International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 3 Issue 3, March-2014, pp: (405-412), Impact Factor: 1.252, Available online at: www.erpublications.com

Spatial assessment of Geo-environmental data using remote sensing and GIS techniques for Rania Area, Sulaimani Governorate, Kurdistan Region - Iraq

Azhar Kh. S. Bety[1], Saad S. Kh. Aubaid[2]

[1]Department of Geology, Faculty of Science, University of Sulaimani

[2]College of Education Alhamdania, University of Mosul, Iraq

Abstract: Techniques of remote sensing and geographic information systems (GIS) have been applied to Rania area, which it located within the administrative boundaries of the Sulaimani City, Kurdistan Region - Iraq, for the analysis and interpretation of the Geo-environmental assessment of the study area. Satellite data TM-Landsat5 and Digital Elevation Model (DEM) has adopted in this study in order to produce a set of thematic maps. Software for remote sensing and geographic information systems were adopted in the analysis, classification and interpretation of these thematic maps in order to get to the building of the Geo-environmental assessment map of the study area.

Introduction

The Geo-environmental information are one the foundations in geomorphological application by highlighting the value of its spatial and find out the most important determinants of the qualifications that lead to the development of standards for appropriate and susceptibility ground, following the method of analysis of the spatial relationships between the phenomena and to ensure that the interpretation of spatial relationships and take advantage of them and understand the reasons for the presence and distribution of phenomena on the Earth's surface and predict the behavior of such phenomena in the future (Sharaff, 2008). The analysis process gives a clear picture of the natural compound of the earth's surface and characteristics of interest to the rights and various activities such as topography, geological and geomorphological processes, as well as the properties of rocks, soil, water and natural vegetation, all of these are represented in the special maps, especially the classification of the land to form the inputs necessary for the purpose of assessing land uses to determine the optimum each item in order to evaluate it environmentally (Gkaneem & Abo-Zanta, 2009).

The effect of environmental elements sensitive to find the variation in the characteristics of ground units are differ proportion to spatial distributions, therefore, any land is valid to use a particular line and the reality if the prevailing level currently determined by the environmental elements sensitive and degree of changes initiated by the environment (Albana,2000). Remote sensing and GIS techniques were used in the natural evaluation of study area through on their maps for the purpose of spatial assessment like the map of soil classification which prepared by the FAO (FAO,2003) and portability of agricultural land in Iraq which prepared by (Al-Tai, 1990). Digital Elevation Model (DEM) also used to determine the characteristics of the surface and declinations. TM Landsat 5 with 30 meters resolution used to assess the land cover and land use in the study area by using Erdas Imagine Programs V.9.1. The problem of research lies in the possibility of the estimating the techniques of remote sensing and geographic information systems in the evaluation of the natural data for the study area spatially as well as determine the appropriate in grades for the appearance of the ground and in line with the reality of the region.

Aims of the Research

The research aims to assess the extent of the natural spatial data and determine the appropriate degrees of ground for the study area by drawing on contemporary technologies to see ratings for this spatial data through the following:

1 - Evaluation of the natural data and their Geo-environmental implications.

2 - Analysis and assessment of land cover and land use depending on the TM satellite image of the study area.

3 - Uses of Erdas. V 9.1 and ArcGIS.V 9.3 software's in preparing a map for environmental assessment and appropriate ground and employability.

4 - Preparing thematic Geo-environmental map to determine the reality of the region environmentally.

Research Hypotheses

The search starts from the premise that the natural area data has a significant impact on the Geo-environmental situation of the study area.

Research Methodology

The research methodology and style of work involved several steps marked by the following:

1- Geographical Location

The area under investigation is located about 130 km from the NW of the Sulaimani City, Kurdistan Region-Iraq, Fig (1). The study area located between longitude (45°00'00" and 44°31'00") E and between latitude (36°10'00" and 36°31'00") N, and covering area estimated by 793 km^2, with height ranging from 532 in the southern plains near Dukan Lake to 2500 m above sea level in the mountainous area in the north.

