Available online at www.jrors.ir

Journal Of Radar and Optical Remote Sensing

JRORS 1 (2019) 7–21

Analyzing and Evaluating the Agricultural and Garden Land Areas, and the Land Use Changes using RS and GIS Technology

Reyhaneh Bahador[a*], Seyyed Zein-al Abedin Hosseini[b]

[a] MSc. Student in Remote Sensing and Geographic Information System, Civil Group, Yazd Branch, Islamic Azad University, Yazd, Iran*
[b] PhD in Geomorphology, Assistant Professor of Remote Sensing and GIS Group, Yazd Branch, Islamic Azad University, Yazd, Iran

Received 14 February 2018; revised 14 December 2018; accepted 19 December 2018

Abstract

Estimating and determining the area under cultivation of agricultural products are among the important aspects in planning and decisions making. Remote sensing data can provide useful information in this regard to agricultural experts by identifying the type and determining the crop area. In this research, agricultural land and garden areas as well as the land use changes were evaluated by using Quickbird and Landsat images for 1984, 2003 and 2015 in Rudasht basin of Esfahan. The required preprocessing was done on the images and then, the educational samples were taken using GPS for classification by the maximum likelihood method and verifying the classification. The geometric correction results for 1984 and 2003 images with acceptable RMSE were 0.48 and 0.42 respectively. The image classification results of Landsat showed that the agricultural land and gardens areas are reduced by 1036.236 and 27.3146 hectares from 1984 to 2015, and Quickbird images showed the reduction of 1036.236 and 119.8833 hectares from 2003 to 2015. In estimating the Quickbird classification error for 2003 and 2015, the Kappa coefficient of maximum likelihood was 0.8576 and 0.8643 and for the years 1984 and 2015 were 0.7967 and 0.8641 respectively.

Keywords: Land Estimation, Evaluation of Changes, Agricultural Lands and Gardens, RS&GIS.

[*] Corresponding author. Tel: +98-9133333060.
Email address: reyhanebahador@gmail.com.

1. Introduction

Development of science and technology in all the domains has reduced the rate of the required activities, and from the other side, it has led to the increasing accuracy and speed of various studies. One of the most important achievements by humans has been using satellite images in all the scientific researches. Regarding their exclusive features, the use of satellite images have been considered as an appropriate tool in evaluating, analyzing, controlling and managing of soil and water resources. Such images are extensively used nowadays in different agricultural and natural resource studies and also in preparing various drawings and maps. Thus, the researchers have analyzed various observations and collected information via the field studies and satellite pictures of the past decades for finding the changes in land use due to the imposing natural and human processes. Based on the technological developments in the domain of remote sensing, the satellite images can nowadays be processed in the shortest time for more precise analysis of the environmental changes, and the final results can be modeled by illustrations. The rate of the related information is rapidly increasing by the satellite images, and many organizations and institutes are trying to utilize such images for their various aims. In this regard, preparing quality satellite images and processing these images are considered as the first step for the process. After selecting appropriate images, a suitable method of classification would be selected. The accuracy of the required data would be evaluated after the classification and determining the cultivated area with the real and received land data by GPS. In this study, the agricultural and garden areas are analyzed and determined by using the classification method of maximum likelihood and the Landsat and Quickbird images, with regards to the high potentials of the satellite images and remote sensing technology and the considered area for the study is Rudasht basin in Esfahan.

