DOI:10.52113/uj05/021-14/1841-1849 ISSN : 2072-6317(P) - 2572-5440(O)

BM-Publisher

جامعة المثنى / كلية التربية للعلوم الانسانية

مجلة اوروك للعلوم الانسانية

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Oil production and its impact on land cover using remote sensing in Kirkuk – Iraq

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Article Info

Date of Article

Received : 2021/5/15

Received in revised form: ----

Accepted: 2021/9/5

Available online: 2021/9/15

Keywords:

Kirkuk,
Production,
Remote Sensing,
Pollution,
Oil,
Land cover.

Abstract

The most of country industrial in the worlds heavily depends on the oil consumption and crude oil use of source main energy and raw materials in industrial sectors, this increases in world request for crude oil, this increases the used of oil in world and puts pressure on the oil producing country to increases oil production operations, in Iraq the first in history oil discovered in Kirkuk, oil was discovered in 1927years and drilling began on 10 October, Kirkuk has a four big oil producing fields with six oil fields not oil producing, Kirkuk oil fields consists of fourteen station of oil producing , its consists of 732 oil wells ,oil production in the oil fields Kirkuk daily reached 386th barrels , of course this oil production operations impact on the environments and including soil pollution , showed the effects of oil production on soil pollution, such as changes in land surface quality or changes land cover , the aim of this study is to evaluate and determination of oil pollution and impact of oil production and processes on soil pollution in the Kirkuk , in study areas the ten images satellite Land sat are used from between years (1989, 1998, 2008, 2015, 2019), in the results showed that there was a strong connection between oil production and soil pollution and this is oil industry operation reflected on the vegetation in Kirkuk.

Introduction

Oil plays an important role in our daily lives; it is one of the most important sources of heating, cooling and lighting, Iraq holds a large percentage of the world's oil reserves [1], However, oil in Iraq lies near the earth's surface; it has been found to flow through the cracks in geological structures, and these near-surface deposits constitute a strategic reserve to Iraq's enormous oil and gas fields[2],Kirkuk is one of the area parts of Iraq with a big oil wealth, because of the good land geology formations and suitable for underground oil accumulation [3], the proven oil reserves of Kirkuk are predicted around 13 billion barrels [4], the Iraqi Oil Ministry of announces that the proven reserves in Iraq are 142 billion barrels, from 11% in the Iraqi oil reserves is located in Kirkuk, Kirkuk consists of a 10 oil fields, four of these fields are oil producing but six oil fields is not producing show table No(1), in 2019 years oil production in the Kirkuk oil fields reached 386th barrels daily [5]

Table , (1) Kirkuk oil fields.

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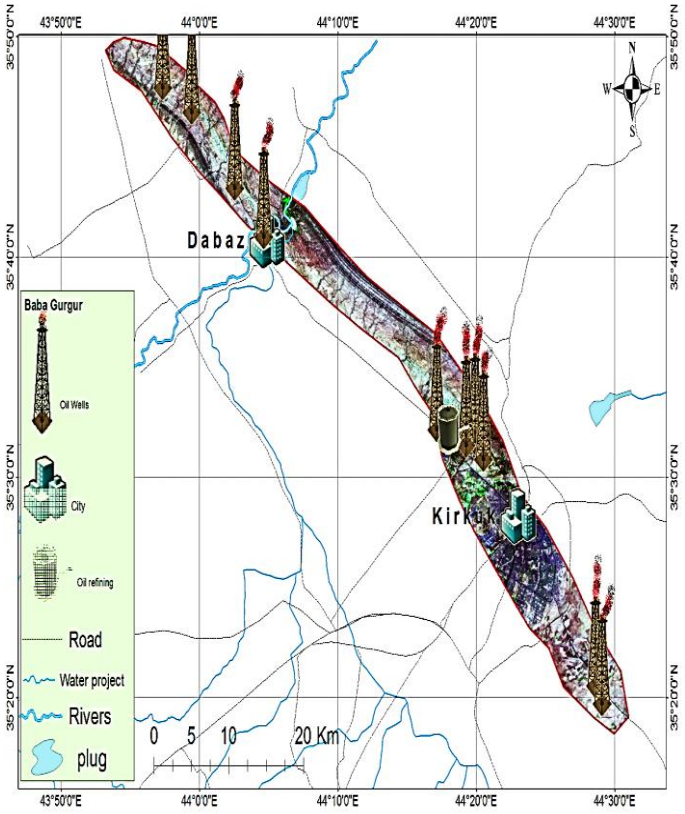
Kirkuk Oil fields	Year of Discovery	Oil wells	API °	Reserve (B,B)	Type of Oil field
Baba Gur Gur	1927	433	36	9	production
Bay Hassan	1960	194	35	2.4	production
Jumbur	1959	61	31 – 36	0.68	production
Khabaza	1981	44	31 – 36	2	Production
Balkanah	1956	8	31	1.5	Non – product
Injana	1927	5	31	0.5	Non – product
Qarjug	1960	2	40	0.13	Non – product
Khanouka	1929	2	43	0.5	Non – product
Jadeda	1977	1	25	0.4	Non – product
Esmail	1996	1	31	2.8	Non – product

