



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

**THE USE OF REMOTE SENSING TECHNOLOGY AND GEOGRAPHIC
INFORMATION SYSTEM TO ESTIMATE THE ACREAGE OF WHEAT
(CASE STUDY IN AZARSHAHR AND ESCO CITIES)**

KHALIL VALIZADE KAMRAN¹, AKRAM MAHAM²

1. Associate Professor- Tabriz University, Department of Remote Sensing and GIS

2. M.A Student in Remote Sensing and GIS in University of Tabriz and Expert in Institute of
Space Extruders, Tabriz - Iranian Space Research

Author: Tel: 09143100423 Email: maktoob5555@yahoo.com

ABSTRACT

Wheat is the most important cereal in the world which has always been considered as the primarily need for people. Since the provision of terrain data about large-scale agricultural work is difficult, time-consuming and costly, so through using satellite images with minimal time and cost, useful information from the acreage can be obtained.

In this research, an area under dry and water farming wheat in Osku cities in terms of geographical location at 46 degrees and 8 minutes east longitude and at 37 degrees and 55 minutes in north latitude and Azarshahr at 37 degrees and 30 minutes north latitude and 45 minutes in the east, was estimated using IRS satellite image analysis in the periods between 2003 and 2010, respectively. By field studies and supervised classification in 4.7 ENVI software on satellite images, we identified wheat farms in the study area and the area under wheat cultivation using software 9.2 ArcGIS, respectively. After evaluation of operations, the overall accuracy was estimated 89%. Then, the findings from the analysis of satellite images were compared with available statistics at Agriculture Organization of East Azerbaijan and it was observed that there is a significant difference between the two assessments in terms of harvested area estimate for wheat and consequently no estimate of the amount of product and by processing satellite images,

the estimation of the acreage was faster, easier and cheaper than conventional methods in agriculture.

Keywords: Satellite images, image processing, supervised classification, acreage, GIS

INTRODUCTION

Now in the farms of country, acreage and yield are traditionally calculated which is very time-consuming and expensive task, and access to the needed and timely information of the product is not possible for the government. To speed up the calculations and obtaining updated statistics on the crops, new techniques such as remote sensing technology should be used in the monitoring of agricultural products. Using remote sensing technology in the field as a means known, leads to saving time, reducing costs and providing information is fairly accurate and updated.

Given that the price of wheat on world markets is different at different times, firstly some methods should be taken up in the cheapest possible way so that when the supply of wheat in the world markets is more than demand, needed wheat to be purchased. This requires knowing the extent of required produced wheat in the country that varies from year to year. In the absence of information on the amount of production, the government is forced to wait for time to prepare the final report of crop production, and after receiving information from the

Ministry of Agriculture, needed wheat are imported.

This period also coincided with more expensive wheat in the global market. Therefore, due to high global demand for wheat and high prices, the government should pay high cost for wheat due to lack of anticipated required amount. Based on this, if we can map the areas under wheat cultivation and produced yield per unit, then we can determine domestic production in a relatively accuracy manner and consequently the amount of required product is also estimated and the government will access it.

Therefore, a glimpse of the main objectives of the study includes the following:

Strategic wheat

Because wheat is a strategic product and the primary need for the food of community, it is necessary that due to the per capita consumption and needs in each year the amount of required wheat is to be estimated.

Estimation of premature wheat

With the early harvest estimates using satellite imagery, the government and large buyers of agricultural products, given the fact

that the amount of product will be more or less than usual, are able to make decisions about when to buy product.

According to world prices within different time, if it is determined timely, it is valuable and prevents the outflow of foreign currency for import in a timely manner as well as timely profitability for export will be obtained.

Product management with knowledge of the acreage situation

Given that the North West region of the country is considered as one of the most important agricultural poles because of strategic agricultural products, so the awareness of acreage particularly wheat products can be valuable in the management of products and contributes considerably in the awareness of the net production or shortage or surplus agricultural products in order to provide stability to the market for government.

In this regard, Saroyie in a study using remote sensing and GIS separated the map of the area under rice cultivation in the city of Amol, Babol using TM Landsat satellite and supervised classification and maximum probability algorithm.