Various studies have been done both in Iran and all over the world about using remote sensing technology and satellite images. Bakhtiarifar et al. (2011) have done a research about the model development based on GIS and multi-criteria decision-making method for evaluating and identifying the existing conditions of the land uses, and also about the changes in the land use with difficulties to appropriate uses. The results indicated that proper considerations and simultaneous compatibility of the land uses are essential in allocating the land uses. In a study, Givi Ashraf and Ardakani (2011) analyzed the land use for evaluating the desertification in Marvast plain/Yazd province by using Landsat-7 images and ETM+ (Enhanced Thematic Mapper) measurement related to 2002 and 2010. The results of the research showed that the desert lands in Marvast, which are among the dry and semi-dry regions, has increased by 30% in the 8-year period, and the wet desert has decreased about 50%. Javanmardi et al. (2011) evaluated combined process of potential production and land proportions for various purposes. Then, the obtained results were compared with the results from the evaluation with the combined technique of the process of hierarchical analysis and GIS. The results indicated the existence levels of land use in the studied region, in which the 5th class with the area of 31% includes most of the area in the region. Zangiabadi and Abolhassani (2012) did a study with the aim to evaluate the management of agricultural lands by utilizing GIS and RS in a descriptive-analytical basis in Esfahan province. The results of this study indicated that the province cities are classified in four different levels with regards to the agricultural areas, in which the city of Esfahan is in the first level, and the cities of Naein, Khomeinishahr, Khansar, and Lenjan are in the fourth level, and the other cities are placed in between the cities of Esfahan and Naein. In a research, Pakpour Rabti (2013) evaluated the susceptible lands for cultivation of corn, barley, and sunflower products in Posveh and Jaldian regions in West Azerbaijan. The results showed that climatic class in the studied area for the barley was properly appropriate (considered as S1) and it was moderate (S2) for corn and sunflower due to the relative humidity limitation during the growth period. In other words, using GIS in the studies for the land proportions increases the accuracy and progress of the research. In a research Arkhi (2014) dealt with controlling the changes in land use in the past and considered the possibility of estimations for the future by using the land change modeler (LCM), the aid of Landsat-4 images (mapped ,1967), Landsat-7 ETM+ (1991) and Landsat-5 (2011) in Sarableh in Elam province. The modeling results of the transmission power by the artificial neural network showed a high rate of correctness (60-86%) in most of the sub-models. The total error in the modeling was 12.84% for 2011, indicating the high rate of conformity of the model predicted image with the land real image, which was acceptable. Pilehforoushha et al. (2014) presented a model for planning about the allocation of agricultural lands to for the best land uses by using calculation of inferring systems on the fuzzy basis, determining the demands and considering the sequence of cultivations. The results showed that, the most appropriate product for cultivation in a definite area can be determined and useful information can be provided for the agricultural planners by using different scenarios. In another research, Davoodi Monazam et al. (2014) evaluated the change in the farm land usage in the city of Shahriar by three different methods of maximum likelihood classification (MLC), neural network classification (NNC), and supporting vector machine (SVM) in 1987-2009, by using Landsat data. Results showed that the urban development in the considered 22-year period had an increasing trend, while the agricultural lands had a decreasing trend. Moradi et al. (2016) compared the pasture land use change with the places where dry farming is done in the cities of Rabar and Arzoueieh, for a period of 15-year. The of land use change trend in the study area by (Dehsard and Kouh Sefid) was processed by the Landsat ETM+ (2000) and OLI (2014) images in the ENVI 5 software, using supervised classification. The results of the research showed that the expansion of farming activities on the pasture ecosystems transform the pastures to low efficiency lands of 9% and 20% in Dehsard and Kouh Sefid regions, respectively. Mullupattue and Sreenivasula Reddy (2013) analyzed the change in the land use using GIS in Tiropatty region in India with regards to topographic drawings and remote sensing data from LISS III, PAN, and IRSID in 2003. According to the results, reducing the water resources and agricultural lands, and destruction of forests are among the lateral effects of land use changes with regards to the accelerated trend in urbanization. Butt el al. (2015) studied the algorithm of supervised classification of maximum likelihood to identify the changes in the land use in Simley region in Pakistan, by using multi-dimensional images of Landsat-5 and Spot-5 for the years 1992-2012. The overlap of maps and drawings in Arc GIS showed the change in the land use of aquatic and plant coverage of the region towards farming and deserted lands with 74.3% and 38.2% ratios, respectively, which is a great threat for the environment. Hegazi and Kaloop (2015) analyzed the change in land use as one of the most important management cases in managing the natural resources of Egypt by using the Markov chain. The growth of urbanization in Egypt has decreased the air quality, increased the flood waters, landslide, and contamination of water resources. Changing the land use in the above mentioned cities in 1985-2010 has increased urban constructions from 28 km^2 to 255 km^2, causing a 40% reduction in agricultural lands. The results can be used by the city authorities for the sustainable development of the considered cities. The main aim of the study by Cheruto et al. (2016) was the quantitative perception of the change in land uses in Makoni region in Kenya for the years 2000-2016. The classification was fulfilled by the algorithm of maximum likelihood and the ERDAS images. The used images were received from Landsat-7 in the years 2000 and 2015-2016, and the considered area was divided into 7 sections with regards to the change in the land use, including farms, aquatic resources, forests, bushes, greenswards, and deserted lands. The results showed important changes in the land use in 2000-2016 for the mentioned area.

2. Materials and methods

2.1. Introducing the studied region

The studied area is Rudasht basin in Esfahan province. which is located in the southeast of Esfahan, in Central Iran, consisting of the two sections of north and south in the end part of Zayandeh Roud basin next to Gavkhoni lagoon. The geometrical coordinates of it are 52°-53° 52' E and 20°-34° 32' N, and the studied area of Rudasht basin is located in the altitude range of 1431.76-1538.04 m, as shown in Figures 1 and 2. Thus, it is rather a high land with regard to its altitude.

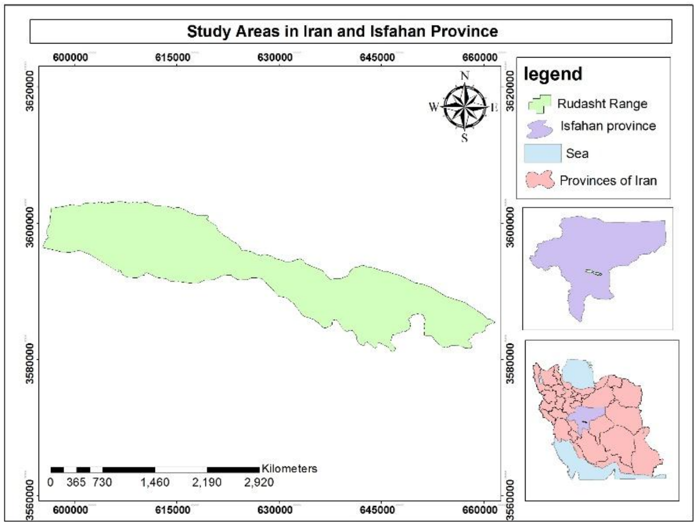


Figure 1. View of the studied area in Iran and Esfahan province.

Figure 2. View of the studied area by Google Earth.

2.2. Methodology

The considered images are Landsat for the years 1984 and 2015 and Quickbird related to 2013 and 2015. The following stages were done for the study:

2.2.1. Geometric correction

Geometric errors cause displacements, deformations, and change of situations on the images. Hence, it is required that the errors to be removed from the images or at least reduced.

2.2.1.1.Method of geometric correction of the images used in this study

a) Selection of benchmarks on the map and determining them on the images – At this stage, the benchmarks are determined on the satellite images, the selected points are specified at places that can easily be identified, and also the density of points in the whole image is homogeneous. The unknowns of the models should be solved by using the land benchmarks for the relationship between the image coordinate system and the land.

b) Determining the coordinates of the benchmarks in the image and land systems – The land benchmarks are taken by GPS receivers. The benchmark coordinates on the image are also determined by the row and column coordinates.
c) Determining the transformation model and analyses of the errors and RMSE – At this stage, using ENVI software, the benchmarks are used as Ground Control Points or Check points. the check points are considered to analyze the errors, regarding the number of taken points and a fifth of them in scattered form are introduced as the check points in the software. Finally, the model remaining errors and the check point error will be obtained for the geometric corrections.
d) Calculating and finding the unknown parameters of the model – After introducing the benchmarks to the image, the software will calculate the unknown parameters of the model, and since the equations are cubic, there will be 20 unknown parameters.
e) Creating a new network of the pixels, and resampling – The simpler the sampling method, the image will encounter less distortion. “Nearest” method is used in this project that is the simplest method of resampling.