Source/ ناجي مزهر عبد الرحمان وهادي عبد الازيرج , الصناعة النفطية في العراق , مطبعة العدالة , الطبعة الأولى , بغداد , 2009, ص 162 .



Map (1) Baba Gur Gur oil fields, 2021 years .

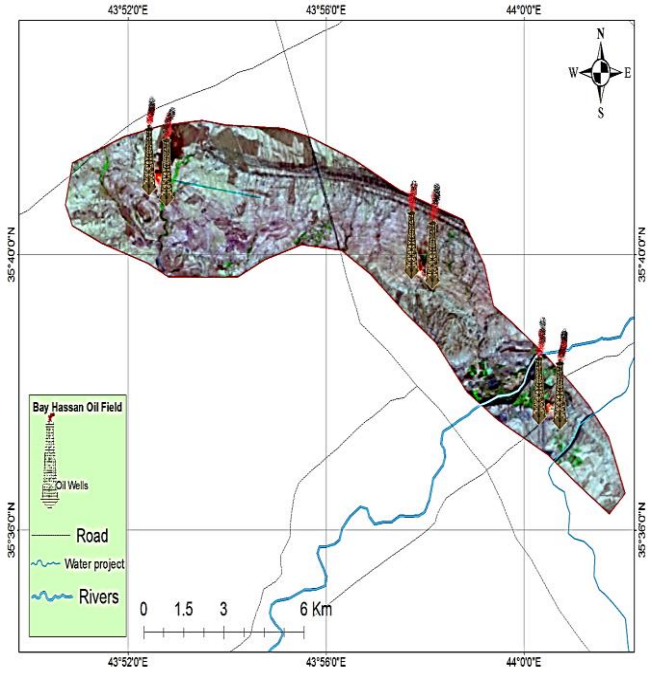
In Kirkuk, the geography of oil fields is distributed from everywhere in the north to south and from east to west[6] Kirkuk has a four big oil producing fields, as following;

1- Baba Gur Gur oil fields:

The Baba Gur Gur oil fields is one of the big oil field oil producing in the iraq, located in the province of Kirkuk northern Iraq, which was oil discovered in 1927 years[7], Baba Gur Gur considered in twenty years a largest oil field in the worlds, the longer oil field Baba GurGur is 100 Km and wide 12 Km[8] show map No (1).

