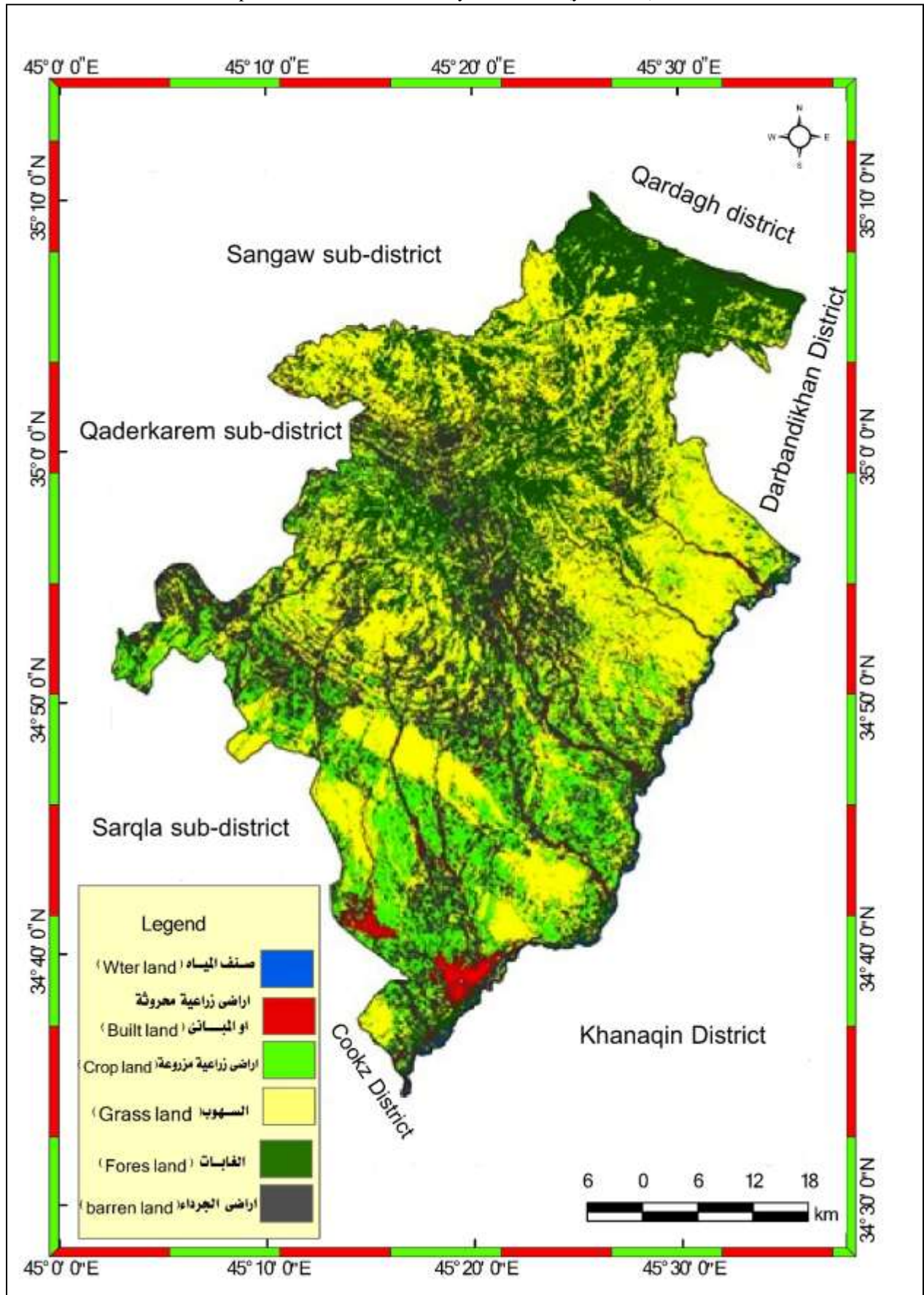
Map No(8)
 Maps of land cover for the study area for the (year 2000)