In a study to determine the area under cultivation of vineyards of Maleka city, Fayzizadeh and Valizade Kamran used

SPOT5 satellite images. To do the research, firstly required corrections to the data preprocessing stage were carried out and then a variety of detection methods used to identify the vineyards.

In the next stage, vegetation was extracted using vegetation index (NDVI), and vine species from other plant species in a field has been sampled by the GPS device and isolated as tree branch classification by sampling procedures and then the resulting map was transferred in the system geographic environment (GIS) and cultivated vineyards were estimated with accuracy of 95% and a map of the vineyards have been prepared. [2]

In vallant Creek, United States Daryozmie et al., determined soybean and corn areas by MODIS data. They also used MODIS sensor data and ground data to acquire the amount of wheat in acreage. [4]

The study area

In this study, the cities of Osku and Azarshahr in the East of the Orommiye Lake were chosen to do the research that has been shown on the satellite image in Figure 1. The study area of Esco located with an area of 1765 square kilometers in 30 kilometers from Tabriz and its height from sea level is 1450 meters. In terms of geographical location, it is at 46 degrees in 8 minutes east longitude and 37 degrees in 55 minutes north latitude.

Azarshahr is one of the oldest and most famous parts of Tabriz city, and with an area of 850 square kilometers (8.1 percent of the province) is located in 50 kilometers from Tabriz and its height from sea level is 1340 meters. In terms of geographical location, it is at 37 degrees in 30 minutes north latitude and 45 minutes east.

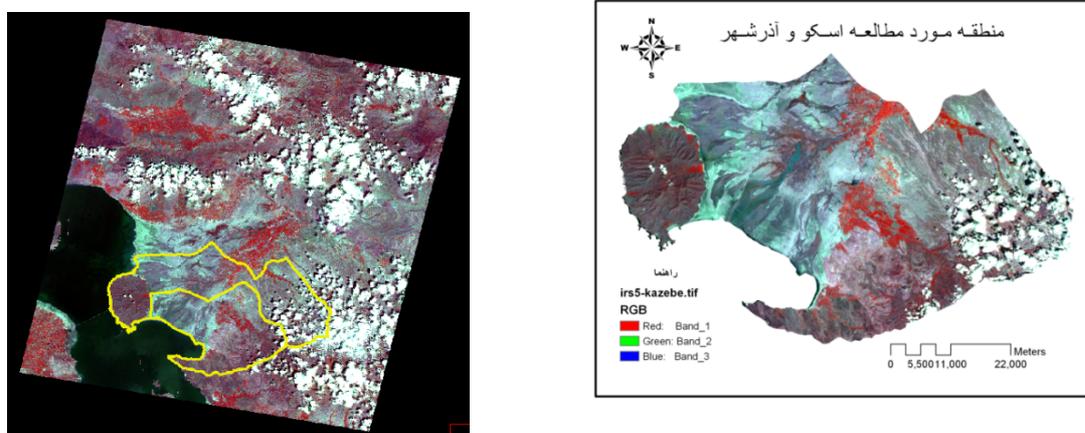


Figure 1: The representation of the cities of Esco and Azarshahr cities on IRS LISS III Satellite image No. 34-62

MATERIALS AND METHODS

In this study, the area under dry and water farming of wheat crops was estimated using satellite images, and ARC GIS ENVI software.

Required data:

- A. The data obtained from Global Positioning System ((GPS
- B. The IRS LISS III satellite images to sin No. 34-62 (years 2003-2010 AD) received from the Iranian Space Agency (C) Landsat satellite images to Sin No. 34-168 (years 2003-2010 AD)
- (D) the statistical information received from

the Azerbaijan Agriculture Organization (1382- 2010 solar years). [5]

In this study, after pre-processing (geometric and atmospheric corrections) on the target image, the image processing operations including field studies, supervised classification to identify the acreage was carried out by 4.7 ENVI software and then post-processing operations for Pictures and calculation of acreage was conducted by ARCGIS 9.2 software.

After completion of the satellite images, the difference between acreage and yield

obtained from remote sensing and ground-based data will be compared.