2- Bay Hassan oil fields :

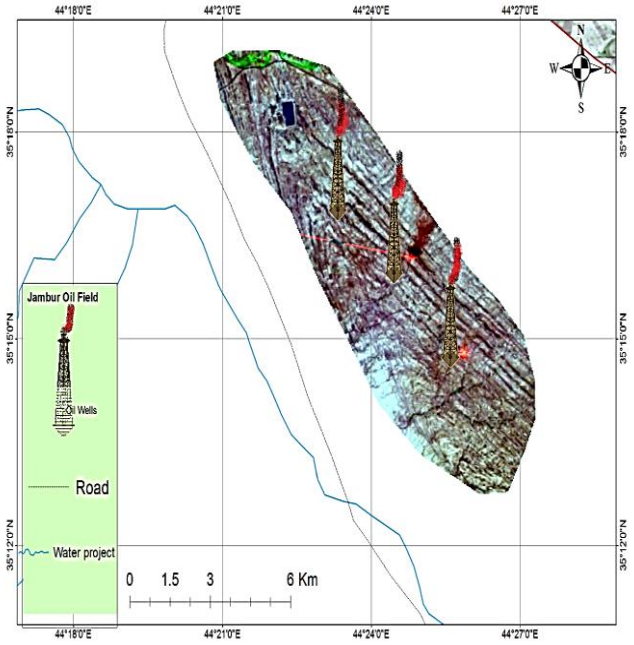
The field oil of Bay Hassan is a productive fields, these oil fields is located 32 km northwest of the city of Kirkuk[9], the Bay Hassan field is a rocky structure 28.5 km long and 3.5 km wide, , the main parts of the big structure is referred in the Ktaka Dome and extends to the northwest in the Dawda Dome[10], show map No (2) .



Map (2) Bay Hassan oil fields, 2021 years .

3- Jumbur oil Fields:

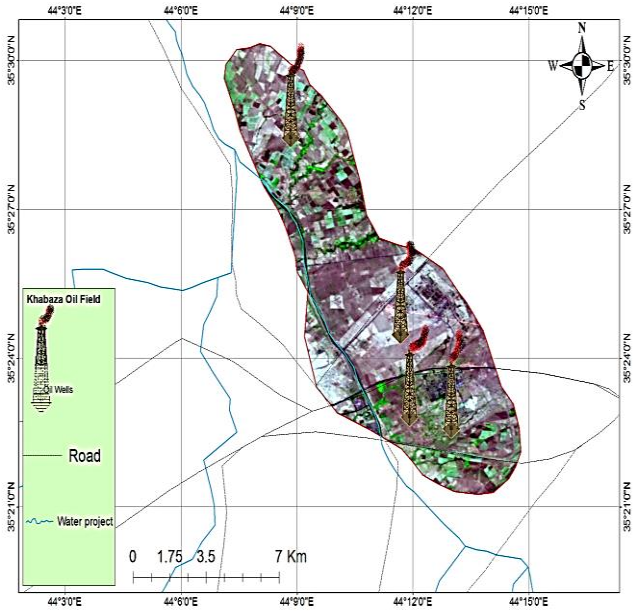
These oil fields is located in 45 km south east Kirkuk, oil was discovered under land from depth 1.4th meters in 1954 years and entered commercial production in 1959[11], the length of the oil pond is 20km with a width of between 3 to 3.5 km It is towards north / south[12], show map No (3) .



Map (3) Jumbur Oil fields, 2021 years .

4- Khabaz oil fields :

The Khabaza oil fields is located 18 km southwest in Kirkuk, between of Bay Hassan and Jambur oil fields , the oil fields are 18 km long and 3.5 km wide ,this oil fields was discovered in 1955 and the exploratory well was drilled in 1976[13] , show map No(4) .



Map (4)Khabaz oil fields, 2021 years .

2- MATERIALS AND METHODS:

2.1. Study area:

Geographic location of Kirkuk is located in north Iraq, Baghdad is location in the south 273 km away, ErbiI is located in the northeast, 103 km away, Sulaymaniyah Governorate in the located east a distance of Kirkuk 120 km, Tikrit Governorate in the southern located a distance of 136 km show map No (5), the total area of Kirkuk is 9679 km^2, Kirkuk is proportion area %2.2 in the Iraq, Iraq has a total area is (437,072 km^2)[14].