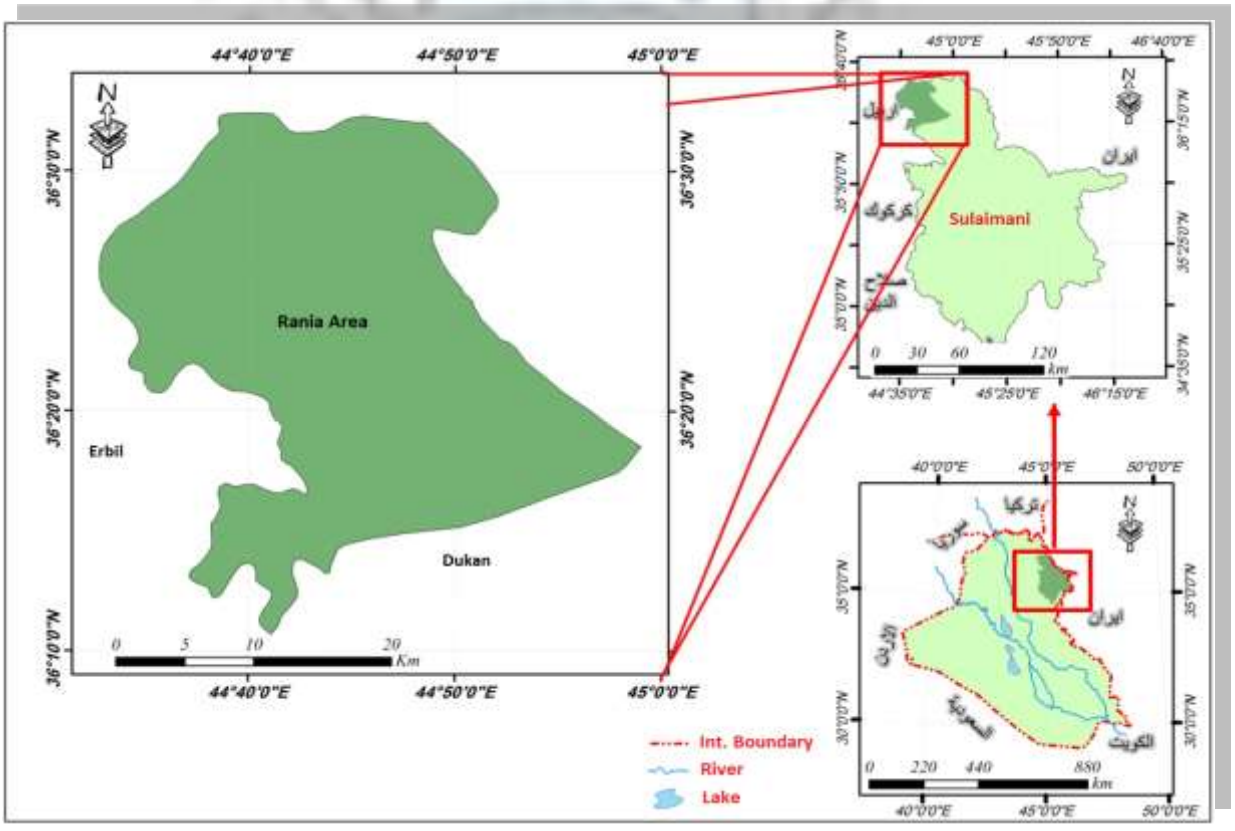

Fig (1) shows the geographical location of the study area.

2- Geological Setting:

According to tecto-structural conditions and physiographical classification the area of study lies within the unstable plateform, high-folded zone, Sulaimaniyahya-Zakho subzone (Jassim and Goff, 2006) Fig. (2), and in the Qamchuqa-Rania subzone according to (Buday and Jassim, 1987).

Tectonically, the study area is located in the Zagros Fold-Thrust Belt, directly to the southwest of the main Zagros Suture Zone, (Buday, 1980, Buday and Jassim, 1987 and Jassim and Goff, 2006).

Hydrologically, the district is situated in the Dukan sub-basin which is a sub-basin of the lower Zab basin (Jawad, 2008).

