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Performance of Supervised Classification for Mapping Land Cover and Land Use in Jeffara Plain of Libya

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Abstract. Different methods accessible for remote sensing image classification; they include supervised, unsupervised and fuzzy classifications. This paper investigates the performance of the supervised classification on remote sensing data for land cover/ land use in North-West Region of Jeffara Plain of Libya. The study used SPOT 5 satellite image taken on January 2009 as a main data. Maximum likelihood classification (MLC) which is based on the probability that a pixel belongs to a particular class were chosen to classifying land cover data/ land use in the study area. The land cover /land use classes for the study area were classified into 5 homogeneous land cover classes of a single land cover and 4 heterogeneous land cover classes. Ground verification was applied to verify and evaluate the accuracy of supervised classification. 48 field points were collected using Systematic Random Sampling. The results showed that 65 % of the study area was classified into heterogeneous land cover classes, while 25 % of the study area classified into homogeneous land cover classes. Derivation heterogonous or mixed land cover classes from the use supervised classification (i.e. crisp classification) led to producing uncertain or vague land cover classes in the study area. For future work, the authors will test the fuzzy image classification to derive land cover and land use data in the study area.

Keywords: Supervised classification, spot image, land cover /land use, Jeffara Plain

1. Introduction

Remote sensing is the activities of recording, surveying, and perceiving objects or events in remote places. The technology of remotely sensed data was developed gradually into a scientific topic after the Second World War. It has been driven by three interrelated factors: (a) improvements in sensor technology and information quality, (b) improved and standardized remote sensing techniques, and (c) research applications [1], [2]. In the last three decades, satellite images became the main sources of information because they can also be utilized for different applications such as agricultural, desertification, monitoring land cover change, monitoring urban growth, forestry, hazards, natural disasters, oceanography, water resources, observing settlement expansion, and so on. Remotely sensed data is a very essential application in land use planning and management. It is a helpful tool for land use/ land cover identification and classification of various features of the land surface in an image received from satellite [1], [3]. It provides a reliable information about the characteristics of various land areas and their behaviour under different land uses. Land use planning has become more and more important for local authorities to better manage the environmental resources and get closer to sustainable conditions. However, there is a need to evaluate the techniques locally in terms of effectiveness and simplicity. Therefore, this paper aims to test supervised classification for classifying land cover/ land use data in North-Western region of Jeffara Plain in Libya.

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2. Background

2.1. Land Cover and Land Use Definitions

Land cover refers to the biophysical state of the earth’s surface and immediate subsurface, containing soil, topography, surface water and groundwater, and human structures. It illustrates both natural and human-made coverings of the earth’s surface. The relationship between land use and land cover is not always direct and apparent. A single category of land cover may support many uses, while a single land use could involve the maintenance of several distinct land covers. Examples of land covers include forest, grassland, cropland, wetland, urban structures, and so forth [3]-[6].

2.2. Image Processing

Image processing systems are a key component of the infrastructure required to support remote sensing applications and have improved in number and capability in the last 30 years. Advancements in computer technology have clearly assisted the development of image processing systems. Remote sensing applications have clearly benefited from the recent phase of development, which has focused on accessibility, integrated with GIS programmes, and increased availability of methods for automated processing of remote sensing data [2], [6].

2.3. Image Classification

There are a number of image classification methods for land cover and land use data such as unsupervised classification, supervised classification, and fuzzy classification. Supervised classification employs such methods as minimum-distance-to-means, parallelepiped, and maximum likelihood classifiers (MLC). Identifying known a priori through a combination of fieldwork, map analysis, and personal experience as training sites; the spectral characteristics of these sites have used to train the classification algorithm for eventual land-cover mapping of the remainder of the image. Each pixel both within and outside the training sites is then evaluated and assigned to the class of which it has the highest likelihood to be a member [7].