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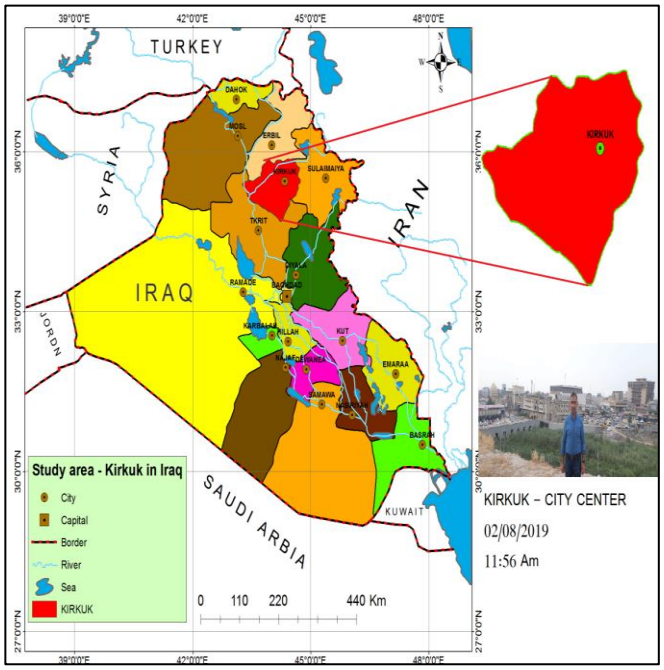


Map No (5) study area, 2021 .

2 - 2 Methods:

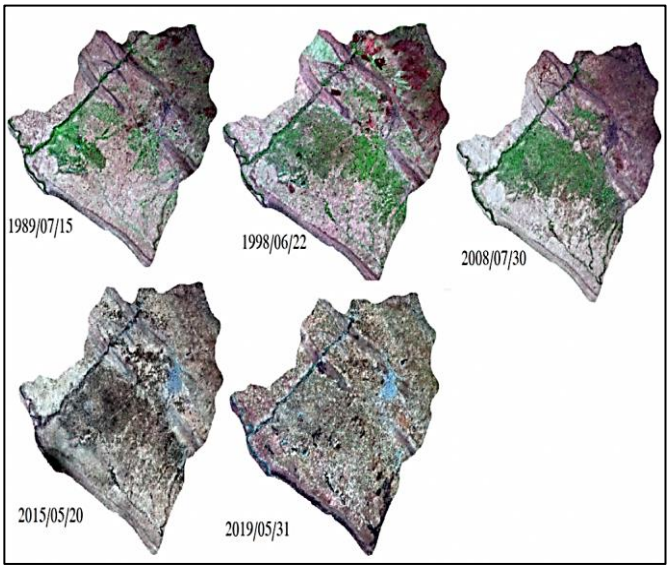
In this research depends on the images satellite Land sat data to analyze changes in land cover in the Kirkuk, the ten Landsat images are used and taken from the USGS Earth Explorer website and Geo-referenced to UTM zone 38, WGS 84 [15],images take from types Landsat-5 and 8 image downloaded, were chooses between May and July months, image Satellites analysis between (1989 - 2019) years, show Table No (2) and figure No(6) , the impact of oil production on the land cover and showed land cover is changes, with some data collected in Kirkuk governorate for example (oil fields data , rain).

Table (2) images Satellite use data on the Kirkuk between years (1989 - 2019).

Landsat Scene ID	Date	Time	WRS Path	ROW	Map Projection	Datum	Landsat
LT05169036198 9071501	15/07/1989	7:06Am	169	30	UTMZONE38	WGS84	5
LT051690 351998062 201	22/06/1998	7:16Am	169	30	UTMZONE38	WGS84	5
LT051690 361998062 201	22/06/1998	7:17Am	169	30	UTMZONE38	WGS84	5
LT05169035201 08070301	03/07/2008	7:26Am	169	30	UTMZONE38	WGS84	5
LT05169036201 08070301	03/07/2008	7:27Am	169	30	UTMZONE38	WGS84	5
LC08169035 2015052001	20/05/2015	7:38Am	169	30	UTMZONE38	WGS84	8
LC081690362 015052001	20/05/2015	7:38Am	169	30	UTMZONE38	WGS84	8
LC08169035201 9053101	31/05/2019	7:38Am	169	30	UTMZONE38	WGS84	8
LT051690 351989071 501	15/07/1989	7:06Am	169	30	UTMZON E38	WGS84	5

LC08169036201 9053101	31/05/2019	7:39Am	169	30	UTMZONE38	WGS84	8

Source / https : //earthexplorer.usgs.gov.