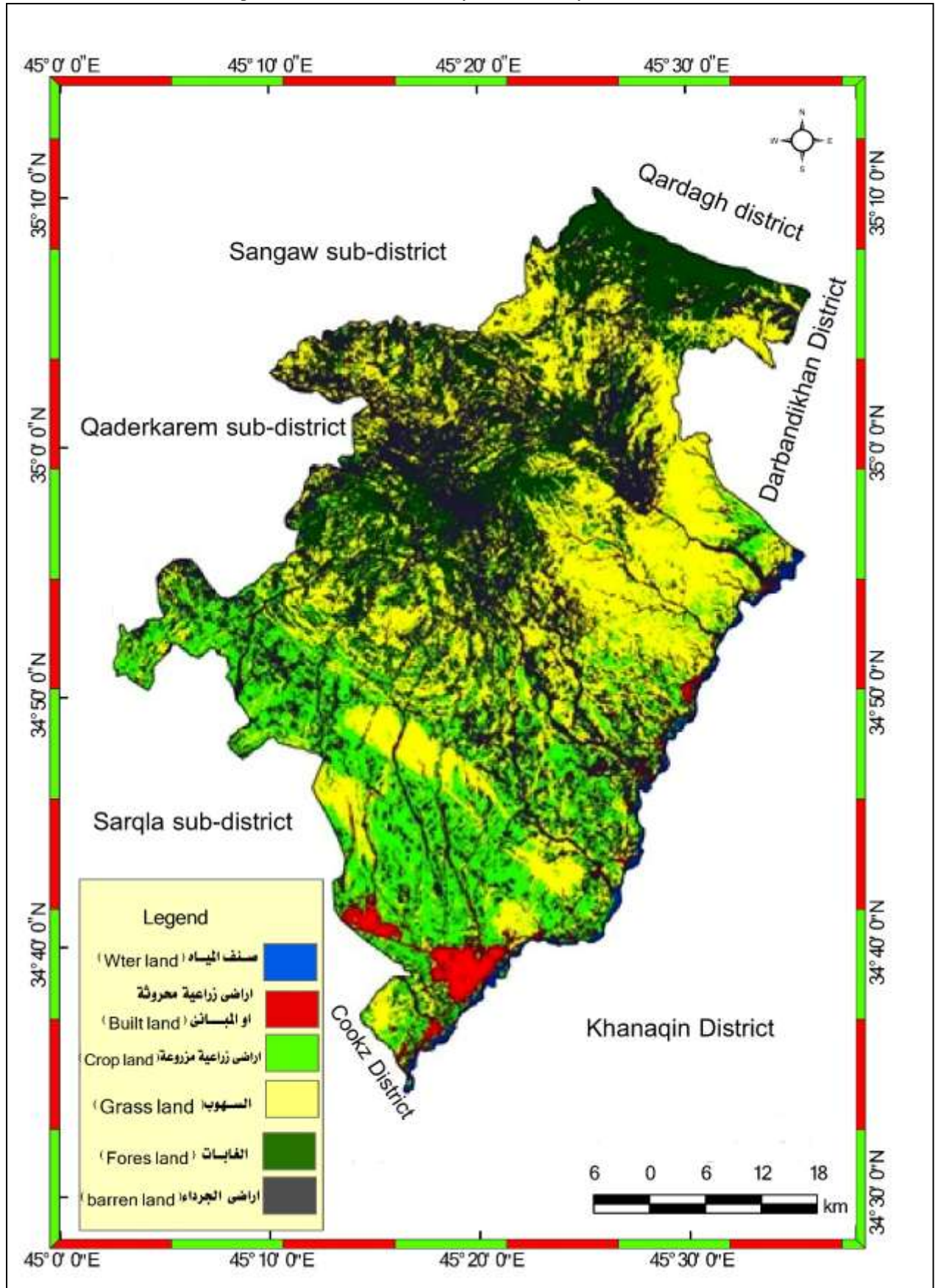
Source: prepared by the researcher, based on the ERDAS IMAGINE 2014_Unsupervised classification program.

Map No(9)

Maps of land cover for the study area for the (year 2008)



Maps of land cover for the study area for the (year 2021)



Source: prepared by the researcher, based on the ERDAS IMAGINE 2014_Unsupervised

classification program.