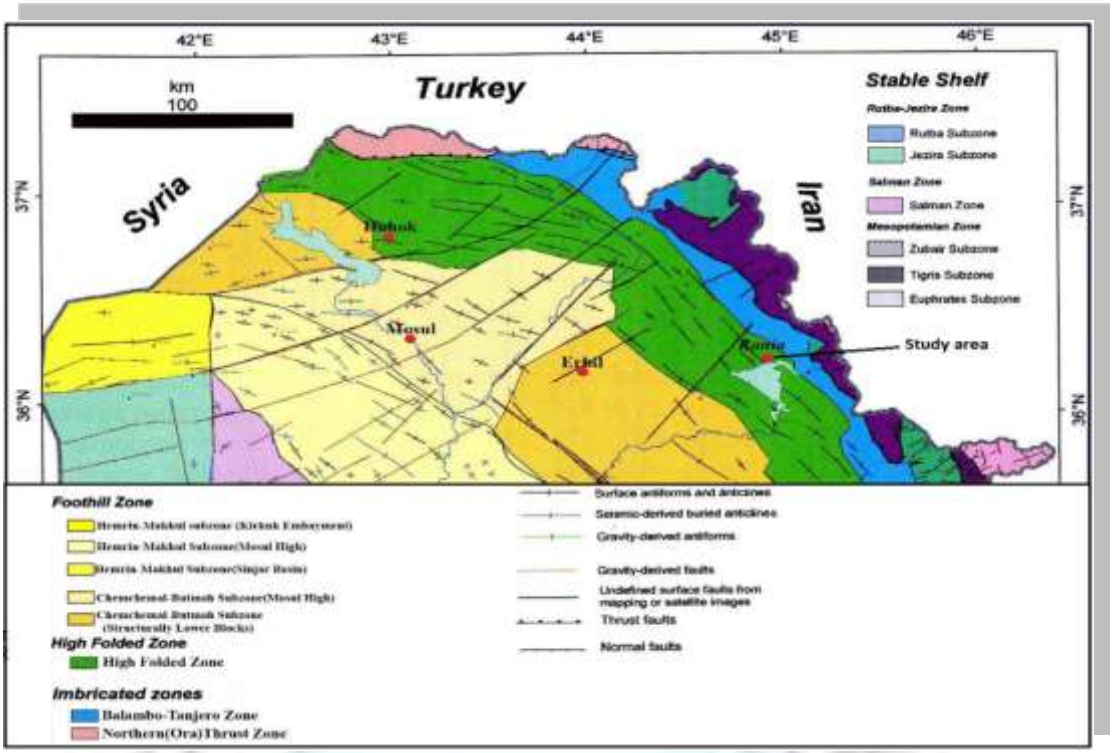

Fig (2) shows the geological location of the study area.

The areas of study representing the Northeastern limb of shaweri anticline, formation of this area mostly are Jurassic formations. Jurassic period of Rania area is divided in to (early, middle, and late Jurassic). In Iraq the early Jurassic representing by a sequence of many formations, (Sarki , Sehkanian, Baluti, Adayah and Alan) formations but in the imbricated and high folded zone we can see only (Sarki and Sehkanian) formations in the Rania area. Rania area composed of different geological rock units, which are shown in Fig. (3). The Quaternary deposits covered a wide area of the Rania plain. The age of these deposits is Pleistocene. They composed of alluvium fan, river terraces, and floodplain deposits, which usually consist of clay, loam, silt, sand and conglomerate, poorly sorted containing a weathered product of the mentioned formations.The geological structures affect on the earth form, as well as, on the quality of the rocks and soils that invest in agricultural operations in particular. Also the geological situation has impact on the amount of groundwater in the region.