A. Pre-processing of satellite images:

1. Atmospheric correction

In the pre-processing of satellite images before identification and extraction of information, removing of any atmospheric effects is necessary. Removing adverse effects of climate is needed to compare the images several times.

Additional energy from distribution and atmospheric dispersion of ground waves would come decrease the rate of conflict and as a result, identification problems will be brought. So to solve this problem, the images of atmospheric moisture should be corrected.

2. Geometric correction

To correct errors that usually occur due to movement of the satellite and the ground when shooting and their compliance with other map information such as topographical maps on the image, geometric correction operation is performed.

Overall, geometric correction is done by linking the image coordinate system and the geographic coordinate system by ground control points. To prepare, two or more satellite images to compare the detection of changes in geometric correction (geo referenced off) images are essential. [6].

For this purpose, after invocation of studied satellite images in ENVI 4.7 software for geometric correction and image analysis, Image to Image are used based on Landsat images with geometric coordinates, and the images were corrected to them.

(B) Image processing

1. The field studies:

To examine the facts and processes in the area and understanding control points and compliant with satellite imagery in several stages with field work, the regional situation and the events have been identified in it totally, these items resulted in an achieving an overview of wheat cultivation area. In this study, fieldwork was conducted in two stages. The first stage was done in May and the second in June 2013 in the presence of Azar and Osku. At this stage, the images and the coordinates of the phenomenon in the area, and the 42 points were collected using a GPS device.

Supervised classification:

In supervised classification, data from field studies and experiences are used to classify interpreter. In this method, the choice of classes is very important for the classification and it is obvious that the determination of number of desired spectrum classes depends on understanding of the interpreter of the

study area, the spectral reflectance and his experience.

Table 1: Specification of IRS LISS III| 7 satellite

Spectrum range of micrometer	Pixel size	Spectrum bands
52-59%	23.5%	Band 1: green
62-68%	23.5%	Band 2: red
77-86%	23.5%	Band 3: near Infrared
1.55-1.7%	23.5%	Band 4: medial infrared
0.5-75%	5.8%	Panchromatic band

For classification, vector layers obtained from the harvest field studies (the GPS) is invoked in ENVI software on the cut image area and supervised classification is conducted using the commands in the software and due to the geographical coordinates of the points identified in the studies.

(C) Post-processing

1. Verification of classification

Careful evaluation of the results of the classification in the most important processes in the post-processing to images. The most common method for quantitative assessment of classification accuracy is the number of pixels of clear sample and comparison of their label with the results of the classification, this type of data is usually called ground truth.

To obtain the precise geometric correction performed using the least squares method of standard deviation RMS, its value can be obtained in the relationship between the error from the following formula: [8]

$$RMS = (\sum (Xi - Ti)^2 / (n-1))^{1/2} \quad (1)$$

By assessment of RMS error, the displacement of a pixel in the corrected image is determined to the actual location on the map. In the investigation IRS image was referenced using Landsat image and Image to Image command with the mean error of 5.0 pixel in pitch 28.

The results of the comparison are often represented by matrix error which is also known as the ambiguity matrix. This error is the result of comparing the pixel to ground truth (known pixels) with the results of classification.

Ground data will appear as columns and classified data in row matrix. Elements on main diagonal show the number of right pixels and non-diagonal elements set to show errors. Overall accuracy is average of the classification accuracy is calculated based on error matrix data as follows:

$$OA = \frac{\sum_{i=1}^c E_{ii}}{N} \quad (2)$$

K: Kappa coefficient calculates classification accuracy relative to a random classification.

$$K = \frac{n \sum_{i=1}^r x_{ii} - \sum_{i=1}^r (x_{i+} x_{+i})}{n^2 - \sum_{i=1}^r (x_{i+} x_{+i})} \quad (3)$$

So that,

If the value of K is equal to 1, classification is quite correct, if K values equal to zero, the classification was done randomly and K negative values is classified as poor. K proportion to the overall accuracy has the advantage that the marginal values or other non-diagonal matrix also uses ambiguity. The closer K to 1, the more correct the classification is. [8]

2 – Transmission of classified image to ARCGIS and measured wheat acreage

After transferring, the images were classified by Maximum Likelihood algorithm. After classification, the image is divided into 9 classes, namely: dry wheat, water wheat, barley, water barley, dry barely, garden, waste, the city, outside the city and water. The result is transferred in Arc GIS data environment and there firstly the area of cultivation of wheat was separated from other areas.