2.2.2.Creating the colored images: Combination of colors (237 and 123, 246 and 123) for the images in 1984, 2003, and 2015, and the agricultural lands with regards to its exclusive features could clearly be distinguished.

2.2.3.Image classification:

a) Identifying the existing land uses in the region – With regards to the identification of the region, analyzing the existing land uses in the area, and using the maps of the Agricultural Organization and the topographic maps (1:50000) of the Geographic Organization of the Armed Forces and related specialists, the required field analyses, assessing fallows, man-made locations, gardens, deserted lands, rivers, green areas and agricultural areas in the region are considered.
b) Selecting the classification method – Analysis pixel base-image is used in this regard; a classic method in classification of appropriate satellite images with the spectral data of the image that is in pixel-pixel form, in which each pixel can be allocated to a class. Classification of the base pixel can be done in supervised and unsupervised classifications. “Maximum likelihood” is considered so far as the most accurate and mostly used method among the supervised classification methods, which is used in this research. Maximum likelihood method evaluates the variance, and covariance of the classes. Thus, it is assumed that all the educational regions have normal transmittal. In fact, the samples of the educational classes should define the classes. Hence, as many as possible samples were used in this study in order to observe considerable changes of the spectral features in this respect.

2.2.4. Evaluation of the classification accuracy, obtained by the general accuracy and Kappa coefficient – General accuracy is a mean of classification accuracy, showing the ratio of the classified correct pixels to the total of the definite ones. Kappa coefficient calculates the classification relative to a quite random classification. Kappa coefficient has this advantage as compared to the general accuracy that uses the non-diagonal elements of the error matrix for the calculation of accuracy.

2.3. Implementation

Some benchmarks were selected by GPS for the geometric correction of the images. No correction was done on the images of 2015 due to proper conformity of the images with the road maps of the surveying organization. The results of the geometric corrections of the used images in this study were such that the rates of RMSE for the images of 1984 and 2003 were obtained to be 0.48 and 0.42, respectively, as shown in Figures 3 and 4 as georeferenced images.

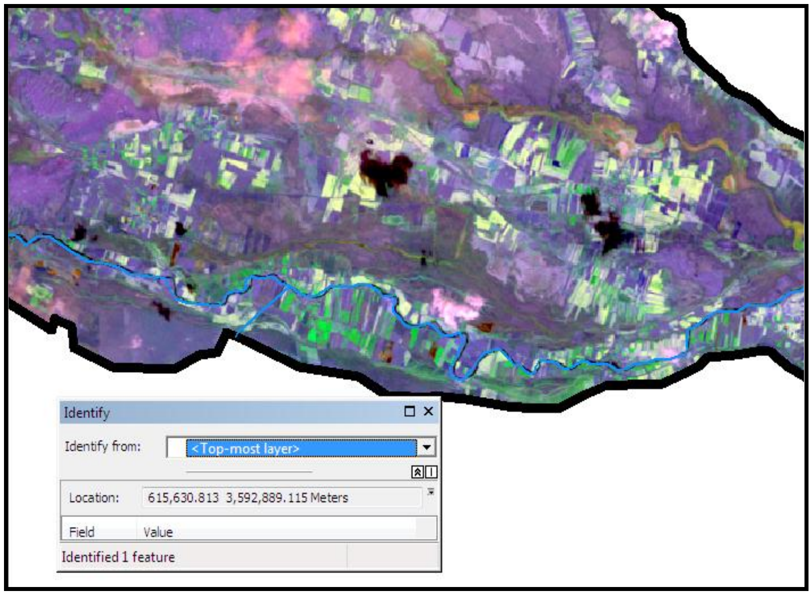


Figure 3. A view of the conformity of the image of the aphorisms with the image having coordinates by Landsat (1984)

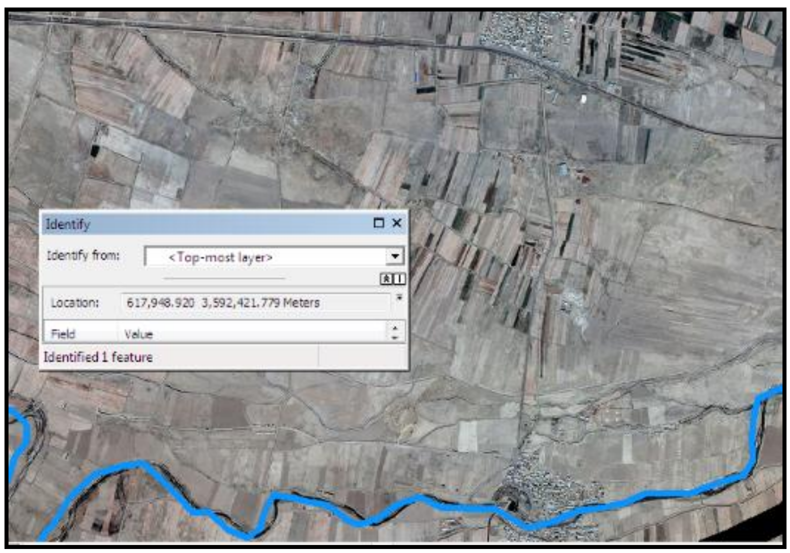


Figure 4. A view of the conformity of the image of the aphorisms with the image having coordinates by Quickbird (2003)

Among the colored images used by the combination of colors, by which the agricultural lands were quite distinguishable, were the combination of the colors (237 and 123, 246 and 123) in this study for the images taken in 1984, 2003 and 2015, as shown in Figures 5, 6, and 7.