A number of major classes were obtained for the study area for the period (2000-2021), as these classes were discussed as follows:

1- Cultivated farmland: This cultivated land represents small farms scattered along the banks of the Sirwan River and river valley in the study area, where the lands of this variety are used in the cultivation of vegetable crops, as these crops are watered directly from the Sirwan River. And that the stability of human settlements and the increase of its population led to an increase in the area of this cultivation, transforming pastoral lands and ritual lands into irrigated agricultural lands.

2- Building lands: This cultivar represents cultivated land in the study area, as part of these lands is a permanent agricultural land which is plowed after the harvest and left until the agricultural season comes for the coming year and the other part is irrigated land that is not actually invested permanently.

3- Medium-density natural plant (steppe): The area of this cultivar represents the pastoral lands scattered in the cultivation area, which were evident in the visuals (2000-2021), which began to decline in subsequent years, due to the difference in climate, increased temperatures, and the lack of seasonal rains.

4- Water class: It is a water body that represents the course of the Sirwan River Valley. This variety was shown as a result of the presence of the course of the Sirwan River in the study area which appears in the visions of the study area clearly visible.

5 - High-density natural plant (forests): The area of this variety represents dense pastoral lands in the years (2000-2021) and is almost completely detecting in subsequent years.

6- The barren lands and abandoned lands: This category represents lands that do not contain any agricultural cover lands that are rocky and stone which are in use in some places as quarries for limestone and climate deterioration has played in the past few years from the breadth of this variety in the study area at the expense of the rest of the items. As for abandoned lands, which represents unexploited agricultural lands, in addition to the conversion of parts of other varieties to this variety due to climatic variations in the study area over time.

Fourth: Map representation and analysis of the land use area and the land cover of the study area:

The area of land use and the ground cover of the study area were classified using the technology of remote sensing and geographic information systems through the automatic visualization of the system according to the USGS system, for the three years (2000, 2008 and 2021) respectively, to several categories, as follows: Table. (1)

1- First class: cultivated lands

It turns out that the invested distance to agriculture has reached during the first year of the study period (2000) about (215,04km²), while in (2008) it reached (266,64 km²) and in (2021) it reached (318,95km²)

2- The second category: land buildings

It represents the area of arable land, but it was not actually utilized by the residents of the study area, and it reached (11,1km²), (19,34 km²) and (39,01km²) for the three years (2000, 2008 and 2021), respectively.

3- The third category: pastures

Natural rangelands are considered as unsuccessful lands dominated by weeds and plants that animals can feed on in the study area, which are areas affected by drought and salinization, and their area has reached (801,23 km²), (642,71 km²) and (579,17 km²) for three Years respectively .

4- Class four: water bodies

The area of water bodies for the three years reached (6,37km²), (6,04 km²) and (12,07km²), respectively.

5- Fifth category: medium density natural plant (forest).

It turns out that the area invested in natural medium plants to some extent compared to the variety before it, it is represented by natural pastures has reached (242,06km²), (282,01km²) and (216,93km²), respectively, for three years.

6- Sixth Class: Barren lands

The area is affected by barren lands for three consecutive years was about (389,1km²), (406,22km²) and (527,52 km²).

7- Class V: Uncategorized disks

It is represented by the area of land occupied by other uses far from the subject of the research, such as the uses of residential, industrial and commercial lands, etc., with an area of (30,1 km²), (1,84 km²) and (1,35 km²) for the three years in a row.

Table (1)
Area of land cover to spend kalar satellite imagery (km²) for the period (years 2000-2021)

The ratio %	Area / sq km For the year 2021	The ratio %	Area/sq km For the year 2008	The ratio %	Area/sq km For the year 2000	Land uses And ground cover	n
18.81	318.95	15.73	266.64	12.7	215.04	Agricultural land planted (Crop land)	1
2.33	39.01	1.14	19.34	0.65	11.1	(Built land)	2
34.17	579.19	37.91	642.71	47.41	801.23	(Grass land)	3
0.71	12.07	0.35	6.04	0.21	6.37	(Water land)	4
12.79	216.93	16.63	282.01	14.31	242.06	(Forest land)	5
31.12	527.5	23.96	406.22	22.95	389.1	(barren land)	6
0.07	1.35	0.1	1.84	0.07	30.1	(un classify)	7
100	1695	95.82	1695	100	1695	plural	

Source: Prepared by the researcher, based on the visuals used in the Arc map^{10,7} program.