Map No (6) images satellite Land of Kirkuk.

3. Results:

3.1. Oil Production:

Oil producing from the Baba Gur Gur oil fields in north Iraq started From Kirkuk in1934 years which, the daily oil production is around 34th barrel, and between 1934 to 1950 years daily oil production (21th to 124th) was very slowly[16], however, after 1950 years, after another's the oil fields was discovered in Kirkuk, the percentage of oil production directions to very high,[17] , show table No(2).

Table (2) Daily of oil production between 1934 and 2019 in Kirkuk.

The year	Oil production (Pr .Da)	The year	Oil production (Pr. Da)
1934	21th	1985	1.207ml
1940	55th	1990	952th
1945	100th	1995	371th
1950	123th	2000	942th
1955	486th	2005	309th
1960	679th	2010	487th
1965	881th	2014	88th
1970	1.142ml	2015	160th
1975	1.100ml	2017	30th
1980	1.262ml	2019	386th

Source/ Republic of Iraq, oil of ministry, Iraq oil Marketing Company (SOMO), Data Published.

In Kirkuk, the oil production process is increasing and its impact on the environment and increases make dangers to changes land covers and soil quilts[18], show table (2) and Figure (1) explain in Kirkuk oil production between (2014 to 2017) is very low but proportion of oil pollution is very high, because the oil fields security of Kirkuk is dangers, ISIS attacked on the oil fields and some oil wells are exploded and some oil well controls[19].

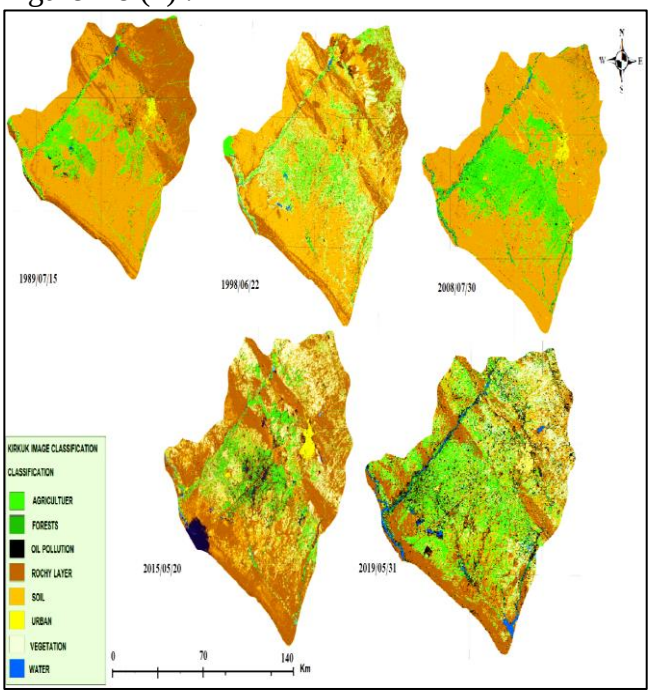
3.2. Image supervised classification:

in the oil fields, the production of oil and refining oil derivatives increases used, which poses environmental risks, Most of the oil production area covers and use of these resources are increased pollution and the effects on land cover changes, and the oil pollution spread on neighboring lands in the rainy season [20], displaying and show the picture No (1) of the oil field in Kirkuk of the first Field work visited in 2012 and the second field work visited in 2019years, shows land cover is difference and changes after of seven years in the first visited, from land unpolluted change to land polluted.

Picture (1), work field visited.