Classified image was converted to zero value and one by Raster calculates command. For example, as shown below 1 and green areas, the area of irrigated wheat is grown, the dry wheat was separated as such.

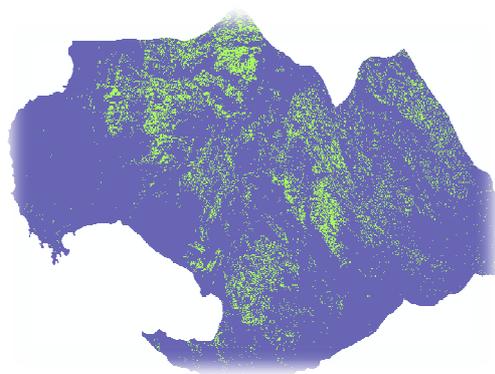


Figure 2: an area planted with dry wheat in the study area (green)

RESULTS

In this study, the area under wheat was estimated by the IRS imagery, and the overall accuracy was calculated 89% and 74% for Kappa index. By comparing the results of processing satellite imagery and

ground data, the significant difference is not observed between the data obtained from the Agriculture organization of the province. Tables 3, 4 and 5 show the results of the comparison.

Table 3: Statistics of acreage and yield from Azerbaijan Agriculture for crop year 82 and 89 (water wheat) Water wheat (per hectare) (tone) (2010) water wheat (per hectare) (tone) 2003

11021	3300	13184	3750	Azar Shahr
13222	3860	17451	4870	Esco
24243	7160	3065	8620	an area under study

Table 4: Statistics received for acreage and yield of agricultural organization crops in -East, 2010, 2003 (wheat)

dry wheat in 2010		dry wheat in 2003		province
area(hectare)	yield (tone)	area(hectare)	yield (tone)	
1550	2200	2559	2100	Azar Shahr
1100	1800	1550	1505	Esco
2650	40000	4109	3605	Area under study

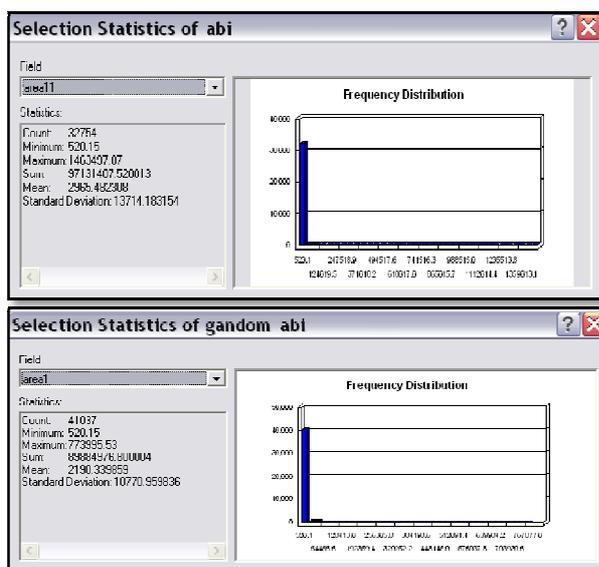


Figure 3: The area of wheat cultivation calculated through satellite images in 2003 and 2010

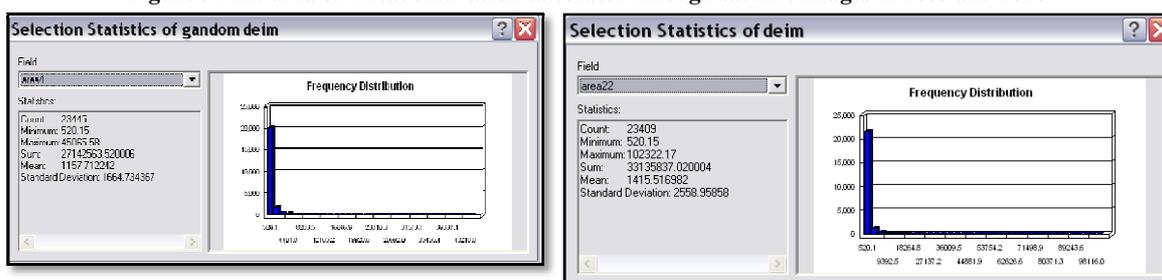


Figure 4: The area under cultivation of wheat obtained through satellite images in 2003 and 2010