Fifth: Map representation and analysis of trends in the area of land use and land cover change:

The features of land use and land cover in the study area vary in terms of the area used for cultivation. The reason for this is due to the prevailing geographic components in the study area. As these areas were indicated, and the areas separated between the seven bands in the study area were determined for the three chosen years (2000, 2008 and 2021) through the use of remote sensing techniques and geographic information systems through which the three judicial views were processed and then categorized and determined the distance of its varieties is as follows. And Map (11) and (12) and Table (7).

1- First class: cultivated lands:

The direction of the area of cultivated land in Kalar the district during the three years covered by the study indicates an increase at the expense of other varieties, as the difference in its area between (2000-2008) and in (2008-2021) reached about (51.6 km²) and (267.36 km²), Respectively, and the reason for this is due to the large consumption requirement of agricultural crops in the study area due to the continuous increase in the growth of the population of the Kalar district, as well as the improvement of the economic situation for many residents of a region, which led them to establish farms and orchards for large areas that may reach a few dunums for the purpose Tourism and entertainment, not for the purpose of production and interest.

2- The second category: land buildings

The high area of arable land in the district between the base year (2000) and the comparison year (2008) up to (8.24 km²), and the continuation of its rise during the period (2008-2021) up to (30.77 km²) is represented by agricultural and irrigated agricultural lands due to the technological development taking place in the methods of lunging the main method of spraying and deliberate punishing by farmers in the cultivation of rustic lands most of the time in the district and to the establishment of farms by the General Directorate for Kalar cultivation in the study area.

3- The third category: Pasture

Decreased areas classified with natural pasture phenomenon in the study area between the base year (2000) and the comparison year (2008) by a difference of (158.52 km²), and the continued decrease during the period (2008-2021) by a difference (420,65 km²), and this means the decline of the areas designated for natural pastures. In eliminating the rest of the classified areas during the study period because of the dry climate characteristics that the study area climate goes to in the last year as well as the increasing population growth in the region and the associated urban expansion, especially the construction of population complexes at the expense of the same class.

4- Class four: water bodies

The direction of the area of water bodies in the study area indicates an increase at the expense of other varieties, especially the Pasture cultivar, if a comparison was made between the base year (2000) and the comparison year (2008) with a difference of (12,07km²), and during the period (2008-2021) with a difference of (11,74Km²) and has changed towards increasing the remaining varieties, whose area is declining, and the reason for this is due to the establishment of some of the small dams on many seasonal valleys in the district in order to store water in the rainy season and benefit from it in the driest season.

5- Fifth class: medium-density natural plant (forest)

The trend of the area of agricultural lands are exploited by medium-density natural vegetation in the study area indicates a decline towards the expense of other varieties, if the comparison was made between the base year (2000) and the comparison year (2008) by a difference (41.04 km²), and during the period

(2008-2021) by a difference (65 , 17 km²) and has changed towards increasing the remaining varieties exposed to its area due to the high water table in the study area due to the construction of some small dams on many seasonal valleys in the district in order to store water in the rainy season and benefit from it during the drought years .

6- Class six: barren lands

The trend of the barren land area in the study area indicates a rise between the base year (2000) and the comparison year (2008) with a difference of (17.12 km²), and its continued rise during the period (2008-2021) with a difference of (510.4 km²), at the expense of other varieties, especially at the expense of the fifth category represented by the medium-density natural plant resulting from the climate extremism occurring in the study area and the accompanying manifestations of drought.

Class seven: Uncategorized disks

Also, the trend of this cultivar indicates an increase in its area if the comparison was made between the base year (2000) and the comparison year (2008) with a difference of (28.26 km²), and during the period (2008-2021) with a difference of (26.91 km²), and it has changed towards increasing the other varieties exposed Its area is declining.