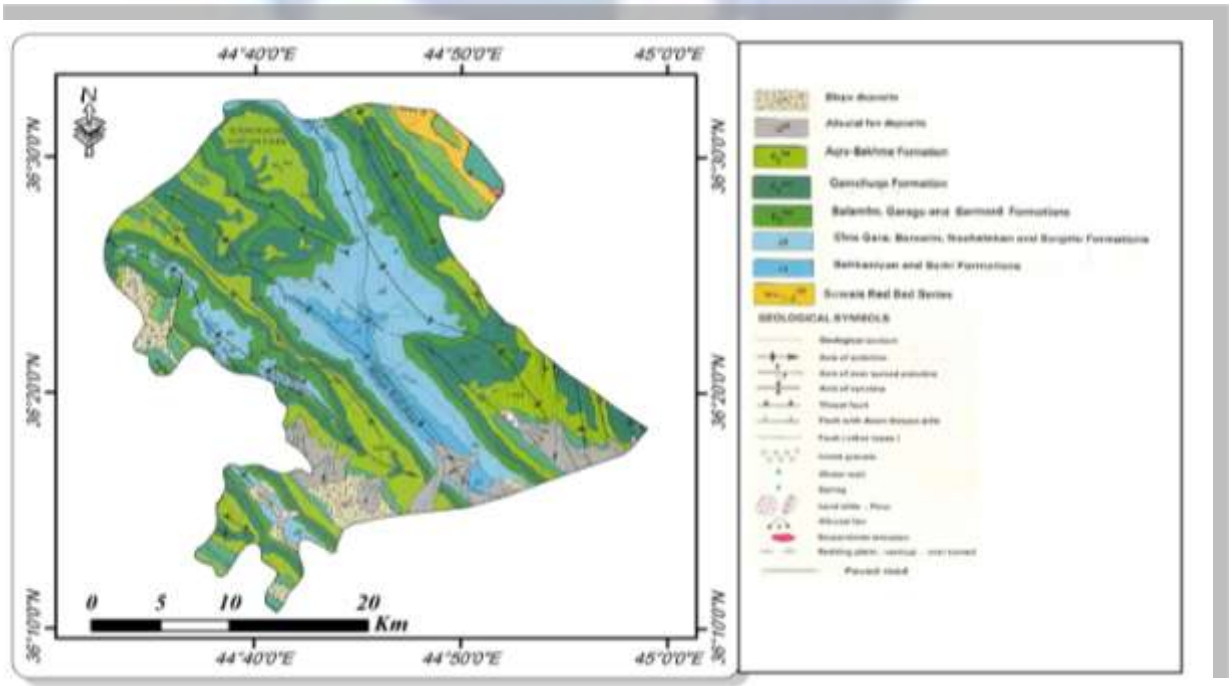

Fig (3) shows the geological map of the study area, (After Sissakian, 997).

3- Terrain analysis:

A DEM is used for the terrain analysis within study area. The DEM is composed of elevation data originally derived from land surveying, aerial photography or satellite images, or derived from contours on topographic maps. A DEM is a numerical representation of terrain elevation; it stores terrain data in a grid format for coordinates and corresponding elevation values (Shamsi, 2005). DEM structure best reflects processes of erosion and deposition mimics paths of steepest gradient (Moore 1991). DEM of the area with 30m resolution shows the difference in surface elevation above sea level; the DEM used in this research are shown in the Fig. (4).

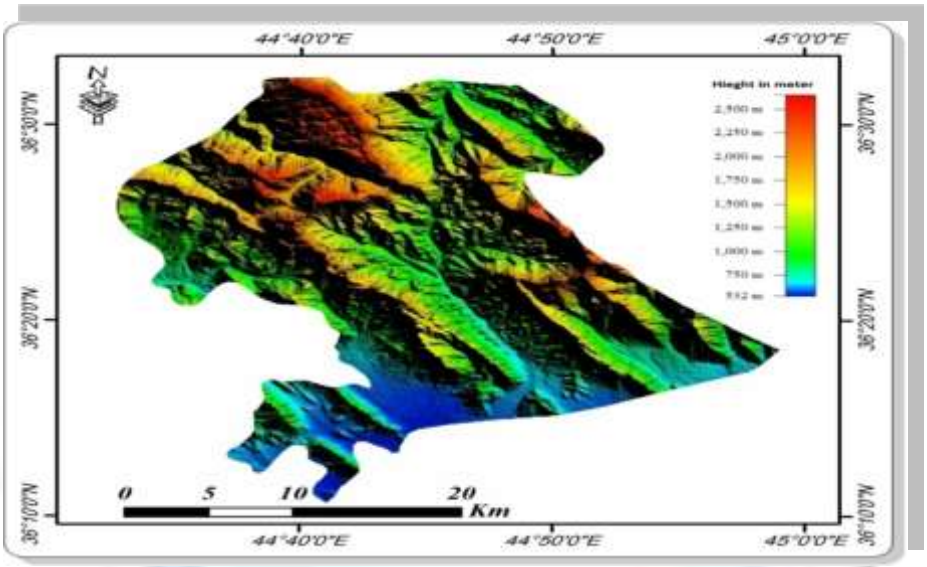

Fig (4) shows the DEM of the study area.

4- Slope:

Landscape tilted on the horizon at an angle called the angle of slope of the surface. It represents sites that occur by the processes of erosion and sedimentation significantly (Finalayson and Statham, 1980). In addition, the slope has an important role in any area; this importance is determined through its impact on the forms of drainage patterns and its effect on the operations of removing, transporting and depositing of soils, as well as its impact on growing vegetations. Slopes play an important role, which must be taken into consideration when considering the establishment of any engineering, irrigation, transports, and residential projects during expansion stages. Calculating slope from a DEM is relatively simple, but attention must be given when selecting an algorithm. ArcMap slope tool calculates the maximum rate of change between each cell and its neighbors, for example, (ESRI, 2008). Recently, slope and many other parameters like aspect, hillshad, and contour line will be extracted digitally from special data by using some remote sensing and GIS programs. The results of the application of this method are displayed in Fig. (5).

