Remote Sensing and GIS Techniques for Monitoring Industrial Wastes for Baghdad City

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Abstract

The city of Baghdad is located in the central Mesopotamian plain of the Twin Rivers. According to the geological surveys, the whole area is covered by recent sediments of alluvial origin, deposited by successive floods of Tigris and Euphrates rivers, and by wind action. Since Baghdad city is the capital it surrounded by network of industrial areas for different purposes and this, affect the environment. Solid wastes generated from both animal and domestic sources can significantly impair drinking, irrigation, recreational water, other water sources and soil in rural and urban areas therefore it must be monitored and controlled very well to protect the wild life and environment and this represent the goal of research tool used for this purpose is remote sensing and Geographic Information System (GIS) due to their ability of monitoring and analyzing large amount of data. The techniques demonstrated in this research include procedures for developing regional spatial data into a coordinated GIS database, characterizing and identifying wildlife habitat, quantifying and assessing land use change, pollution due to changes in land use and demonstrating the application of these GIS and modeling methods for assessing cumulative environmental effects associated with landuse change.

Geographic Information System (GIS) and remote sensing techniques are used to monitor the environment in Baghdad city especially the industrial waste. Using GIS and remote sensing techniques in the environmental assessment give a quick and low cost. Preliminary investigation can be considered as aiding tools to the traditional and detailed investigation procedures.

1. Introduction

This research demonstrates several ways that GIS can be used as a tool for performing environmental assessment for Baghdad city. Over the past decade environmental analysis professionals have increasingly embraced the idea that in order to fully assess the impacts of a project on the environment a holistic approach is needed which can assess the additive and interactive responses to both single and multiple actions across time and geography. [1] Data capture technologies include as well remote sensing by satellites and airborne platforms. Satellite imagery of the land is received in various wavelengths so that particular aspects of the land surface can be characterized through image processing procedures. The integration of remote sensing and geographic information systems (GIS) has been widely applied and been recognized as a powerful and effective tool in monitoring environment. Geographic information system (GIS) technique provides a flexible analysis for entering, and displaying digital data from various sources necessary for environment feature identification, change detection and database development.

The objectives in this research can be summarized as following

- Monitoring industrial wastes in Baghdad city
- Producing digital maps for Industrial areas in Baghdad employing the capabilities of GIS and remote sensing techniques

2. Classification

Unsupervised classification is carried out by using satellite image of Baghdad _ IKONOS satellite sensor to show land use (1M spatial resolution) [2]

2.1unsupervised Classificatin (The ISODATA Clustering)[3]

The ISODATA method in unsupervised classification that uses minimum spectral distance to assign a cluster for each candidate pixel.

The process begins with a specified number of arbitrary cluster means or the means of existing signatures, and then it processes repetitively, so that those means shift to the means of the clusters in the data.

Because the ISODATA method is iterative. Figure (1) shows the classification result of applying the ISODATA clustering algorithm .

3. Industrial Areas in Baghdad City

Solid waste streams should be characterized by their sources, by the types of wastes produced, as well as by generation rates and composition [4].

The range of industrial wastes generated as broad as the manufacturing industries that generate them, and as the waste management options used - which combine recycling, recovery and disposal techniques.

In Iraq, large industries have mainly been in the oil / gas, petrochemical, fertilizers.

Medium-sized industries are likely to include electroplating facilities, tanneries, workshops and garages [5].

Based on Baghdad mayoralty records, small and medium sized enterprises, as well as some large ones, do not always have the expertise or the resources to ensure that the management of their waste does not have environmental impacts.

Manufacturing waste consists of food, wood, paper, chemical, non-metallic mineral, basic metal and other waste. The oil industries are major generators of a wide variety of industrial waste. Although industrial waste can include process waste, chemicals, ashes and other special and hazardous wastes, the industrial waste that could be accepted as part of the municipal solid waste stream should be limited to housekeeping wastes, packaging, food waste, construction and demolition materials and non-hazardous off-specifications products. All other hazardous industrial waste should be handled separately from the municipal solid waste stream [6].

Figure (2) shows the geographical distribution of industrial areas in Baghdad city with their descriptive data that will help in analyzing data later with accuracy depend on satellite image.