Table 5: Comparison of acreage using data from ground statistics and data from processing satellite images

Water farm (2010)	Water farm (2003)	Dry farm(2010)	Dry farm (2003)	Comparison of results
7160	8620	4000	3605	Statistics of acreage of agriculture organization in the study area
8988	9713	3313	2714	The data from processing satellite imagery of the study area.

So it can be concluded that by processing of satellite images and supervised classification, the acreage of wheat can be faster and easier and at a lower cost and consequently the amount of yield.

Also in this study, it was concluded that cultivation of wheat is declining in a period of time and it is because of the drought prevailing in the area, dehydration and drying of lake water and salt in the region. As well as reviewing of dry lands shows increased cultivated area and it is also due to recent droughts, water scarcity and dryness of Lake area and an area of salt marsh which farmers have turned to dry land farm.

BARRIERS

AND

RECOMMENDATIONS

In the present study, image acquisition in a particular year is difficult due to the conformity of growth with May and June and due to the climatic conditions, the study area is cloud-covered during the months. And given that the measurement is not possible and if the images are partially cloudy, classification accuracy will be very low and the research will be faced with many problem.

In the research, the increased accuracy of classification should also be taken in order to the time of harvest point is compatible with the images using a GPS device so that if for

any reason, the harvest time training is not consistent with the time imaging, classification accuracy will be reduced.

According to the results of this study, it is suggested that the acreage of wheat and other agricultural products to be estimated using satellite imagery and information processing in order to optimize the management of import and export and provide for the country's government. Preparation of land under cultivation in any year could be helpful for the optimal management (import or export) of agricultural products, especially strategic crops such as wheat. The images used in this research are IRS liss III satellite images and the investigation showed that the accuracy of processing satellite images for this research is similar with other studies. Landsat satellite due to the similarity of the spatial resolution of the sensor is ease of access and cost to do proper research. And in addition, Aster sensor due to higher spatial resolution is suitable to carry out similar studies and using satellite images is also recommended to do this type of research.

It also recommended that another study to be performed by radar images (which measurement of these images is possible in any conditions and at any hour of the day)

and the result of both classification accuracy are compared.

ACKNOWLEDGEMENTS

Thereby, I wish to gratefully thank all the professors from department of Geography, University of Tabriz, especially Mr. doctor Rezaei Moghaddam and Mr. doctor Hashim Rostamzadeh, Iran's Space Organization, especially Jannati, the head of development office and application of space research and also agriculture Organization of East Azerbaijan in addition to sharing the images, data.

Symbol lists:

$X_i = (X_i, Y_i)$ real position of control point

$T_i = (X_i, Y_i)$ computed position of control points

n the number of ground control points

OA's overall verification indicator

N represents the total number of classified pixels

$\sum_{i=1}^c E_{ii}$ profile for total pixels in diagonal matrix error (the number of pixels correctly classified)

R the number of rows in the matrix line

X_{ii} the number of observations in row i

i total observations in row i

i total observations in column i

REFERENCES

- [1] Saroyie, S and AS. Nasiri, 2001, "The Use of Technology.
- [2] Fayzizadeh, Bakhtiar and Valizade Kamran, 2008. Estimation of Vineyards acreage in city Malekan city Using SPOT of Geography Journal and Planning, No. 27, page 31-22.
- [3] Data from Statistics and Informatics Department of Agriculture in Azerbaijan
- [4] H. Alizadeh Rabiei 1999. Remote Sensing, Principles and Applications, published by Tehran Press.
- [5] Alavi Panah, K., 2006. The application of remote sensing of Earth Sciences, Tehran University Press.
- [6] Heroic AA, 1388. Fundamentals of Remote Sensing Applications, University of Tabriz.