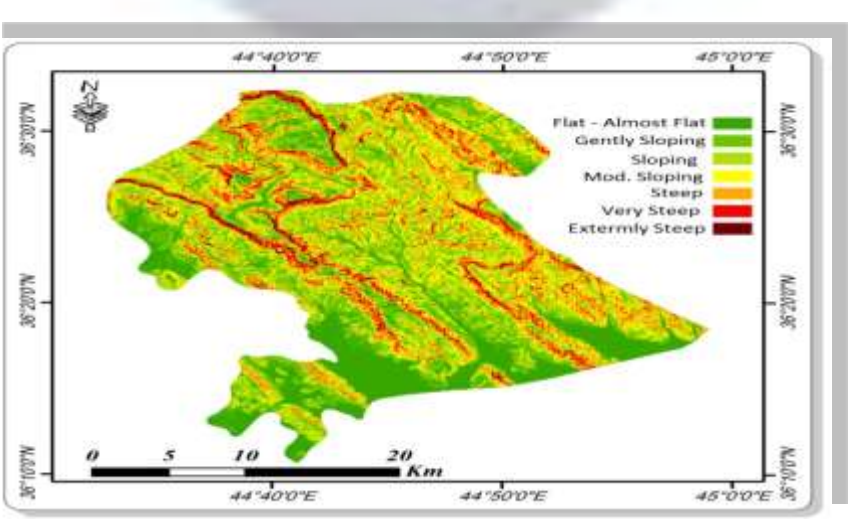

Fig (5) shows the classification of slope within the study area

According to ITC classification, (Zuidamm & Zuidamm, (1979), the slope map of study area shows seven classes of slope, for each classes the area were calculated and the result of analysis was put in the table (1).

Table (1-1) shows the slope classes and their area.

Class Name	Slope Degree	Area km^2
Flat –Almost Flat	0-1.14	141.18
Gently Sloping	1.72-4.0	162.13
Sloping	4.57-7.41	166.32
Moderately Steep	7.97-11.30	142.26
Steep	11.85-28.8	112.62
Very Steep	29.2-54.46	55.06
Extremely Steep	>54.46	13.58

In all of the above, the study area suffers from severe environmental risks represented in the steepness of the surface, making it suffer from the problems of water erosion, especially if we know that winter in the area of study are snowy and rainy. This is what we observe through the categories of moderately steep to extremely steep area, which is concentrated in the highland areas, or rather the tops of the mountains, which are exposed to continual water erosion because of the amount of rainfall received by the area during the winter or spring on either end.

5- Susceptibility land

Soil is an important component of the natural environment, which represents an important place, cannot be dispensed with in agricultural production processes. The importance of soil being in the provide plant with nutrients important for growth. The susceptibility of land classified to eight classes, they expressed by Romanian numbers from I to VIII, these items are located in the two groups. The first one contained classes from (I to IV), which is convenient for use for agricultural purposes. The second group covered classes from (V to VIII), which cannot be used for agricultural purposes with usual ways (Al-Mashhadany, 1994), because of the risk of erosion increasing with increase of land susceptibility, that shows with the map of land susceptibility (after Dr. Falih Hassan, 1990). Fig (6) shows the map of land susceptibility within the study area. Tobacco, wheat, barley, sunflower, etc…. farming is popular in the study area as a field crops.