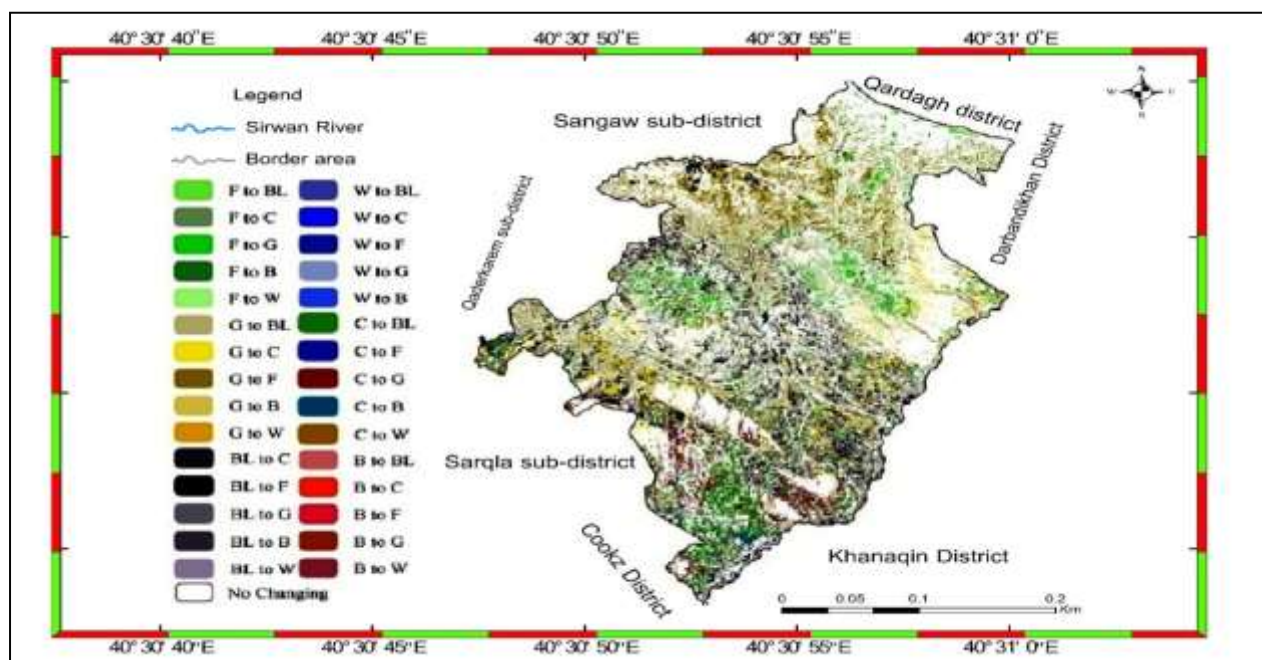
Table (2)
Change of land cover area (km²) for the period (years 2000-2021)

the difference between Colloquial (2008-2021)	Area / sq km For the year2021	the difference between Colloquial (2000-2008)	Area / sq km For the year 2008	Area / sq km For the year 2000	Land uses and ground cover	n
267.36	318.95	51.6	266.64	215.04	(Crop land)	1
30.77	39.01	8.24	19.34	11.1	(Built land)	2
420.65	579.19	158.22	642.71	801.23	(Grass land)	3
11.74	12.07	0.33	6.04	6.37	(Water land)	4
65.17	216.93	40.04	282.01	242.06	(Forest land)	5
510.4	527.5	17.12	406.22	389.1	(barren land)	6
26.91	1.35	28.26	1.84	30.1	(un classify)	7
1577.53	1695	309.51	1695	1695	Plural	

Source: Prepared by the researcher, based on the visuals used in the Arc map^{10.7} program.