3. Materials and Methods

3.1. Study Area

The Jeffara Plain is one of the most important coastal plains in Libya both strategically and economically. The area for this work lie within the Jeffara Plains and located in a region between Tripoli and Al- Aziza (Fig. 1).

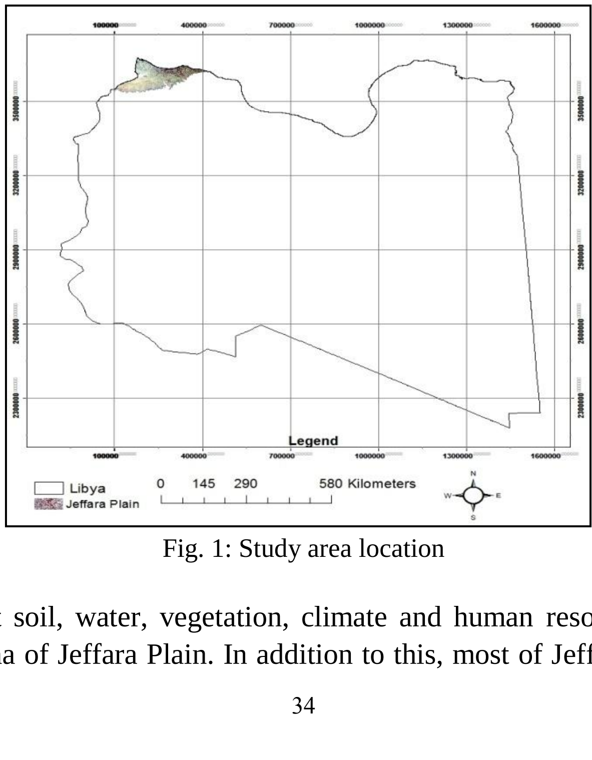

Fig. 1: Study area location

The area has significant soil, water, vegetation, climate and human resources. The study area covers approximately 306749.348 ha of Jeffara Plain. In addition to this, most of Jeffara Plain is irrigated area and receives some supplementary irrigation water. This region consists of about 50% of total irrigated lands in Libya and produces about 60% of total agricultural products.

3.2. Data Availability

The primary data used in this study was SPOT 5 data with 10 m spatial resolution taken on January 2009. The satellite image was obtained from the Libyan Remote Sensing Centre. In supporting the study, secondary data were obtained from the Libyan Survey and Mapping Centre which includes contour map (scale1:50000).

3.3. Model Structure

Spot 5 data, Image processing, contour map, supervised and unsupervised classification, ground verification, accuracy assessment, and output derivation are the main components involved in this study (Fig. 2).

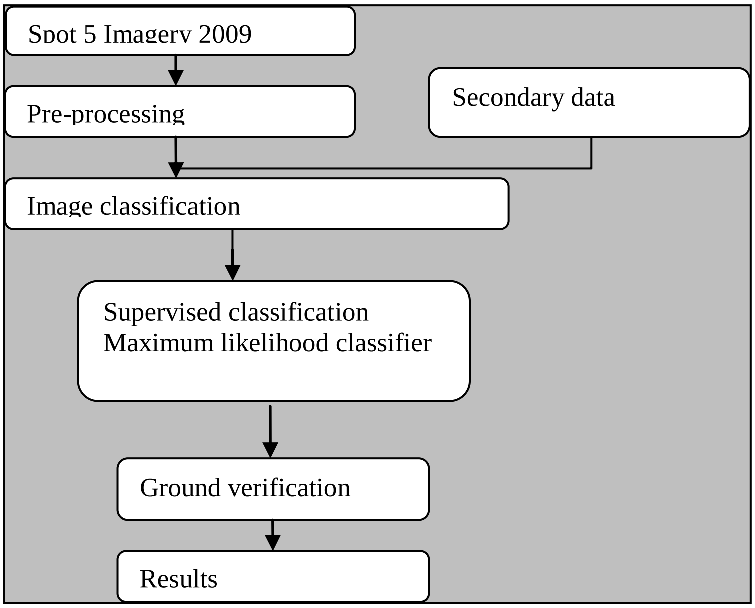

Fig. 2: Model structure

The Garmin GPS used to navigate the location of selected samples during ground verification. Digital camera utilized to photograph 48 ground truthing sites (Fig. 3).The digital image processing was carried out using a personal computer equipped with ERDAS IMAGINE software for classification and analysis of the spot imagery.