3.1 Production of Buffer for Industrial Areas Wastes around the land

The Geographic Information System (GIS) and the remote sensing techniques were used to monitor and detect the type of waste that is discharged. Baghdad city have suffered from rapid urban and random expansion over the last 60 years due to accelerated economic growth and other factors. The industrial areas are played a vital role in pollution of Baghdad city.

Satellite remote sensing collects multispectral data, and turns them into information valuable for understanding and monitoring industrial areas processes and for building urban land cover datasets. GIS technology provides a flexible environment for entering, analyzing and displaying digital data from various sources necessary for urban feature identification, change detection and database development. By using GIS techniques the industrial areas are classified according to the distance this helped in recognizing the pollution in the soil around the industrial areas.

Figure (3). Shows the distances values to center of industrial areas computed using spatial technique method that depend on taking coordinate from corrected image of Baghdad then making interpolation between these values.

After the buffer of distance is built then this buffer is tied to the quantity of waste help in producing thematic map contain information about the most dangerous industrial areas on the soil as shown in figure (4), a and b that shows the most dangerous areas

4. Normalized Difference Vegetation Index (NDVI)

Normalized difference vegetation index (NDVI) has been found to be a good indicator for vegetation cover and surface radiant temperature. It was found that there is inverse relationship between NDVI and surface reflectance. NDVI image was computed from red and near-infrared (IR) of LANDSAT image using the following formula [7].

NDVI= IR - RED / IR + RED	**1**

The original NDVI had the values between -1 to +1. Generally, residential and paved areas have low value of NDVI due to urban development which usually gives rise to a dramatic change of the Earth's surface, as natural vegetation is removed and replaced by non-evaporating and non-transpiring surfaces such as metal, asphalt and concert [7]. See figure (6) this figure help in producing values of NDVI

(Their range is +1to -1) and it uses in the comparation between reflectance of Radiometer and IKONOS Image

5. Comparison between reflectance of Radiometer and IKONOS Image

The Spectral Profile allows you to visualize the reflectance spectrum of a single pixel through many bands. This technique is particularly useful for hyperspectral data that can have hundreds of layers. It can be compared the profiles that you generate to those from laboratory (or field) spectrophotometers [8]. In the field the

radiometer is used to measure spectral profile. Aradiometer is a sensor that measures the intensity of electromagnetic radiation emanating from all objects within its field of view (FOV) and wavelength range.

The radiometer is one of the non-imaging instruments that measure electromagnetic radiation using optical techniques. The instruments are non-imaging in the sense that they do not produce a picture but rather integrate over time, space, and wavelength to produce a spectral curve . See Figure (7) which represents the location of the sample that is measured using radiometer.

Four filters were used in this research (as available), they have spectral band covering the range (0.42-0.780) micrometers, as shown in Table (1).

After the measurements of the radiometer are obtained then compared with the spectral reflectance of IKONOS

Table (1) Filters and bands used in radiometer

Band	**Range of Band (μm)**	**Peak (μm)**
Blue	0.420 – 0.530	0.486
Green	0.490 – 0.570	0.538
Yellow	0.470 – 0.650	0.580
Red	0.580 – 0.780	0.620

image of Baghdad for the same location Figure (8) shows Comparison between digital number of Radiometer and IKONOS Image.

6. Conclusions

1. The Babil 1 ,Babil2 ,Medical cotton factory ,and Electrical industry as shown in figure(2-4a) are more dangerous on land cover as a result of GIS analysis.
2. The integration of remote sensing and GIS was found to be effective in monitoring and analyzing environment patterns and helped in producing maps that illustrates the danger of industrial areas.
3. .The capability of GIS to produce overlaid information of more than one environmental property in the form of thematic map can help in representing the information and properties collected in a different prospective that take into account the combined affect of the properties used.
4. The digital image classification coupled with GIS has demonstrated its ability to provide comprehensive information on the nature, rate and location of environment monitoring