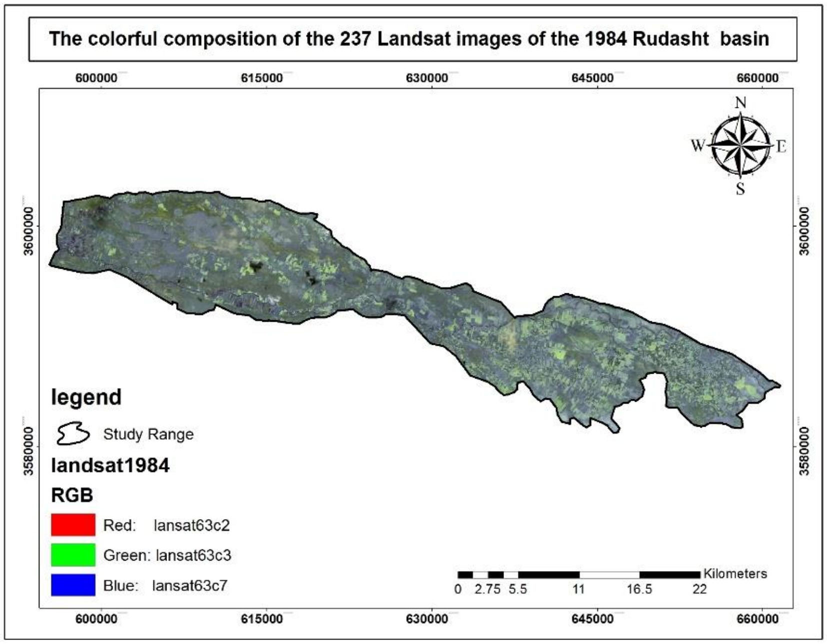


Figure 5. Color combination (237) in 1984 by Landsat

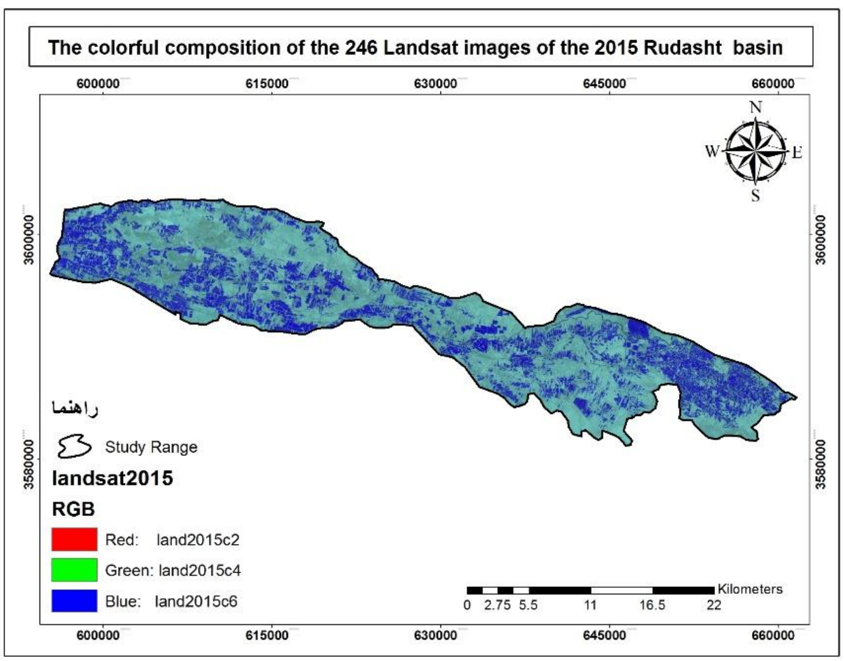


Figure 6. Color combination (246) in 2015 by Landsat

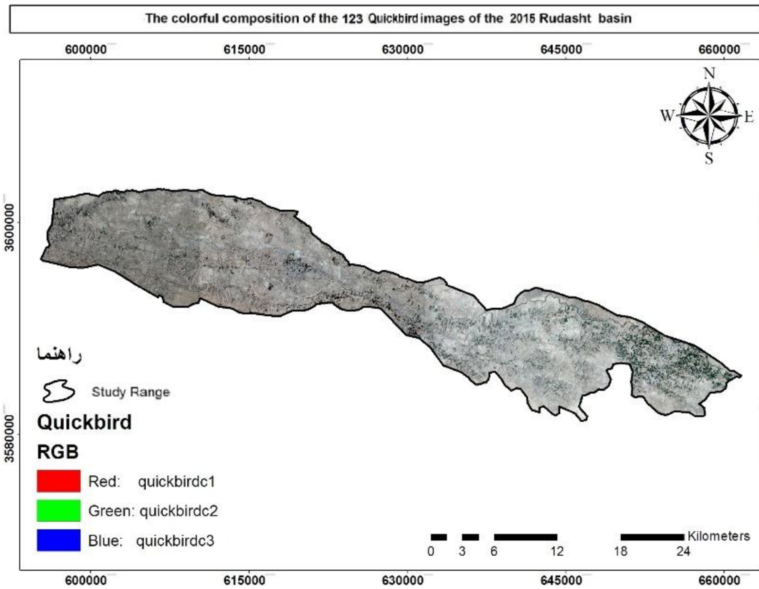


Figure 7. Color combination (123) in 2015 by Quickbird satellite

For the image of the studied area, the land use classes were defined according to the field visits and the experts' viewpoints. The land use classes included fallow land, man-made regions, gardens, deserts, rivers, green areas, and agricultural areas, the land use images of which for the years 1984, 2003, and 2015 were prepared with the maximum likelihood method, as shown in Figures 8 and 9.