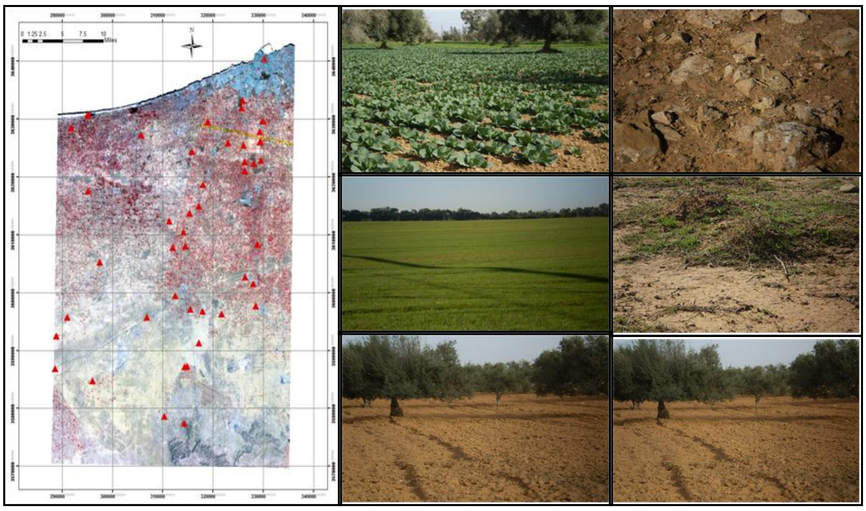

Fig. 3: Ground truthing points on the map (left side), and examples of the land cover classes

Different combination bands were taken in to consideration to produce different composite effects on land cover/ land use. A false colour composite of Red-Green-Blue band was applied for additional analysis. The algorithm applied in supervised classification is the Maximum Likelihood Classification (MLC).

4. Results

Supervised algorithms was used to derive land cover and land use map in the study area based on natural grouping and ground truthing of the enhanced image of SPOT 5 imagery. The results showed that study area was classified into 4 heterogeneous land cover classes and 5 homogeneous land cover classes. These are shown in Fig. 4 and Table 1.