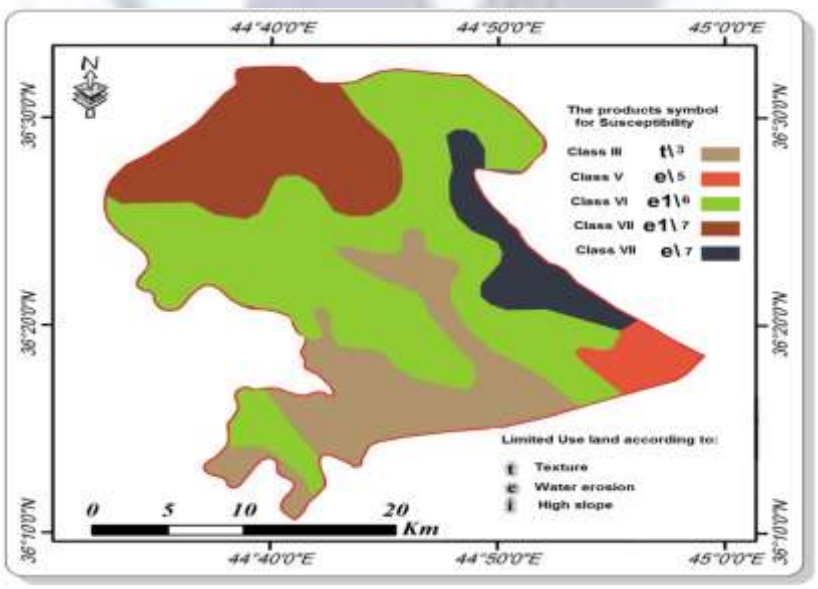

Fig (6) shows the map of land susceptibility in the study area, (After A-Tai 1990).

6- Land Cover and Land Use (LCLU) of Study Area:

TM Landsat satellite image, Fig(1-6), was used to produce the LCLU of the study area, the pre-processing were done with image, thin suitable bands were selected with band compensation and those bands have the higher coefficient of difference on the visual expression and perception cartographic through an optimization process for the visible spectral satellite.

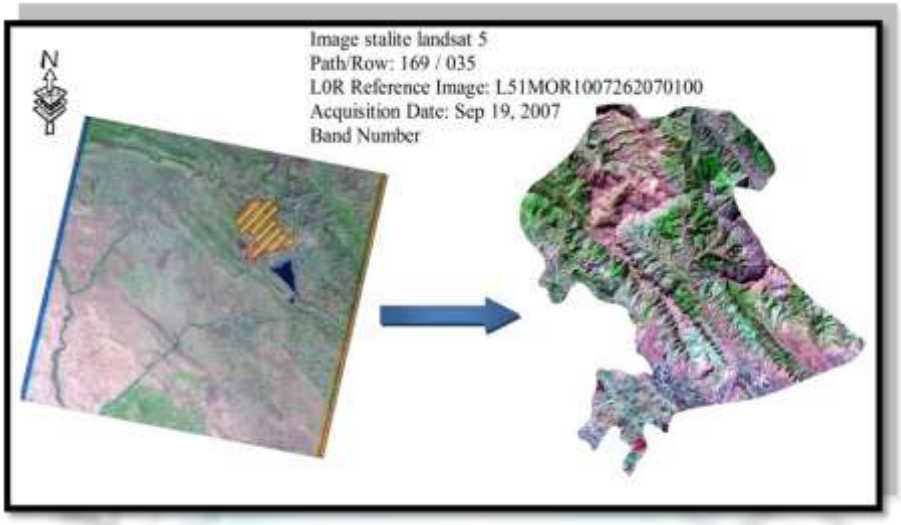

Fig (1-6) shows the TM satellite image of the study area.

Digital classification process was done with the satellite image after identifying areas of ground samples. Supervise classification is used with two stages, the first stage include the selected samples within study area by unsupervised classification of the TM image, the second stage is include samples which been identified for training (Training Area) and thin the spectral signature were taking from those samples by using the ERDAS Software Program. After that the LCLU map of the study area was produced, Fig (7).