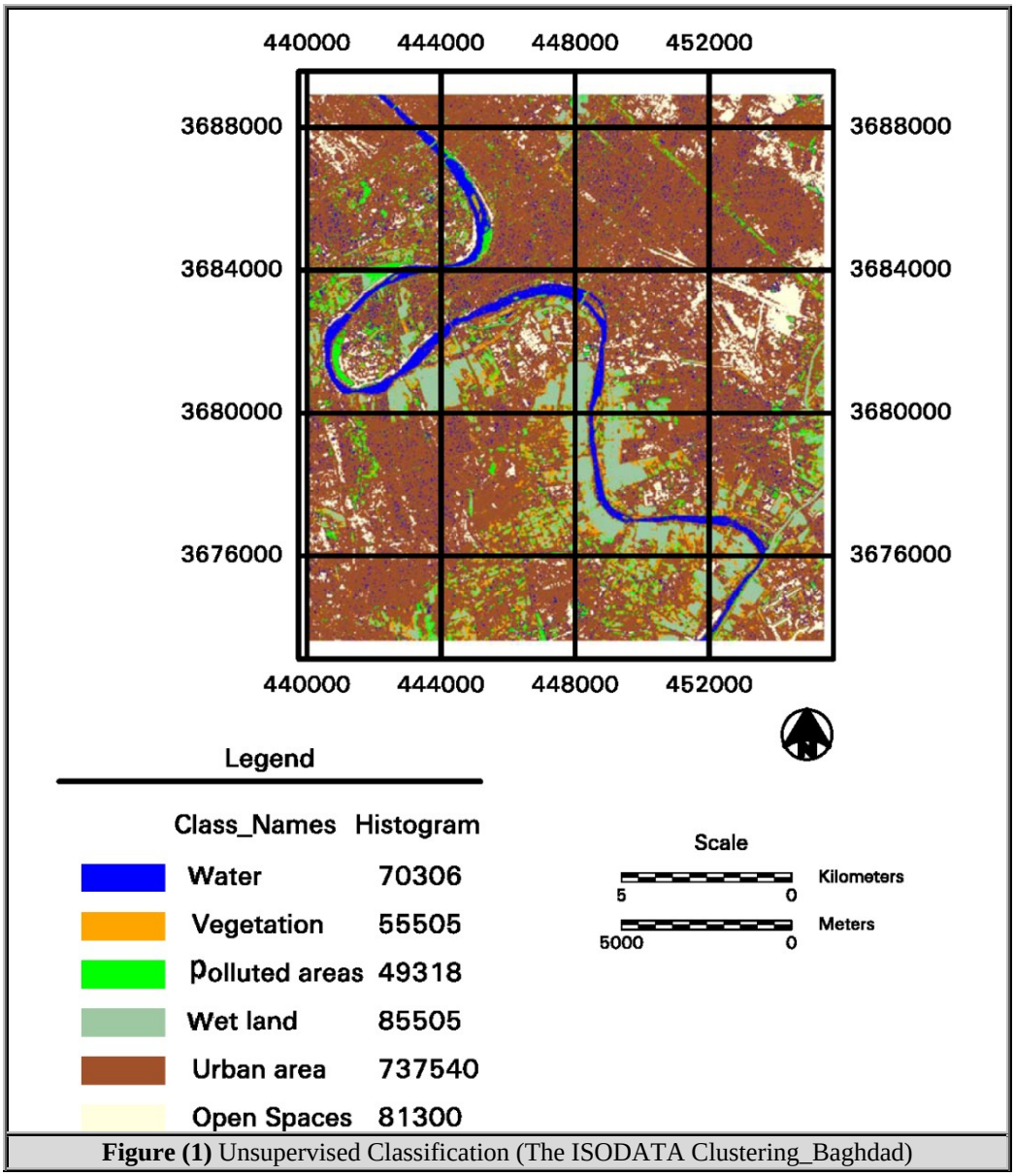

Figure (1) Unsupervised Classification (The ISODATA Clustering_Baghdad)