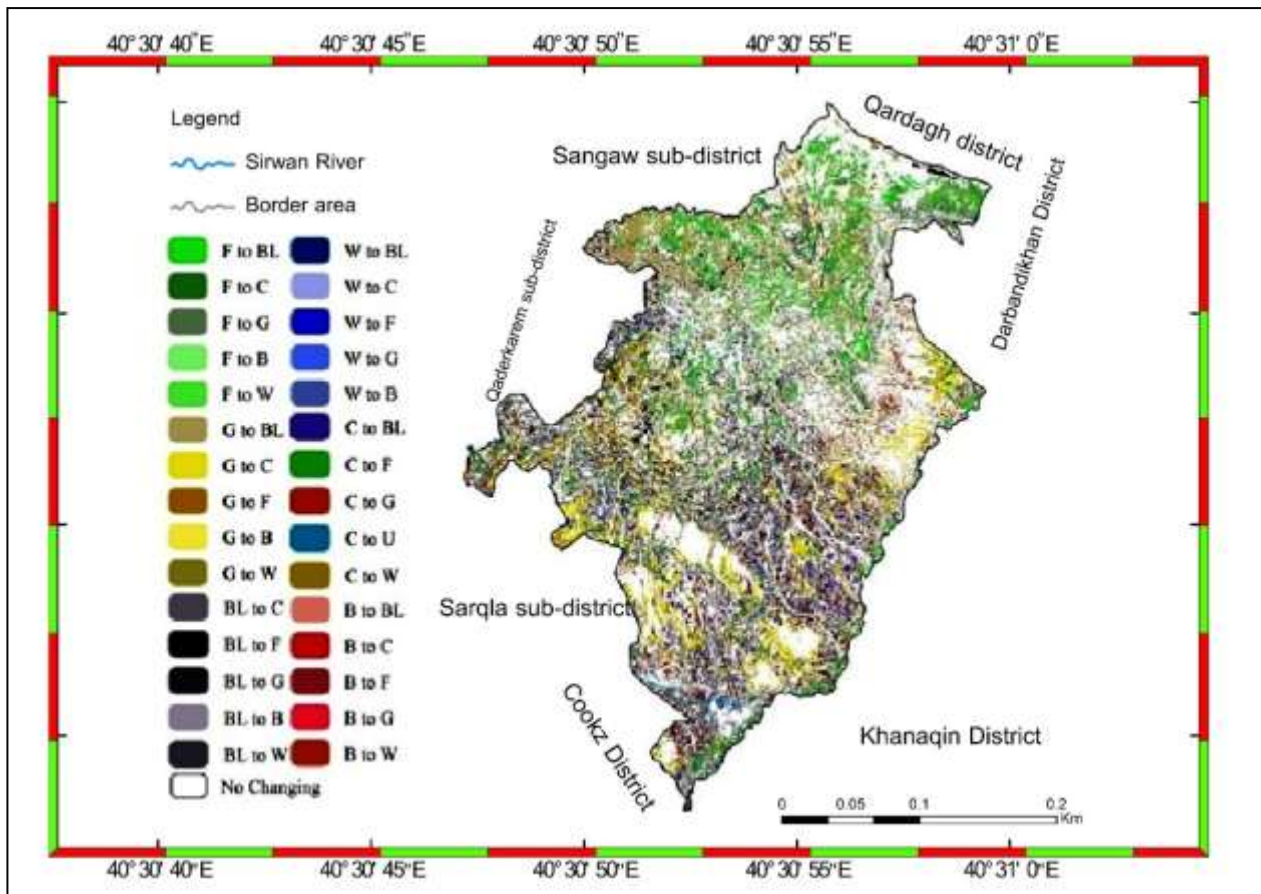
Map (11)

The trend of changes in the land cover in the Kallar District, (years 2000-2008)



Source: Prepared by the researcher based on the ERDAS IMAGINE 2014 program, using the Density Slicing method.

Map (12)
The trend of changes in the land cover in the Kahler district, (years 2008-2021)



Source: prepared by the researcher, based on the ERDAS IMAGINE 2014 program, using the Density Slicing method.

Discuss the results

The human intervention in establishing a housing and agricultural project had a fundamental role in changing the nature of the region in terms of land uses and land cover, as these two projects contributed to change in the ratio of the area of the remaining varieties, as the climate played a fundamental role which was represented by high temperatures and lack of rain in subjecting the study area to create drought, which affected the two species (medium-density natural plant) and (high-density natural plant) as follows:

1- The effect of the Sirwan River and the river valleys on the categories of land uses: The formation of the water surface which is represented by the Sirwan River and river valleys, which reached (90,3 km) in the study area and river valleys with an area of more than (212,07km²) (Year of the research) led to an impact on the area of the varieties that flooded Part of it is due to the expansion of the area of this variety. The variety (medium-density natural plant) was affected, as it was inundated about (216,93 km²), as it was the variety (barren lands and abandoned lands), where it was inundated about (527,52 km²).