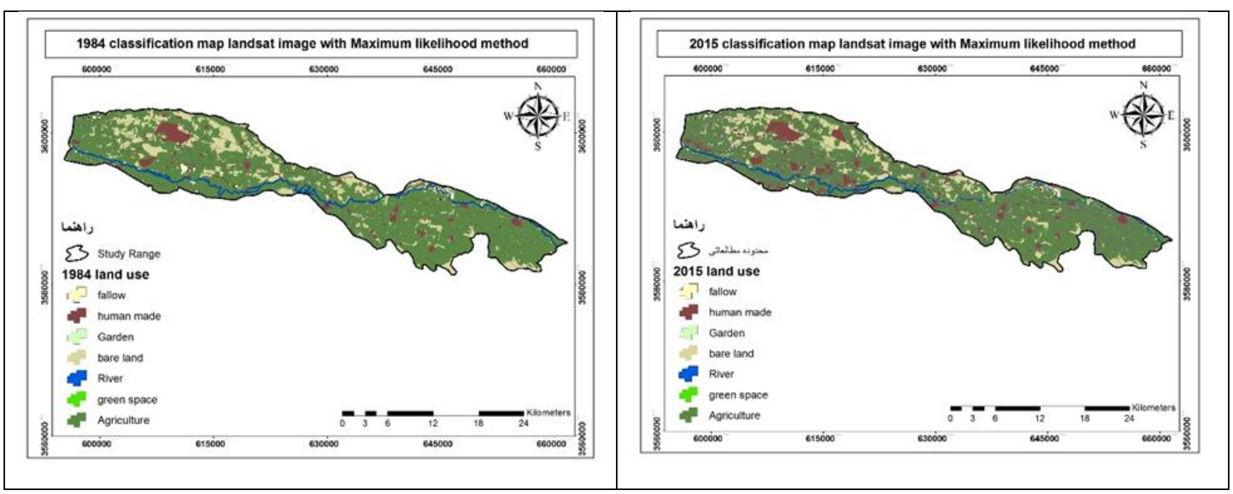


Figure 8. Classification image for 1984 and 2015 by Landsat, by maximum likelihood classification method

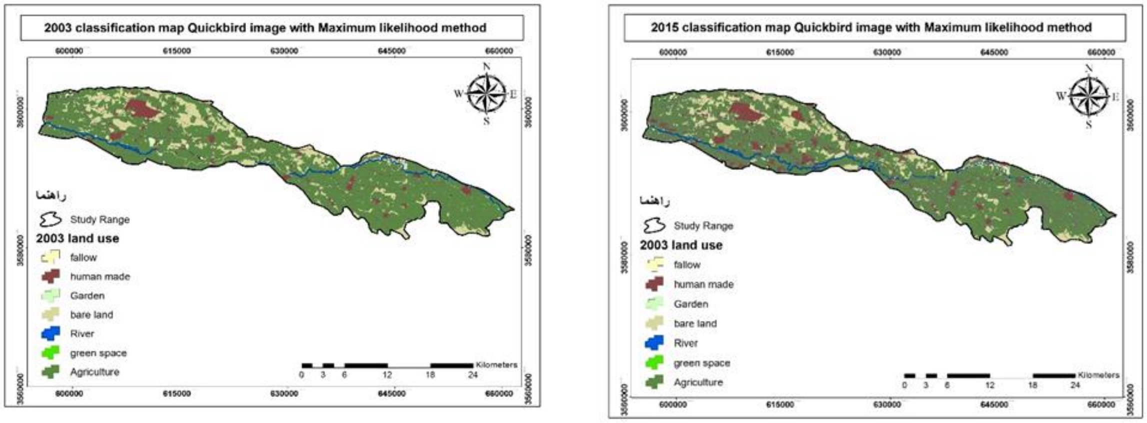


Figure 9.classification image for 2003 and 2015 by quickbird, by maximum likelihood classification method

3. Results and discussion

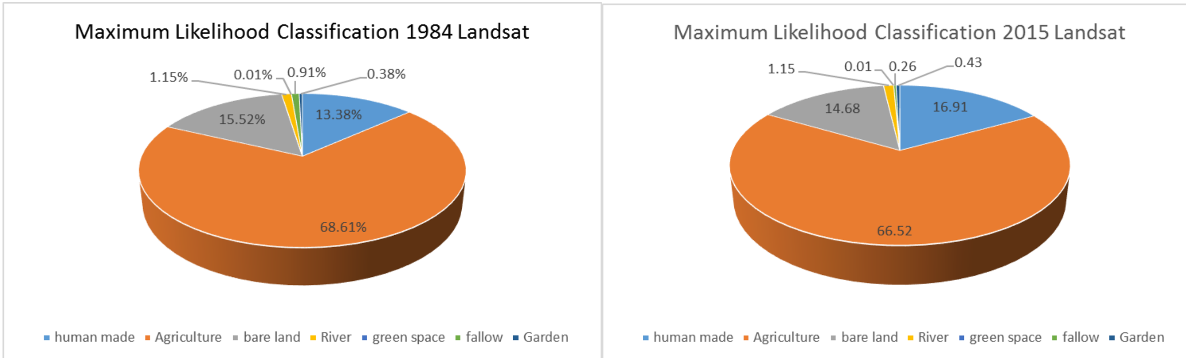
The Landsat and Quick bird images with the resolutions of 30 m and 2.5 m were used in this study. The required preprocesses were first done on the images, and after creating the color composition, the images for the years 1984 and 2015 were classified, and then the agricultural lands were specified. After that, the agricultural lands in the images of the studied periods were separated by the classification method and their cultivated areas were calculated. The results for the areas under cultivation of the remote sensing technique were compared with the results for the cultivated areas received by the agricultural organization and the results were considered as follows:

3.1. Analyzing the changes in the levels of land uses

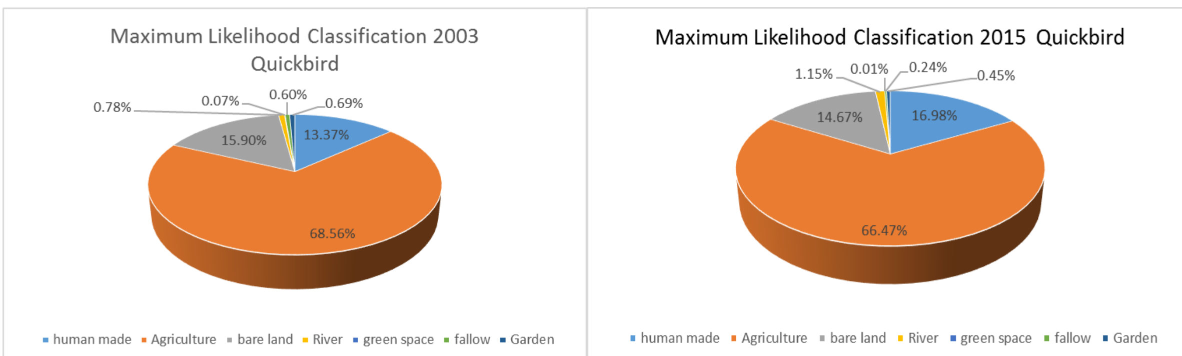
After the classification of the images, the required information was entered in the GIS system, the areas of the land uses were calculated, and the changes were specified, as shown in Table 1. The rates of land use for 2003 and 2015 are shown in Graphs 1 and 2.