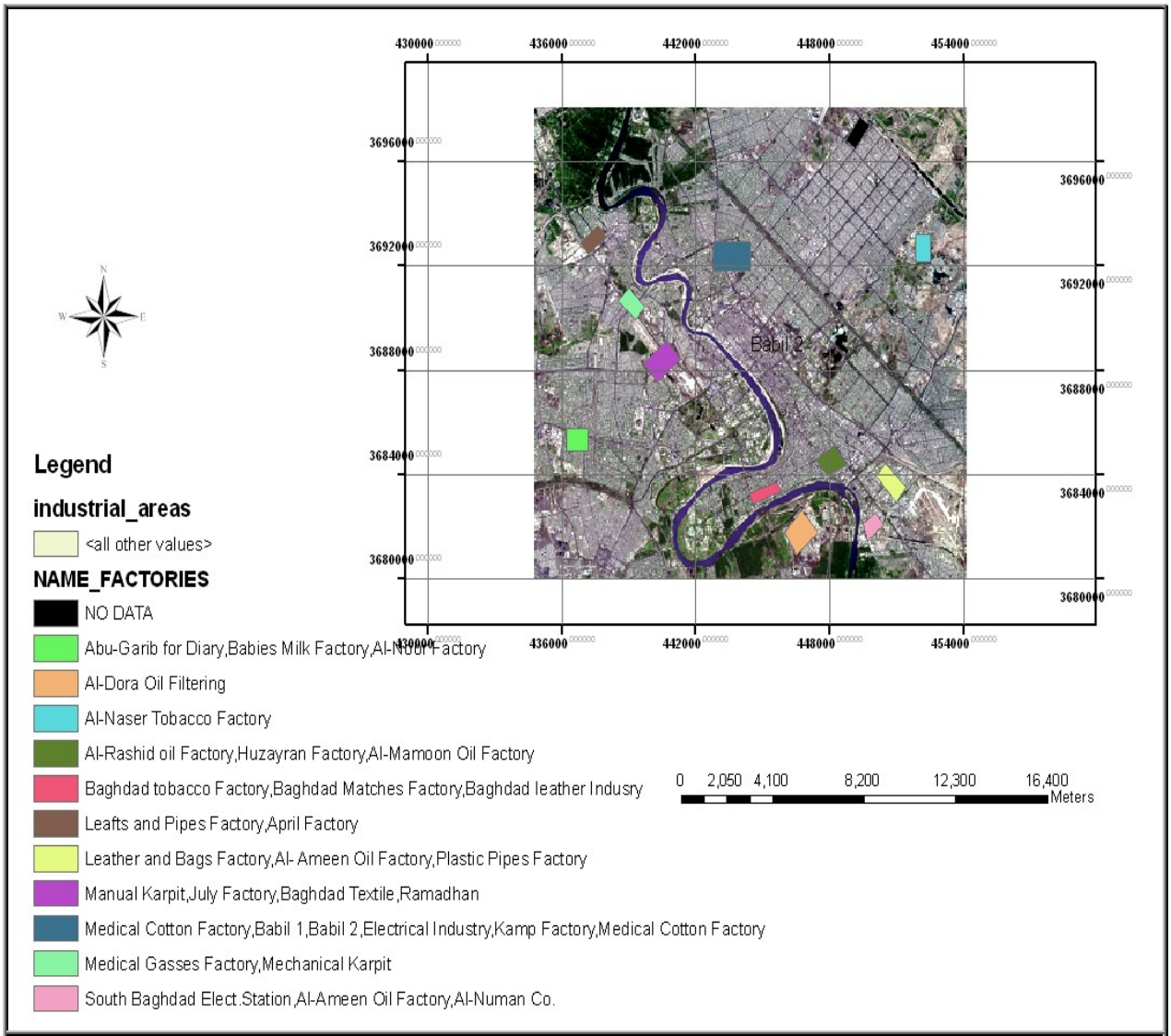

Figure (2) Industrial Areas in Baghdad City extracted from maps

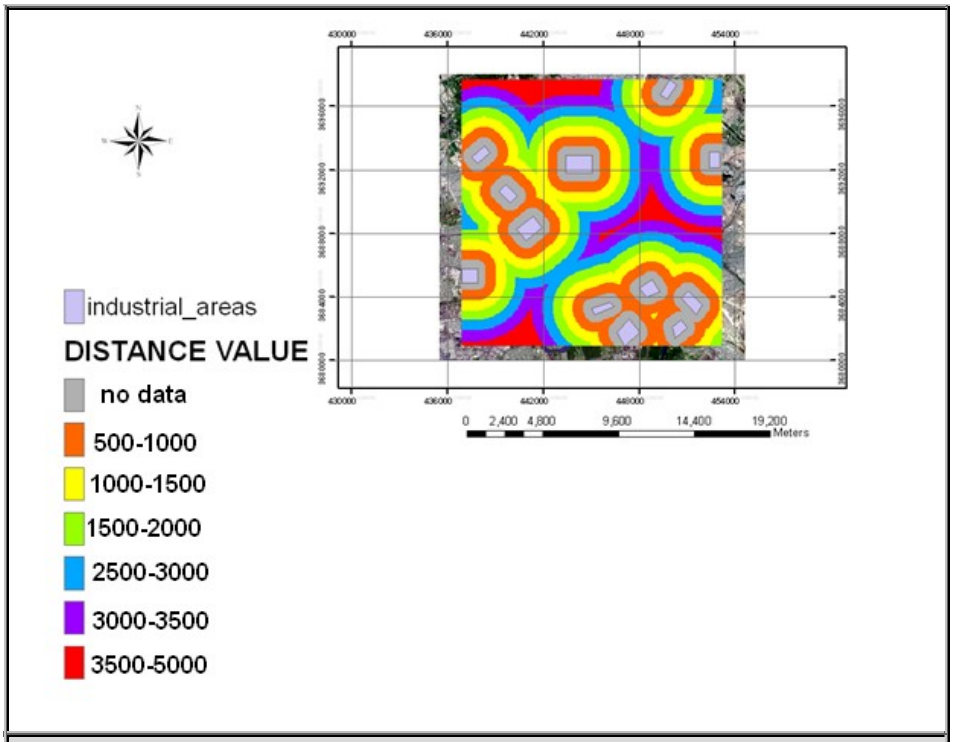

Figure (3) Buffer of Distance to industrial areas _the distances extracted from the satellite image using GIS