2- Climatic variations worked to deteriorate the potential and functional efficiency of agricultural land: in the study area in addition to the human factor, which reflected negatively on the environment in this region.

Conclusions:

The results of this study showed that the use of time-lapse visualizations increases the possibility of integration with systems that use geographic information systems in obtaining information and monitoring environmental changes and agricultural activities with high accuracy and the possibility of representing and analyzing maps for land uses as they can be relied on preparing reports and research for various purposes. That is, the study showed the possibility of adopting thematic maps from the directed classification because these maps have high accuracy and credibility and can be strengthened with numbers, and this methodology can be used for applications of land use and land appearance at the regional level, and the possibility of calculating the results of changes in the land features in the study area on Clear changes occurred in the types of land appearance and its area during the study period limited between (2000-2021) and between the base year (2000) and the comparison year (2008) and during the period (2008-2021), if the two classes of pasture and natural intentions are limited to medium intensity At the expense of other varieties, due to the low levels of groundwater in the study area, the prevalence of long dry periods and the decomposition of organic matter. In addition to this the aggravation of the problems of overgrazing in the study area, as well as the increase in population growth and the increase in urban activity widely at the district level, especially in Kalar district and Rizgari sub-district. This amounted to the

number of classes of land appearance in the study area according to the USGS system. For the purpose of determining the areas of land cover and its area according to the maps, the Urban Differences Guide (NDVI) for the study area.

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التمثيل والتحليل الخرائطي لتغيرات استخدامات الأرض والغطاء الأرضي
في قضاء كه لار باستخدام المعالجة الرقمية
أرام حسن محمد ماجستر_ جامعة كهرميان_ كلية التربية الاساس -
قسم العلوم الاجتماعية

المستخلص: تتناول هذا البحث التمثيل والتحليل الخرائطي ومدى تغير استخدامات الأرض والغطاء الأرضي في منطقة الدراسة وذلك من خلال مراقبة ذلك الغطاء بالصور والخرائط خلال مدة زمنية تعود إلى 17 سنة (2000 - 2021) ، وتحديد نوع التغير ومقداره في حالة ومساحة التغطية النباتية واستخدامات الأرض وتحليل مسببات ذلك التغير، من خلال توظيف معطيات المعالجة الآلية للمرئيات الفضائية في استخراج مساحة التغطية النباتية لأعوام مختلفة في منطقة الدراسة، وتشكل بيانات المرئيات الفضائية المصدر الرئيس لهذا البحث ، والتي تم معالجتها آليا من خلال مجموعة من البرامج الرياضية ومنها (Arcmap10,5 و ERDAS IMAGINE 2014) المرئيات الفضائية المتعاقبة زمنيا والمأخوذة لنفس المنطقة تعطي تحليلا واضحا عن مدى تغير استخدامات الأرض والغطاء الأرضي في منطقة الدراسة. اعتمد نظام مصالحة المساحة الجيولوجية الأمريكية (USGS) في تصنيف الخرائط المنتجة لاستخدامات الأرض والغطاء الأرضي. ونتيجة للتغيرات في النشاط البيئي والزراعي من جراء انشاء الوحدات السكنية والتوسع العمراني. تم تحليل التغيرات الحاصلة في اصناف استخدامات الأرض والغطاء الأرضي خلال الفترة الزمنية من عام 2000 لغاية 2021 باستخدام نظام التصنيف الموجه وحسابات دليل الاختلافات الحضري في تحليل استعمالات الأرض والغطاء الأرضي باستخدام برنامجين (Arc map^{10,7} و ERDAS IMAGINE 2014).

حيث خلصت الدراسة إلى نتائج تبين مدى الانحسار الكبير الذي حصل لتغير استخدامات الأرض والغطاء الأرضي في منطقة الدراسة. أظهرت نتائج هذه الدراسة إن تمثيل الخرائطي واستخدام المرئيات المتعاقبة زمنيا تزيد إمكانية التكامل مع الأنظمة التي تستخدم نظم المعلومات الجغرافية في استحصال المعلومات ورصد التغيرات البيئية والأنشطة الزراعية بدقة عالية إذ يمكن الاعتماد عليها في إعداد التقارير والبحوث و لمختلف الأغراض.

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