The outcomes of the image satellite land sat supervised classification, based on ten different

mosaicked Landsat images, Landsat 5 TM (1989, 1998, 2008), Landsat 8 ETM+ (2015, 2019) , explain from graphs and maps, the supervised classification statistics for all oil pollution and change land cover in Kirkuk explain in table No (3) which shows the spatial patterns of land cover type in square mile, soil coverage percentage of oil pollution size and class areas and the change difference land use between 1989-2019 respectively , show map No(7) , shows that the dense oil pollution class which was the area cover in 2015 and 2019 has very high from %6.4 to %8.3 , this percentage of oil pollution class and pixels is size a large area covers year after year, however, proportion covers of oil pollution in 1989 in to 2008 direction for very low with oil production in oil fields is high , because in Iraqi unstable security situation[21] , reveal the statistics of supervised classification for proportion pixels of Kirkuk change's land cover in 1989 to 2019 and impacts on the Environment, show map No (7) and Figure No (2) .



Map No (7) Supervised Classification of image Kirkuk between (1989 – 2019)

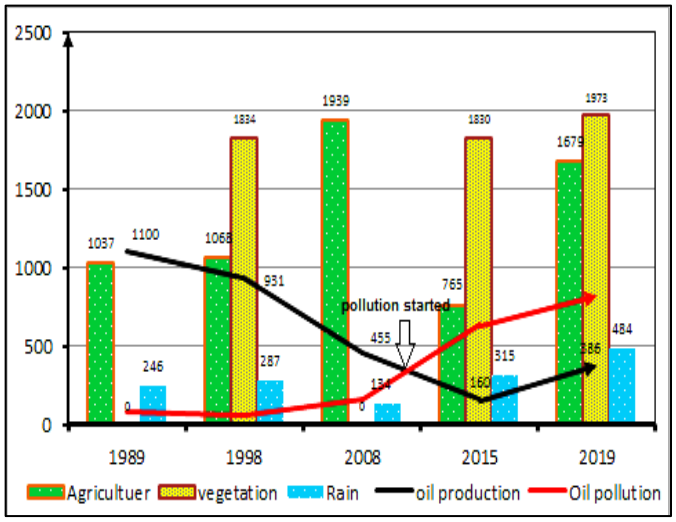


Figure No (2) supervised classification images of Kirkuk between (1989 - 2019) .

Explain Figure No (2) in 1989 to 2019 there was a decrease in oil production in Kirkuk (1100 to 386) and vegetation classes increase (%0 to %15) while there was an increase in land agricultural (%10 to %16).

In the results of remote sensing satellite image analysis and supervised classification in Kirkuk area shown that the dense oil pollution class(%6.4 to %8.3) which was the big area cover in 2015 to 2019,shown figure (2 and 3).