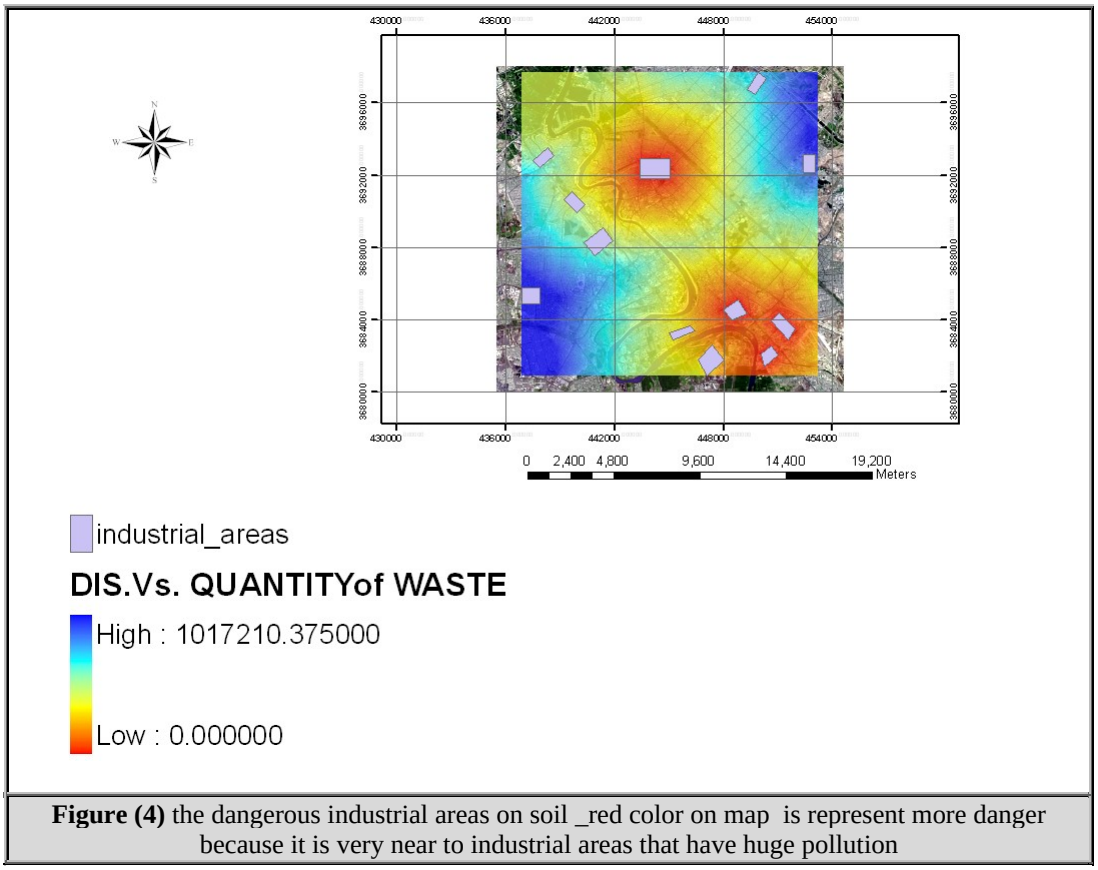

Figure (4) the dangerous industrial areas on soil _red color on map is represent more danger because it is very near to industrial areas that have huge pollution