Table 1. Area and the changes in the land use levels according to Landsat and Quick bird images

No.	Land use	Area of land uses: Landsat 1984 (Hectare)	Area of land uses: Landsat (Hectare)	Changes in the levels 1984-2015: Landsat images (Hectare)	Changes in the levels 2003: Quickbird images (Hectare)	Changes in the levels 2015: Quickbird images (Hectare)	Changes in the levels 2003-2015: Quickbird images (Hectare)
1	Man-made	6641.3009	8390.7961	1749.5	6634.0292	8424.4121	1790.38
2	Agricultural	34043.2366	33004.7544	-1038.482	34017.0504	32980.8141	-1036.236
3	Deserted	7700.1049	7285.5078	-414.5971	7893.1654	7280.4672	-612.6982
4	River	574.114	574.114	-	388.3252	574.114	185.789
5	Green area	9.4789	8.234	-1.2449	35.6651	8.234	-27.4311
6	Fallow	453.9372	218.126	-322.7347	300.5869	224.2741	-180.3844
7	Garden	190.807	131.2025	27.3146	344.1574	120.2025	-119.8833



Graph 1. Classification of maximum likelihood – by Landsat images



Graph 2. Classification of maximum likelihood – by Quickbird images

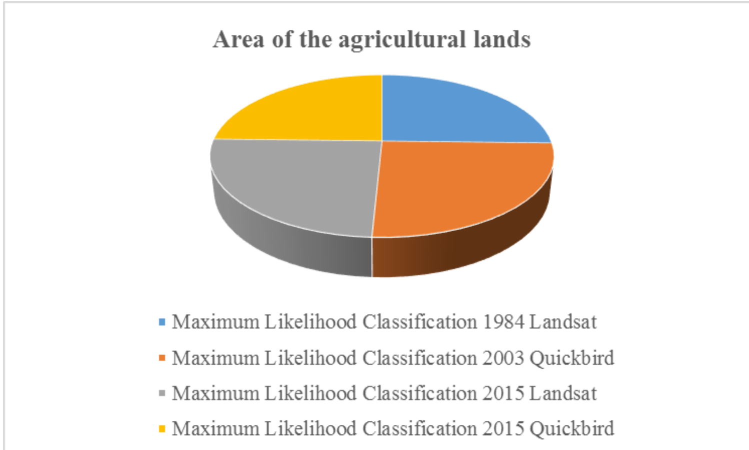
By analyzing the changes of the agricultural area in Rudasht region by Quickbird images from 2003 to 2015, the reducing trend with 1036.236 hectares and by Landsat images from 1884 to 2015 and the reduction by 1038.482 hectares have been observed while the lands with man-made constructions have always increased. The deserted and man-made lands have increased due to the reduction of agricultural lands (Table1).

3.2.Identifying all the agricultural lands and gardens in the studied area

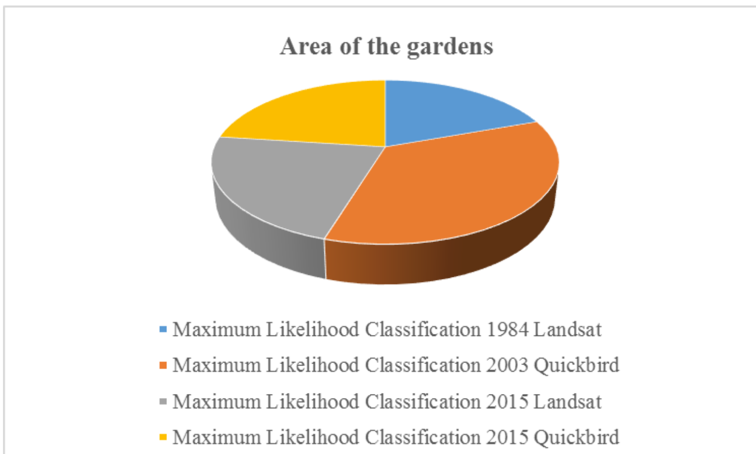
After putting the satellite images and the required data in GIS software, processing, interpreting, and classifying of the images identified the agricultural lands and gardens will be done. At this stage, the agricultural lands were separated in the classified images for their areas to be determined out of the whole studied area within the studied period. The changes of agricultural lands and gardens are shown in Table 2. The areas of the agricultural lands and gardens are determined in Graphs 3 and 4.

Table 2. Changes of the agricultural lands and gardens in the studied period

Images	Area of agricultural lands	Garden areas
Classification of maximum likelihood: Landsat (1984)	34034.2346	190807
Classification of maximum likelihood: Quickbird (2003)	34017.0504	344.1574
Classification of maximum likelihood: Landsat (2015)	33004.7544	218.1216
Classification of maximum likelihood: Quickbird (2015)	32980.8141	224.2741



Graph 3. Area of the agricultural lands in the studied area



Graph 4. Area of the gardens in the studied area

3.3.Evaluation of the classification accuracy

The prepared land use maps were compared with the GPS points and the existing situation of the region, and the Kappa coefficient as well as the general accuracy were obtained by using the matrix for the established error. Kappa coefficient and the general accuracy are acceptable in case they have a rate of over 70%. Otherwise, the classified points should be reclassified by new GCP, and the new Kappa coefficient and the general accuracy should be recalculated.