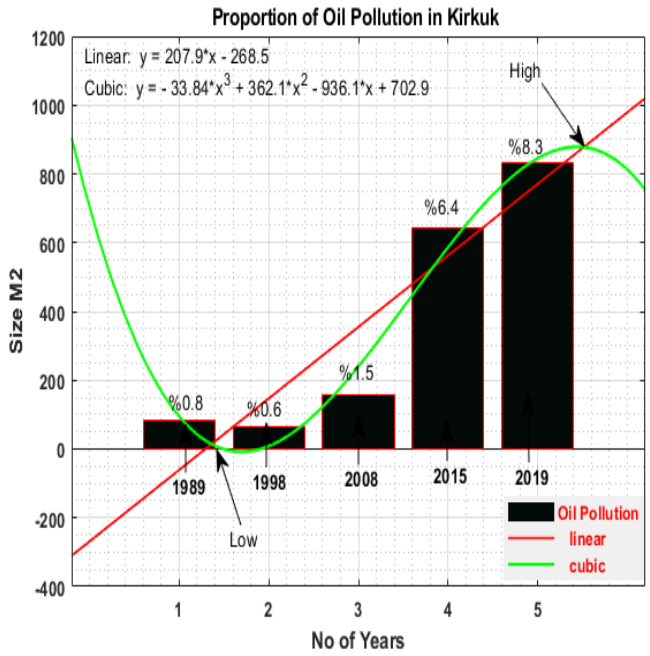
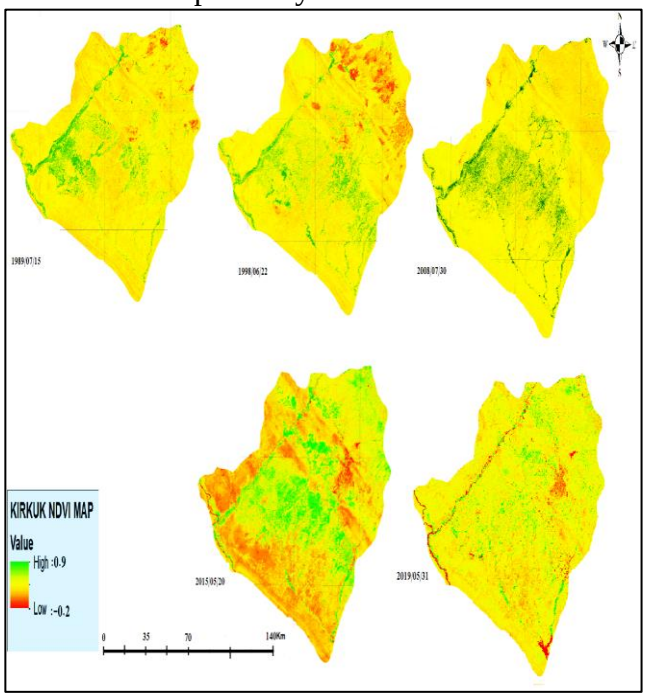


Figure (3) proportion of oil Spread in Kirkuk between (1989 – 2019).

In map (7) and Figure (2 , 3) signal the statistics of land cover in Kirkuk attributes and proportion of the image supervised classification for the oil production and its impacts on the land cover over five levels period of times, the outcomes display that degradation of agricultural class and Kirkuk vegetation has dramatically increased from 1989 to 2019, oil pollution and its impacts on the land cover in Kirkuk began in 2008 years.

3.3. Kirkuk NDVI Map :

In the results of the NDVI statistics analysis have shown in Map No(4,8)which explain the level area of land cover and non- land cover in square miles, coverage percentage for the years 1989, 1998,2008,2015 and 2019, and the shows change difference between 1989-1998 , 2008 and 2015 -2019 respectively.



Map No (8) Kirkuk NDVI Map between (1989 – 2019) .

The NDVI results indicate that vegetation cover high value has increased from 0.2 to 0.8 from 1989 to 2019 while vegetation area has increased, the shown map (8) and Figure (4) of (NDVI) data analysis shows and explain the different values of vegetation rate for each Landsat satellite images, for example, Landsat 5 TM 1989, the value of high and low vegetation is between (0.4+ and - 0.2) ,the Landsat 8 ETM+ 2019 shows (0.9+ and -0.2) and for the Landsat 7 , 2008 is between (0.9+ and -0.3) value near of 1 class the vegetation areas .

