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# Investigation of the Percentage of Vegetation Changes Using Satellite Images (A Khuzestan Region Study)

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## Abstract

In general, from ancient times to the present, there are various methods for collecting location-based data, including astronomical observations, photogrammetry, mapping and remote sensing. Remote sensing is one of the data collection methods in which it has the least amount of direct contact with the objects and features being measured and unlike other methods in which human factors play a role in collecting and interpreting terrestrial data, in remote sensing method the task of collecting information will be the responsibility of the sensors. Due to the over-exploitation of natural resources, the landscape is constantly changing and monitoring these changes as well as updating maps is costly and time consuming, so many developed countries now have to prepare maps in Different levels use satellite data. The factors studied in this research include 1 preparation of land cover maps and land use of a part of Khuzestan lands. 2 Evaluation of bio-ecological potential in agricultural development of the study area by weighted overlap method. With regard to collecting information, studying the obtained maps and calculations, determining the criteria, final weights and classification of layers in determining the potential of the region for agricultural use, the amount of changes in agricultural areas between 2014 and 2016 was determined. According to calculations, it is about twelve percent, which according to the changes that have taken place are very significant and show the intensity of the changes in recent years. Loss of vegetation is a factor in increasing wind speed and destroying soil texture and structure. It is also a cause of dust, the result of which can be seen in recent years.

***Keywords**:* Weighted Overlap, Remote Sensing, Vegetation (Plant Cover)

## 1. Introduction

Human life depends on the existence of plants, and in addition, its health indirectly depends on the

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production and cultivation of healthy plants. Green plants are the main source of food for animals and play an important role in the production of medicinal products and environmental health. Therefore, paying attention to plant health helps maintain good health in humans (Maghsoudi et al., 2015). Frequent floods in Iran, the destruction of large areas of forests, desertification and abandonment of fields due to the migration of villagers to cities, has imposed very serious conditions on ecological environments and can be a factor for the destruction of fertile agricultural land in Less than half a century later (Firoozi et al., 2020).

Remote sensing is one of the greatly beneficial methods for acquisition of information concerning vegetation (Kumar et al., 2019). Providing a vast view of the area, data repeatability and integration are among the characteristics of the respective technology, causing the researchers to utilize this technique for their studies (Nguyen, Tam et al., 2020). Agricultural lands are large and scattered. In order to study and maintain it, satellite imagery is necessary (Soffianian et al., 2011).

In recent years in Iran, the assessment of bio-ecological potential has been proposed as a necessity in land use planning (land management). This is reflected in national economic, social and cultural programs. Due to the fact that Khuzestan has vast and fertile lands, it is necessary to use new techniques such as remote sensing and geographic information system, to assess its ecological potential for various uses, especially agriculture, and after recognizing the basic uses Optimally, the findings will be used in future planning.

The results of a study showed that the difference between the predicted performance values and the actual performance (prediction error) is between 7.9 and 13.5% for Landsat 8 images and between 3.8 and 10.2 for Sentinel 2 images (Al-Gaadi et al., 2016). Siyal et al (2015) Showed that by calculating the difference index of normalized vegetation during the grain filling stage, the best yield of cereal plants can be estimated (Siyal et al., 2015).

Water erosion caused by floods and torrential rains lead to destruction of agriculture lands. And, this destruction is completely visible in satellite images. Appropriate planning can be made by identifying the eroded areas and causes of erosion can be determined and plans can be proposed to mitigate or alleviate erosion (Yu et al., 2014).

Hill and colleagues evaluated desertification changes based on remote sensing methods. In this study, two images with two different times of TM sensor (1995 and 2001) were used to evaluate changes in desertification. The results showed that the desert lands were developed at a rate of 51 square kilometers (Hill et al., 2006).

Yang stated that access to updated and new statistics and information and awareness of the trend of variations is one of the key factors in planning, decision-making, and managerial tools in any organization, which will be enabled via deployment of detection process of land use variations (Yang et al., 2015).

Satellite images are capable of assessing cultivation area of major crops and their health. Also, yield of products in different areas can be predicted and their marketing can be planned in different areas depending on the demand level (Luo and Wei 2009). Water deficiency in leaf causes changes in absorption and reflection of electromagnetic waves. In other words, reflection of a leaf with water-saturated membrane is different from that a leaf suffering from water deficiency at varying wavelengths (Jeong and Howat, 2015).

Today, via transmission of images from movement of clouds, position of high-pressure systems, and so on, meteorological satellites can help us get aware of presence of precipitation in the area approximately or with an acceptable probability. Hence, the farmers can plan the cultivation time with further assurance based on the weather forecast. Also, the moisture content of soil can be analyzed using RADAR images (Peña and Brenning, 2015).

Knight, (2003). Examined GIS and systems approach in environmental planning. The objectives of this project were to determine the relationship between diversity, production, sustainability and existing pressures and models of aquatic and terrestrial ecosystems, and finally to apply the results of this type of attitude in larger areas and at different scales (Knight, 2003). In planting stage, satellite images, and in particular, RADAR images may help the farmers for better preparation of the land

(Bhatu, Chavda, and Pampaniya, 2020).