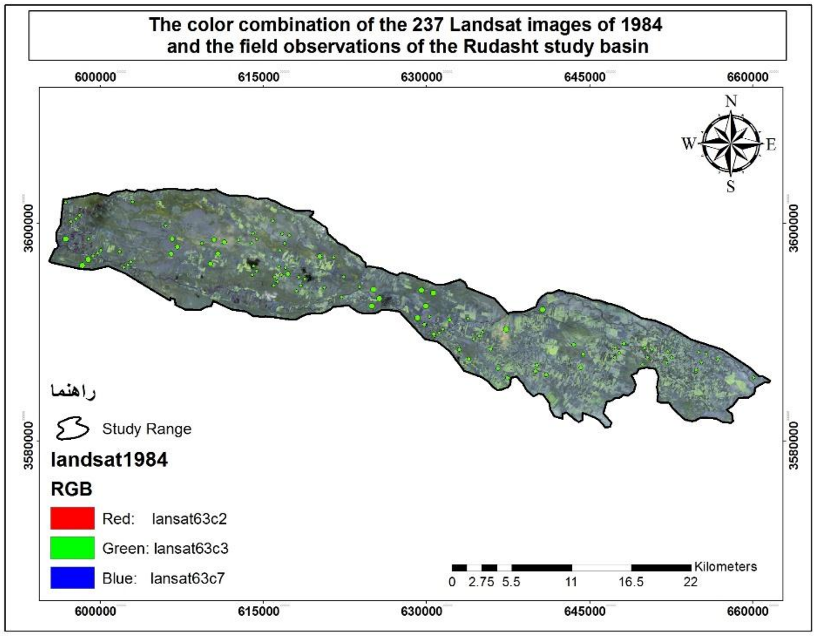


Figure. 10. Satellite image of the studied area and the taken GPS points

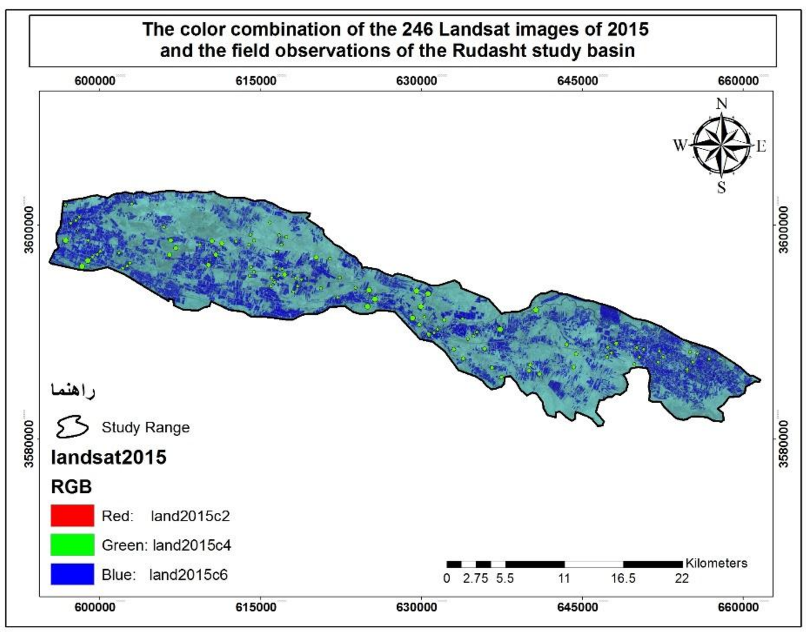


Figure 11. Satellite image of the studied area and the taken GPS points

Table 3. Kappa coefficient and the general accuracy of the land uses by separate satellites in the classification of maximum likelihood

Statistical parameter	Landsat 1984	Landsat 2015	Quickbird 2003	Quickbird 2015
Kappa coefficient	0.7967	0.8461	0.8576	0.8643
General accuracy	0.8461	0.8881	0.8709	0.8911

3. Conclusion

Preparing the land coverage maps is essential in natural resources and environmental management to study the plans for the land, identifying the capacity of the lands, and it is considered as an important information source for making principle decisions and organizing the developing programs. Preparing the land use drawings in intermediate scale from different regions without field techniques and interpretation of aerial photos is costly and time consuming, due to the wide areas of lands and impracticable passages. Since the type of land usage and coverage in the basin area are among the important features, precise determination of it as a management parameter can aid the planners in different executing sections in managing and developing water resources in the basin area. Regarding the spectral similarity of the phenomena and the unevenness of such regions, the spectral information cannot only be adequate for the classifications and precise distinguishing of different classes.

After applying the geometric corrections, different controlling technics were used for the changes. Analyzing the geometric quality of images used in this study showed that the images have appropriate quality. Proper conformity of the leveled roads and water ways on the geometric corrected images indicated the proper capability of the method of benchmarking the land for correcting the images. The geometric correction results of the 1984 and 2003 images with the RMSE for both images were obtained 0.48 and 0.42, respectively that were in conformity with the research by Weng et al. (2002) who did the geometric correction of the images by Landsat-TM by using the topographic images (1:50000) to analyze the change in the land use in Zhujiang Delta in China, reporting the rate of RMSE of three images in 1989, 1994, and 1997 to be 0.73, 0.62, and 0.58 pixels, respectively, and also with the studies by Khodakarami and Sefianian (2012), Arkhi (2014), and Moradi et al. (2016). The rates of RMSE of greater than “1” pixel for clear changes lead to higher or lower estimations than the real rate of changes. Generally, the results obtained from this study have been compatible with the obtained results by Hosseini et al. (2016), Mullupttue (2013), and Cheruto et al. (2016).

By the obtained results from the error matrix for the max. likelihood method, it can be observed that this method has high accuracy, which is indicated in Tables 2 and 3, and the optimized performance of it depends on the educational data and their normal distribution. The results from the supervised classification, which is introduced according to the educational samples and from different compacted levels with appropriate dispersion in the region, showed that the accuracy of each level was acceptable in the supervise classification, but the accuracy in all the land uses was obtained to be 75%. It can generally be said that the accuracy of the classified methods was appropriate in all the studied years. Darvishsefat et al. (1997) stated that if the region is rather even and has less unevenness, the rate of accuracy of the used methods will be increased.