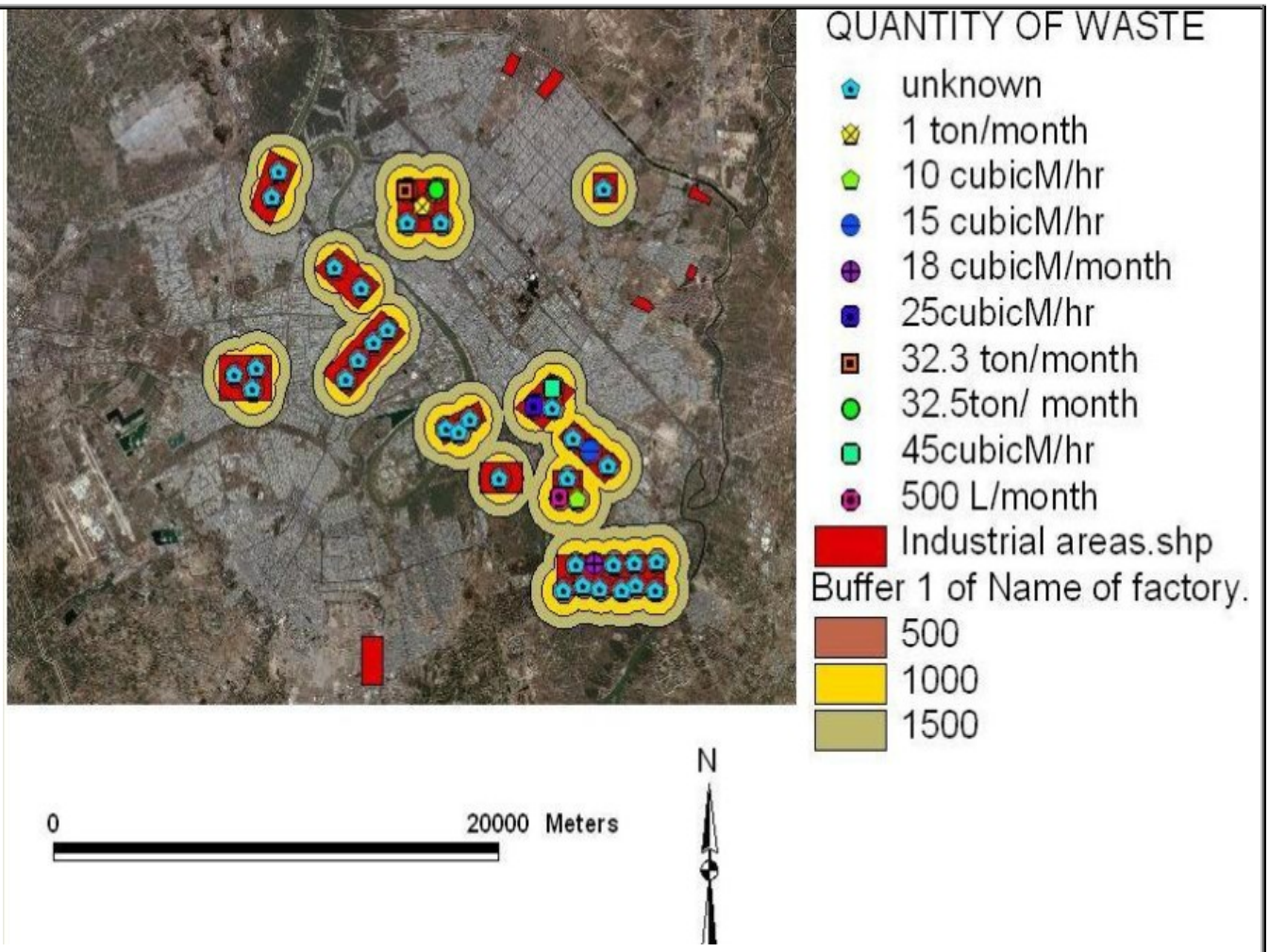

Figure (5) Quantity of Waste in Industrial Areas

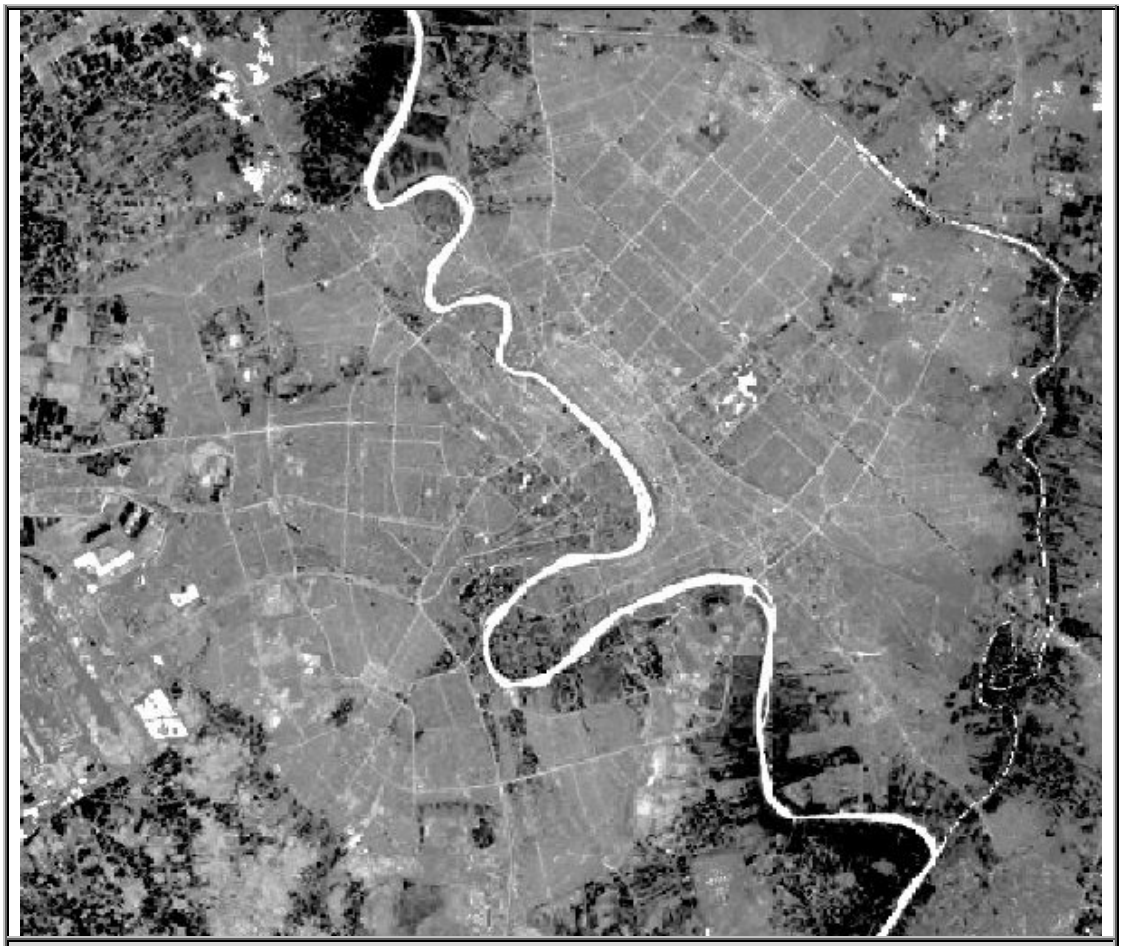

Figure (6) NDVI image

Figure (7) Location of the Sample

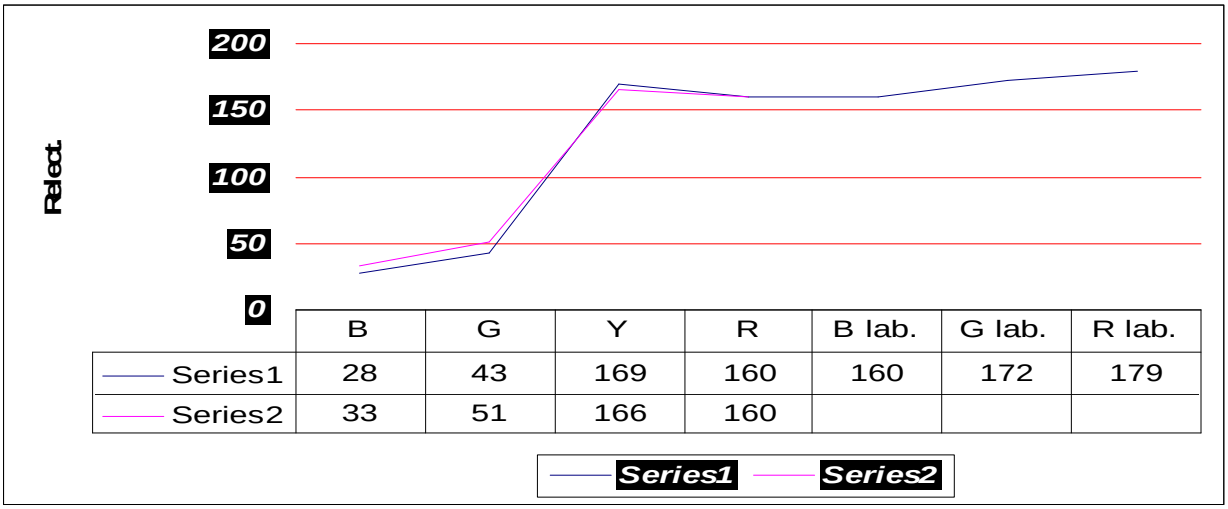

Figure (8) Comparison between digital number of Radiometer and IKONOS Image_(the B,G,Y,R are represent the bands of the radiometer)

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الملخّص

إنّ مدينة بغداد واقعة في وسطِ سهلِ الرسوبي المتكون بفعل النهرين الخالدين دجلة و الفرات. طبقاً