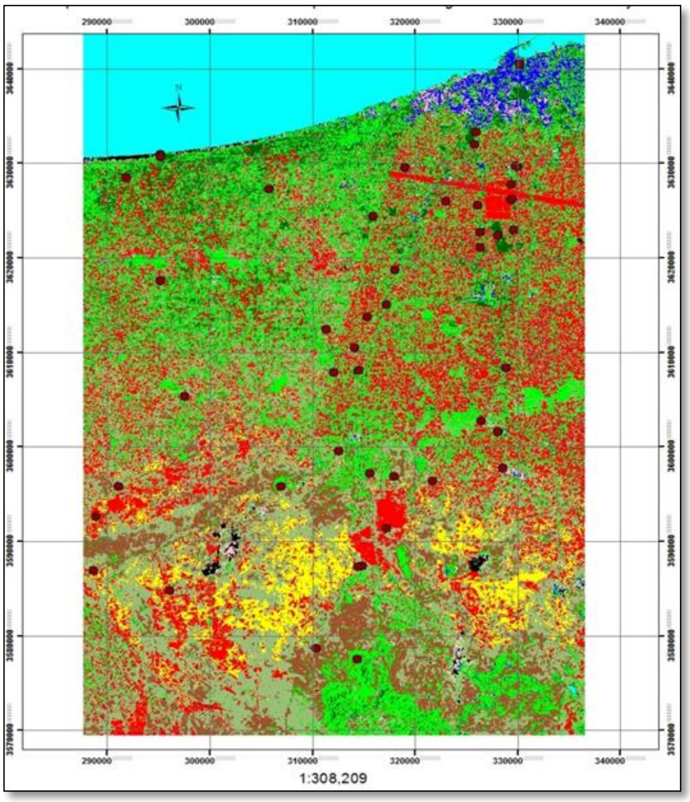

Fig. 4: Supervised land cover/land use map in Jeffara plain of Libya

Table 1: Classification of Land Cover and Corresponding Predicted Area

	Classes	Area (Ha)
	Bare Soil	2001.788
	Shrubs + Irrigated Crops	21879.5
	Shrubs + Rangeland	31441.1
	Urban	5451.47
	Rainfed + Irrigated Crops	86087.7
	Natural and Seminatural Terrestrial Vegetation	17561.4
	Rainfed Crops + Shrubs	58904.7
	Vegetated Urban Area	4278.29
	Irrigated Crops	79143.4

5. Conclusion

The results of land cover /land use data derived from Spot 5 imagery in the study area indicated that study area was classified into 4 homogenous classes (unmixed pixels) and 5 heterogonous classes (mixed pixels). Derivation heterogonous land cover / land classes based on using supervised classification (i.e.

crisp classification) led to produce uncertain or vague land cover classes. An alternative way to ovoid this problem is to apply the fuzzy rules such as fuzzy c- means to classify land cover classes. The Fuzzy classification may deal perfectly with the case of mixed land cover/ land use classes, as many authors discussed [8]-[12]. The future works for the authors is to test fuzzy rules to derive land cover data in the study area.

6. References

[1] S. E. Franklin. *Remote Sensing for Sustainable Forest Management*. New York .Lewis Publishers, 2001.

[2] S. E. Franklin, "Classification of SPOT HRV imagery and texture features," *International Journal of Remote Sensing*, 1990, **11**: 551-556.

[3] A. De Sherbinin, Land use and land cover change, 4 A CLESIN Thematic Guides, Palisades, YN. Centre for International Earth Science Information Network of Columbia University. 2002, pp. 67.

[4] J. B. Campbell. Introduction to Remote Sensing, 4th ed. New York: Guilford Press, 2007.

[5] Q. Weng. Environmental impacts of land use and land cover change in the Zhujiang Delta, China: An analysis using an integrated approach of GIS, remote sensing, and spatial modeling, Ph.D. dissertation, University of Georgia. Athens, GA. 1999.

[6] B. L. Turner, D. Skole, and S. Sanderson. Land-Use and Land-Cover Change. Science and Research Plan. 1995.

[7] A. Abkar and N. Mulder, "Likelihood classification of high resolution images to generate the initial topology and geometry of land cover segments," IAPRS. GIS between visions and application, Stuttgart, 1998, **32 (**4): 1-7, 1998.

[8] P. F. Fisher, "Sorties paradox and vague geographies," *Fuzzy Sets and Systems*, 2000, **113**: 7-18, 2000.

[9] G. M. Foody, "Sharpening fuzzy classification output to refine the representation of sub-pixel land cover distribution," *International Journal of Remote Sensing*, 1998, **19**: 2593-2599.

[10] G. M. Foody, "Approaches for the production and evaluation of fuzzy land cover classifications from remotely-sensed data," *International Journal of Remote Sensing*, 1996, **17**: 1317-1340.

[11] J. C. Bezdek, R. Ehrlich, and W. Full, "FCM: The fuzzy c-means clustering algorithm," *Computers and Geosciences*, 1984, **10**: 191−203.

[12] A. J. Comber, "The separation of land cover from land using data primitives," *Journal of Land Use Science*, 2008, **3** (4), 215-229.