## 2. Materials and Methods

In this research, after performing the correction and processing of LANDSAT satellite images, the land use map of the area was extracted and the information were analysed in GIS environment using Envi and ArcGIS software packages. Land capability assessment maps were then prepared by means of fuzzy and weighted overlay techniques. At the last stage, the maps were integrated based on land use priorities and the land use capability map was prepared. Envi and ArcGIS software packages and multiple-criteria analysis and fuzzy methods were used to analyse the data of the prepared map.

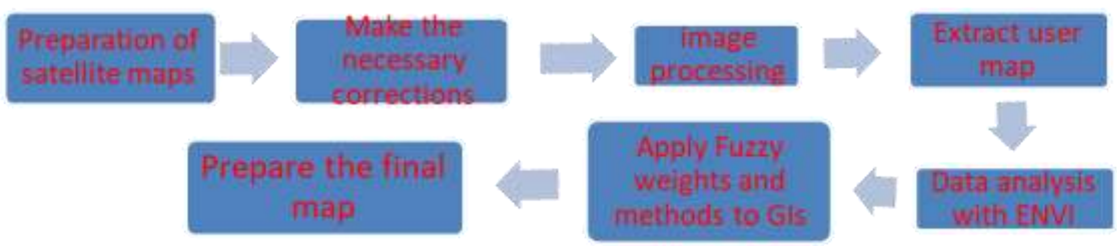


**Figure 1.** Flowchart

## 3. Results and Discussion

The weighted linear combination method is the most common technique in multi-criteria evaluation and decision analysis. The weighted linear combination method (WLC) can be implemented using the Geographic Information System (GIS) and the overlap capabilities of this system.

After preparing the images and performing the required preprocessing operations, the supervised classification operation was performed in the most similar way. For this purpose, four main classes of vegetation, urban areas, soil and water were considered. The classification results were then estimated for comparison between 2014 and 2016.

Overlap techniques in the Geographic Information System (GIS) allow standard map layers to be combined to produce a composite map layer. The following formula is used to determine the appropriate map.

$$suitability \quad Map = \sum\left[foctor \quad map \quad ccn\right] * weight(wn) * constra\,\mathrm{int}(bo/.1)$$

Criteria used include land slope, distance from surface water sources, distance from roads and land texture (geological layers).

**Table 1.** Criteria, final weights and how to classify the layers in determining the potential of the area for agricultural use

| Criteria | Weight | Classify layers | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Slope (percentage) | 0.429178 | 0-5 | 5-10 | 10-15 | 15-30 | >30 |
| Distance from surface water sources (meters) | 0.262341 | 0-1000 | 1000-2000 | 2000-3000 | 3000-4000 | >4000 |
| Distance from roads (meters) | 0.179451 | 0-1000 | 1000-2000 | 2000-3000 | 3000-4000 | >4000 |
| Earth texture (geological layers) | 0.12903 | Terrace reservoirs and new low-altitude alluvial fans | Grayish and slightly aerated brown limestone, hollow gypsum, red marl and siltstone (Aghajari Formation) | Cement mass conglomerate with severe alteration and slightly aerated sandstone with cross-stratification (Bakhtiari Formation) | Altered, slightly aerated gray marl with bands of resistant limestone (Mishan Formation) | Anhydrite, salt, altered gray and red marls with anhydrite, clayey limestone and lime (Gachsaran Formation) |

Due to the location of the study area in two Landsat image frames, after receiving the data, the images were mosaicized (Figure 2).

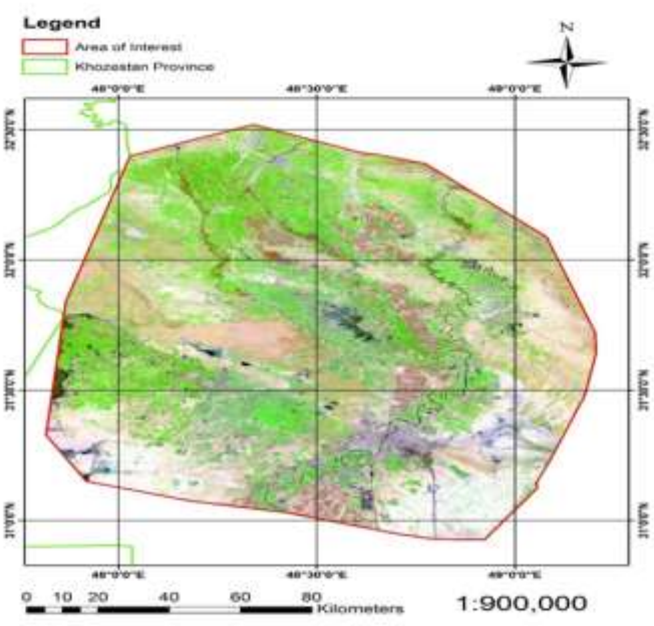


**Figure 2.** Mosaic images for the study area

The four main vegetation classes, urban areas, soil and water for 2014 and 2016 were surveyed (Figure 3).