للمسح الجيولوجي، المنطقة كاملة مغطاة بالرواسبِ مِنْ الأصل الغريني،المتكون بالفيضاناتِ المتكرّرةِ مِنْ نهرِ دجلةِ والفرات وبعملِ الريح. لان مدينةِ بغداد العاصمةُ أحيطتْ بشبكةِ المناطق الصناعيةِ للأغراض المختلفةِ وهذه تُؤثّرُ على البيئةِ في بغداد.ان للمخلفات الصلبة تأثير على تلوث مياه الشرب و السقي و مياه الترفيه و مصادر المياه الأخرى والتربة في المناطق الحضرية والريفية لذلك يجب مراقبتها و السيطرة عليها بصورة جيدة لحماية الحياة البرية و البيئة وهذا يمثل الهدف من البحث نظام المعلومات الجغرافية (GIS) وتقنيات التحسس النائي ْ تُستَعملُ لمُرَاقبَة البيئةِ في مدينةِ بغداد لقدرتهما على مراقبة و تحليل كمية كبير من البيانات.القنيات المستعملة في هذا البحث تتضمن ما يلي نقل البيانات المكانية الى قاعدة بيانات،تمييز الحياة البرية للبيئة ، ربط التلوث بالتغير في استعمال الارض و اعطاء نموذج لتقييم التاثيرات البيئية المرتبطة بالتغير في استعمال الارض. إستعمال نظام المعلومات الجغرافيةِ وتقنياتِ التحسس النائي في التقييم البيئي يوفر تحقيق كلفةِ سريعةِ ومنخفضةِ ويُمْكِنُ أنْ يُعتَبرَ كأداة مُسَاعَدَة إلى ألادوات التقليديةِ التفصيلية الاخرى.