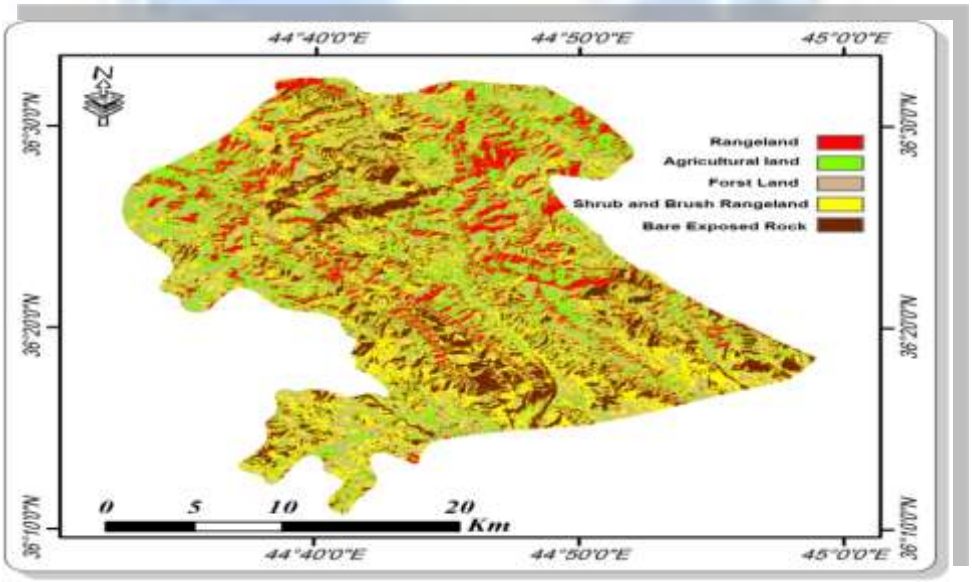

Fig (7) shows the map of LCLU of the study area.

7- Geo-environmental Map of the Study area:

The process of mapping classes' informatics are one of the main topics of the Geo-environmental assessment by degrees of risk, with which they can identify land and degrees of environmental assessment through scientific modeling for a cartographic maps produced and mentioned in the search. The Fig (8), shows the stages used in this research to publish the Geo-environmental map of the study area.

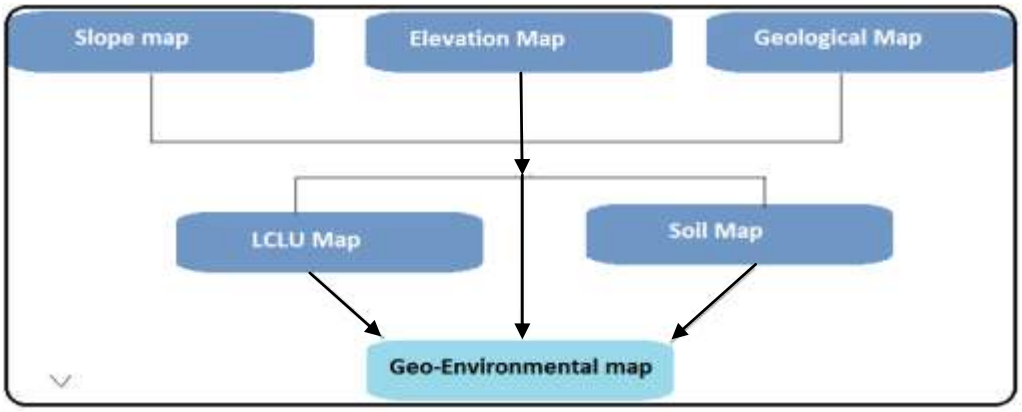

Fig (8) shows the stages used to publish the Geo-environmental map

The ITC system is used to construction of maps of the environmental assessment and by degrees of risk and benefit from the environmental assessment processes. Spatial analysis tools are used in the matching of maps to construct the main map, Fig (9), which showing three classes of risk geo-environmental land depending on the visual perception of Excellence Geo-environmental data for the Rania area by using remote sensing and GIS techniques.