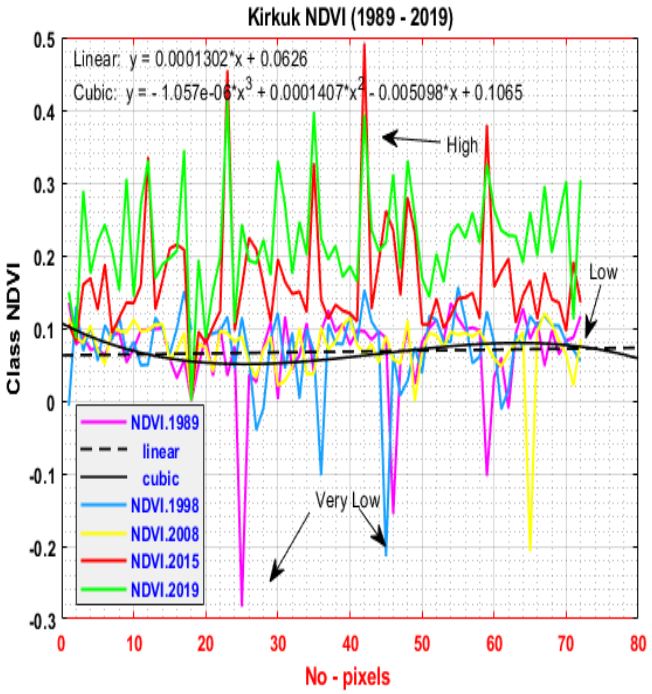


Figure (4) Kirkuk proportion NDVI (1989 – 2019) .

The results of remote sensing image analysis Figure (4) shown NDVI statistics analysis in Kirkuk have shown, the different values of vegetation rate for each images satellite Landsat in (1989 , 1998 , 2008 , 2015and 2019), a collection of factors that impacts on the value vegetation and land cover in Kirkuk for example (security situation , Rain percentage , spread oil , soil pollution)[22] .

CONCLUSIONS

This research aimed at applying remote sensing in discriminating image Landsat 5 - 8 and image pixels classification of oil polluted and land cover kinds using published oil spill sized incident records as the basis for formulating impacts on the land cover and validation in Kirkuk sites. In addition, NDVI and oil pollution Indices with

DOI:10.52113/uj05/021-14/1841-1849

image classification were fused and land cover with oil production in fields to support the reflect process on the vegetation levels in study area ,the conclusions of the changes importance showed that NDWI images and image classification are significant variables in distinguishing oil polluted and non-oil – land cover, especially in agricultural areas ,Kirkuk is one of the riche area a large oil reserves in Iraqi, the oil produced has continued from 1934 in to now, of course, oil production process impacted on the change land cover, this study shown there is a strong relationship between oil production and in land cover changes and oil pollution and impacts on the land cover in 2008 starte in Kirkuk.

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الخلاصة :

يعتمد كبيراً من الدولة الصناعية العالمية على الإستهلاك وإستخدامات النفط الخام كمصدر رئيسي للطاقة والمادة الخام في القطاع الصناعي , وهذه أدى الى التزايد الطلب العالمي على النفط الخام , وهذه تزداد من إستخدامات النفط تضغط على الدولة المنتجة النفطية يزايد من إنتاج النفط , تم إكتشاف النفط لأول مرة في تاريخ العراق إكتشفت النفط في كركوك من 10 تشرين الأول في سنة 1927 وبدأت بالحفر أبار النفطية , الأن يوجد في كركوك أربعة حقول المنتجة نفطية كبيرة مع ستة حقول غير منتجة ، حقول منتج نفط يتكون من أربعة عشر محطة منتجة للنفط ، وتتكون من 732 بئراً نفطية , وبلغت إنتاج النفط في حقول نفطية كركوك يوميا 386 برميلا , بدون شك هذه العملية إنتاج النفط تأثيره و أثاره كبيرا على البيئة من ضمنها تلوث التربة, ومن النتائج يظهره التأثيرات المنتجة النفط على تلوث التربة مثل تغيرات نوعية سطح الأرض أو تغيرت الغطاء النباتي ، ومن الهدف الرئيسي من هذه الدراسة هو تقييم وتحديد التلوث النفطي أو تأثيرات عمليات إنتاج النفط على الغطاء النباتي في كركوك بإستخدام إستشعار عن بعد , لغرض التحليلات التأثرات النفط على الغطاء النباتي وأستخدمت بيانات عشرة الصورة من النوعية الأقمار الصناعية لاند سات (5 - 8) من بين السنوات (1989 , 1998 , 2008 , 2015 , 2019) ويظهره العوامل التغييرات من الغطاء النباتي, وأظهرت النتائج وجود العلاقة القوية بين انتاج النفط وتلوث التربة وانعكاس عملية صناعة النفط على الغطاء النباتي في كركوك .