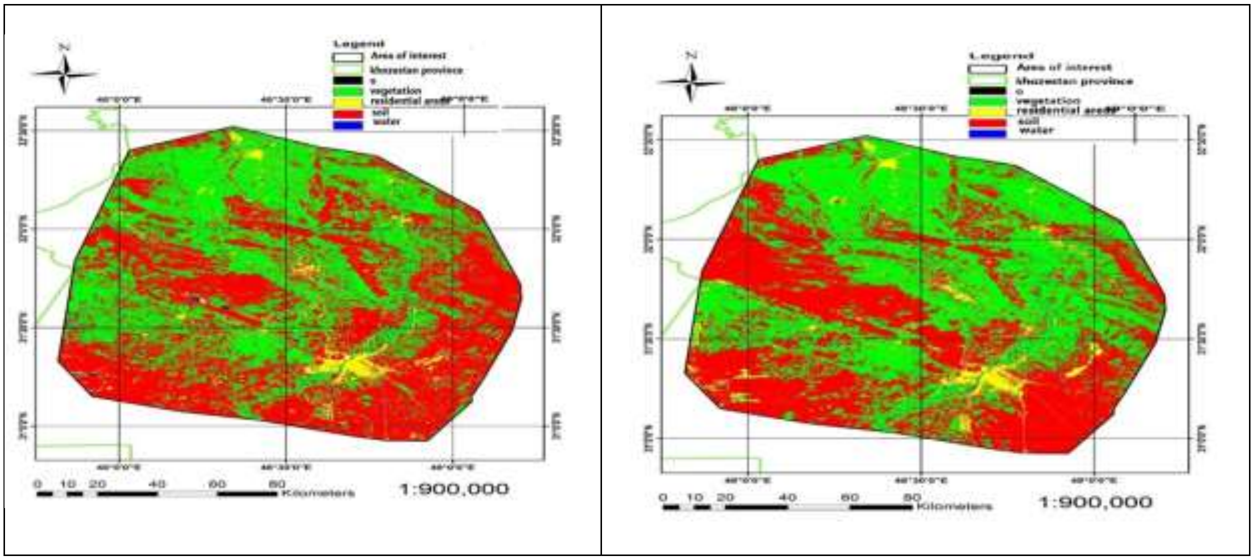


**Figure 3.** Classification results for 2014 (left) and 2016 (right) data

A comparison of the four main vegetation classes, urban areas, soil and water for 2014 and 2016 was performed (Table 2).

**Table 2.** Comparison of classification for 2014 (a) and 2016 (b) data

(a)

| Overall Accuracy = (104761/105691) 99.1201% Kappa Coefficient = 0.9803 | | | | | |
|---|---|---|---|---|---|
| Ground Truth (Pixels) | | | | | |
| Class | Veg | City | Soil | Water | Total |
| Unclassified | 0 | 0 | 0 | 0 | 0 |
| Veg [Green]1 | 13790 | 60 | 525 | 7 | 14382 |
| City [Yellow] | 2 | 11972 | 170 | 8 | 12152 |
| Soil [Red]76 | 44 | 114 | 75887 | 0 | 76045 |
| Water [Blue] | 0 | 0 | 0 | 3112 | 3112 |
| Total | 13836 | 12146 | 76582 | 3127 | 105691 |

(b)

| Overall Accuracy = (294586/297814) 98.9161% Kappa Coefficient = 0.9775 | | | | | |
|---|---|---|---|---|---|
| Ground Truth (Pixels) | | | | | |
| Class | Veg | City | Soil | Water | Total |
| Unclassified | 0 | 0 | 0 | 0 | 0 |
| Veg [Green]1 | 103238 | 24 | 1284 | 0 | 104546 |
| City [Yellow] | 277 | 5777 | 368 | 2 | 6424 |
| Soil [Red]18 | 1241 | 31 | 185379 | 0 | 186651 |
| Water [Blue] | 1 | 0 | 0 | 192 | 193 |
| Total | 104757 | 5832 | 187031 | 194 | 297814 |

## 4. Conclusion

According to the results, the rate of change in agricultural areas between 2014 and 2016 is about twelve percent. This figure is very significant. Research (Yu et al. 2014) also shows this. This shows the intensity of changes in recent years. Important policy centers in the region and the country should think of ways to prevent the destruction of national agricultural resources. It was also shown that with the decrease of vegetation, the rate of evapotranspiration from the ground has decreased. The results confirm the results of the research Jeong and Howat 2015. It was also found that with the decrease of vegetation, the amount of barren soil has increased significantly, which can cause the destruction of water resources and increase dust in the regions of Khuzestan, which we have witnessed in recent years. This also confirms the research of Bhatu, Chavda, and Pampaniya, 2020; Jeong and Howat 2015.

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