Revealing the changes is one of the common applications of remote sensing, which has various technics to execute it. Selecting the appropriate method of revealing the changes depends on the aim of the study, the region specifications, and the existing data, having considerable importance in the obtained results. The comparison technique after the classification is one of the most prevalent methods of revealing the changes, which in addition to the types of changes; it also determines the change in the area of each classification. The areas of different agricultural land and garden classes were calculated according to Table 1, showing that according to the max. likelihood classification, the area of agricultural lands, based on Landsat images from 1984 to 2015, reduced by 1038.482 hectare, while the reduction shown by Quickbird satellite was 1036.236 hectares. According to the max. likelihood classification, the area of gardens, based on Landsat images from 1984 to 2015, reduced by 27.3146 hectares, while, according to Quickbird, the reduction was 119.8833 hectares from 2003 to 2015.

The general results from the present study can be classified as follows:

- The remote sensing devices can be used as an important factor in generating the information in management of natural resources and agricultural lands.
- Existence of Landsat images related to the past years can be considered as a reliable source of data.
- Comparing the images and analyzing the expressed classification verifications, the Quickbird images were determined to be more appropriate than the ones from Landsat.
- The most important problem in using satellite pictures in analyzing the land use changes is the lack of land benchmarks from the past years.

- The obtained information from comparing the maps regarding the plant coverage should be evaluated according to the lateral information.
- Field operations are essential for optimum interpretation of the images, increasing the accuracy of the results.
- The results of such studies can be used in estimating the physiologic compaction of the population, determining the distribution, and extend the land uses as well as other environmental studies.
- The values and prominence of using the satellite images can be found, in case the time factor and the estimated cost for the cultivated area by this method are compared with the land surveying data, and if the errors due to the applied field studies that are mainly by human interventions are taken into consideration.

References

Ahmadi Nadoushan, M., Safiyanian, A., & Khajeheddin, S. J. (2014). Survey of land cover changes in Arak city using remote sensing and GIS. *Journal of Environmental Technology Science*, 93.

Alavi Panah, S. K. (2006). Remote Sensing in Earth Sciences. *Tehran University Press*, p. 437.

Arkhi, S. (2014). Predicting the trend of changes in the location of land uses by using LCM model in GIS domain. *Scientific – research two-seasonal magazine of supporting and preserving the jungles and pastures*, 1(12).

Bakhtiarifar, M., Saadi Mesgari, M., Karimi, M., & Chehrqani, A. (2011). Modeling the change of land use by multi-criteria decisions and GIS methods. *Environmentology publication*, 58(37).

Butt, A., Shabbir, R., Ahmad, S. S., & Aziz, N. (2015). Land use change mapping and analysis using Remote Sensing and GIS: A case study of Simly watershed, Islamabad, Pakistan. *The Egyptian Journal of Remote Sensing and Space Science*, 18(2), 251-259.

Cheruto, M. C., Kauti, M. K., Kisangau, P. D., & Kariuki, P. C. (2016). Assessment of land use and land cover change using GIS and remote sensing techniques: *a case study of Makueni County, Kenya*.

Darvishsefat, A. A. (1998). *Text book of remote sensing. Natural resources faculty, Tehran University*, p. 164.

Davoodi Monazam, Z., Hajinejad, A., Abbasnia, M., & Pourhashemi, S. (2014). Control of the land use changes by remote sensing. *Remote sensing and GIS in natural resources journal*, 1(5).

Givi Ashraf, Z., & Sarjargar, A. (2011). Controlling the land use by remote sensing for evaluating the desertification. *Geomatic National Conference*.

Hegazi, I. R., & Kaloop, M. R. (2015). Monitoring urban growth and land use change detection with GIS and remote sensing techniques in Daqahlia governorate Egypt. *International Journal of Sustainable Built Environment*, 4(1), 117-124.

Hosseini, M., Karimi, M., Saadi Mesgari, M., & Heydari, M. (2016). Designing and implementing an integrated modeling system for changing the land use of urban areas. *Geographical science publication*, 40(16).

Javanmardi, S., Faraji Sabokbar, H., Yavari, A. R., & Pourkhabaz, H. R. (2011). Evaluating the suitability of lands for agriculture by GIS. *Environment researches*, 4(2).

Khodakarami, L., Sefianian, A. (2012) "Application of multi-time remote sensing in determining the cultivated land" *Agriculture and natural resources science and technology and water and soil sciences journal*, 59 (16)

Mahdavi, E., Kiani, M., & Daneshvar Ameri, J. (2017). Evaluation of Barriers to Agricultural Land Integration. *Iranian Journal of Agricultural Economics and Research*, 48(2).

Mallupattu, P. K., Reddy, S., & Reddy, J. (2013). Analysis of land use/land cover changes using remote sensing data and GIS at an Urban Area, Tirupati, India. *The Scientific World Journal*.

Moradi, A. R., Jafari, M., Arzani, H., & Ebrahimi, M. (2016). Evaluation of pasture land use to dry farming by satellite pictures and GIS. *Remote sensing and GIS in natural resources journal*, 1(7).

Pakpour Rabti, A., Jafarzadeh, A. A., Shahbazi, F., & Ammari, P. (2013). Evaluation of susceptible lands for crops using GIS in some regions in West Azerbaijan, *Water and soil publication*, (23).

Pilehforoushha, P., KMarimi, M., & Taleie, M. (2014). Determining the suitable lands for crops by using GIS and fuzzy inferring systems. *Remote sensing and GIS publication*, (6).

Weng, Q. (2002). Land use change analysis in the Zhujiang Delta of China using satellite remotesensing, GIS and stochastic modeling. *Journal of Environmental Management*, 64, 273-284.

Zangiabadi, A., & Abolhassani, F. (2013). Applying GIS and RS in planning for the spatial control by emphasis on agriculture sub-section. *Geographical information (Sepehr) magazine*, 86(22).