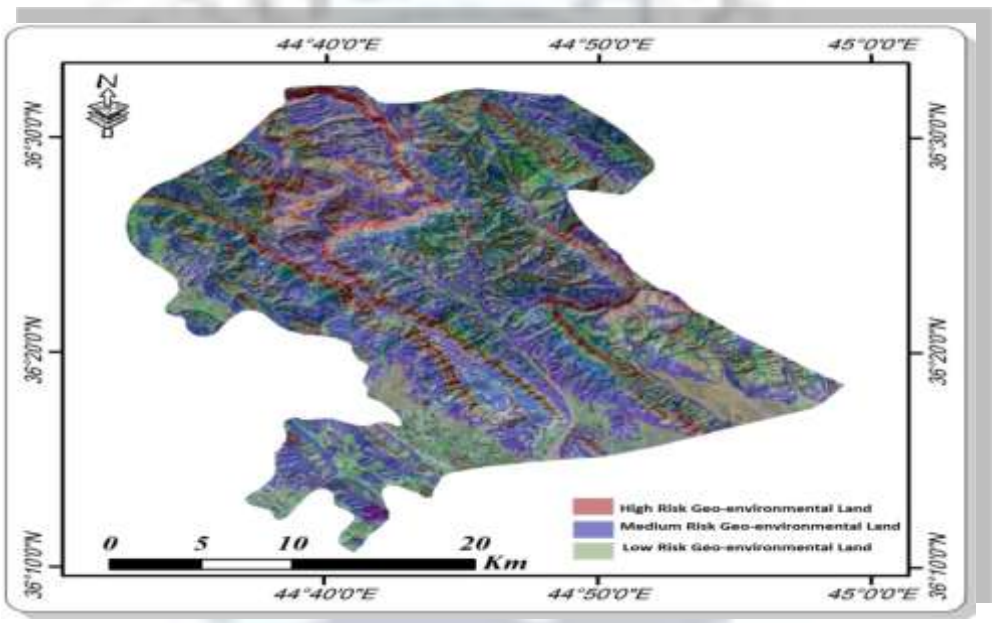

Fig (1-9), which showing three classes of risk geo-environmental land

Conclusions

After reviewed the research methodology and the stages of this work, the most important conclusions can be mentioned as follows:

1- The geological situation has affected on the general landscape of the study area.

2- The diversity of the terrain characteristics had a major role in the diversity of recipes and types of soils that are based on the geological structure, also helped to diversity in land cover and use of agricultural land in the region.

3- The remote sensing and GIS techniques show a good ability to constructs different thematic maps in this kind of studies.

4- Low risk geo-environmental land mostly covered area of Quaternary deposits especially with area of alluvial fan deposits.

5- Medium and high risk geo-environmental land distributed with area of other formation with the study area, mostly the high risk shows area of faults and thrust faults.

Reference

[1]. Al-Banna, A. A., (2000). Environmental problems and conservation of natural resources in the study of the geographical Applied, Dar Alfkir Al-Arabey , Cairo, p. 106.
[2]. Al-Mashhadany, A. S., (1994). Survey and classification of soil, Dar AL-Kuttib Pub. House. University of Mosul, Iraq.
[3]. Al-Tai, F. H., (1990). Map susceptibility of agricultural land in Iraq, the Ministry of Agriculture and Irrigation, scale 1000000 \ 1, Baghdad.
[4]. Buday, T., and Jassim, S.Z., (1987). The regional geology of Iraq, Vol 2, (Tectonism and magmatism), GEOSURV, Baghdad, Iraq, 352P.
[5]. Buday,T., (1980). The regional geology of Iraq, Stratigraphy and paleogeography, Dar AL-Kuttib Pub. House. University of Mosul, Iraq. 445 P.
[6]. ESRI, (2008). Environmental Systems Research Institute (ESRI), (2008) Arc/Info, version 9.3, Online Users Guide.
[7]. Finlayson, B. & Statham, I. (1980). Hill Slope Analysis (source and methods in geography), 1 st ed., Butter Worth & Co.(publishers) limited., London, 230 P.
[8]. Food and agriculture organization of the United Nations Fao/unesco , (2003) Version 3.6, completed in January, 2003.
[9]. Gkaneem, O. M., & Abo-Zanta, M., (2009). Sustainable development - philosophy and methods of planning and measurement tools, Dar fineness for publication and distribution, Amman, Jordan. P. 191.
[10]. Jassim, S. Z. and Goff, T., (2006). Phanerozoic development of the northern Arabian Plate, In: Jassim S.Z., Goff, J. C., Geology of Iraq, publication of Dolin, Prague and Moravian Museum, Brno, 341p.
[11]. Jawad, S.B., 2008. Toward a National Groundwater Monitoring Network. Proceeding from the first conference on Environmental Challenges in Iraq, Iraq- Sulaimani, 11-12/1/2008.
[12]. Moore, I.D. (ed.) (1991). Digital terrain modelling in hydrology, Hydrological Processes 5.
[13]. Shamsi, U. M. (2005). GIS applications for water, wastewater, and storm water systems, Taylor & Francis Group.
[14]. Sharaf, M. I.,(2008). Spatial Analysis Using Geographic Information Systems, Dar Al-Maarfa for printing, publishing and distribution, Egypt, P51.
[15]. Sissakian, V. K., 1997. Geological Map of Arbeel and Mahabad Quadrangles, scale 1:250000. State Establishment of Geological Survey and Mining, Iraq-Baghdad.
[16]. Zuidamm R. A. & Zuidamm C. F. (1979), "Terrain Analysis and Classification Using Aerial Photographs. Ini ITC Textbook of Photointerpretation", ITC , Vol,VII-6, ITC, Holland, Netherlands, P.130.