Investigation and Identification of Govkhoni Arg using Sat Light Images (Land Sat ETM+)

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Abstract: *Erg of Gavkhooni Playa is one of the important geomorphologic landforms of Quaternary period in Iran. The area is located on the western part of Gaovkhoni Playa and 140 km to the Southeast of Isfahan, Iran. This study presents a display of landform of Erg and the area has been divided into three parts (North-Central and South). The objective of this study is to identify geomorphologic faciese by GIS t and RS. The research method is a processing technique such as basis analyzing, a composite of panchromatic band with multi-spectral band, to examine line spectral curved, to examine optimum composites using an enhancement method such as filtering and contrast. As a result, to display sand landforms and geomorphologic faciese such as Barkhan, Safe, Star hill, playa's faciese, Skirt and Delta, Sand Zone and the sediment between the hills and geomorphologic landform map are based on Erg of Gavkhoni Playa and geomorphologic faciese of the area.*

Keywords: *Erg Govkhooni Playa, Erg morphology, land sat images, geomorphologic map.*

1. INTRODUCTION

Ergs are like the largest and dynamic density landforms of the wind erosion system and playa's faciese area. In Iran, in desert areas there are over 40 active wind erosion centers. They are the outcome of the Quaternary climatic dry period and the present time. The area of the desert is over 80 million hectares such that 35 hectares of the area is composed of sand hills and wind erosion landform while 2.5 hectares of the area is located in Esfahan. In Esfahan, wind erosion lands are 1866026 hectares of which 1219420 hectares are affected by wind erosion and 646606 are affected by sediment. Near Isfahan there is an area with the largest wind erosion near Govkhooni Playa. The area is about 265700 hectares of which 240942 hectares is affected by wind erosion and 24758 hectares is affected by sediment. Erg of Govkhooni Playa is the largest wind erosion area in Esfahan city which will be the focus of this study.

A number of researchers who have studied the Erg area are Mahmoodi (1994), Tabatabaee (1995) and Pakzad (2004). In this research, Erg landform has been identified by a remote sensing technique and GIS environment.

The remote sensing technique and application of land sat images are one of the best techniques to identify and enhance geomorphologic landform in the desert area. The method of this study is the use of land sat images (ETM) to recognize and enhance Erg landform in the western part of Govkhooni Playa. The method involves digital data such as land sat images. On processing the land sat images, involves geometric corrections, examining composite band, using PCA, applying panchromatic (ETM) to composites of multi-spectral and spectral curve. The result of the study was to identify Erg landforms by resolution of geomorphologic faciesses and to make a geomorphologic map of Erg which could be used to identify geomorphologic landforms in desert areas.

2. STUDY AREA

Gavkhooni Playa is a subside of Negen-Quaterner located 140 kilometer of Esfahan. During the pelio-quaternary, the Govkhooni playa was larger than its present form. One study has been identified that pleo realms of Govkhooni playa are in 4 trace.

The continuous climatic Quaternary has controlled the back and forth movement of the realms of playa and the formation system of the area as well as the geomorphologic processing. At present, the time wind erosion function is an important system for formation in the area. Geomorphologic landforms of the area are pediments, alluvial plane, deltas, flood plains and salt area. There are suitable landforms for wind activities. Wind erosion causes forms and wind landform such as Erg which are located in the western part of the Govkhooni Playa. And Govkhooni Playa is a base level and stationing factor for wind activities in the area.

The geographic location of the Erg is 52, 40 to 52, 47 East and 32 to 32, 24 North. The Erg of Ghovkhooni Playa is limited to the south of Zayandeh Rood delta, the western part of Govkhooni playa, North Ezadkhast pediment and East flood plain of Varzneh and Khara.

In this study, land sat (ETM) images with a row of 163-38 on May 27th 2000 and ETM spectral band have been used. High quality images are selected in order to identify landform desert and sand dune with a high ability. The images are important to recognize the dimensions of landform and geomorphologic faciesses and to enhance the landforms.

In this study, the data formats are based on B.S.Q or continuous band format and all the images converted the band in ER-Mapper environment. ILWIS, ER-Mapper and Arc view were used for processing and analyzing. The vector data are like the topography map on a scale of 1:250000 within Abadeh and Naeen city and the topography map on a scale of 1:50000 of the study area.

Filed work has been done in the study area to make geometric corrections and to check processed images in 5 stages. The image-processing technique will be explained shortly.

2.1. Examination of Spectral-Curves Bands and Combination of Different Colors

A profile was made to examine the relationship between the bands and identification of the conduct of spectral curves of sand dune in the study area using the composite colors of spectral curves.

The profile shows different conducts of the spectral of bands in the North, Center and South of the study area. Because of dynamics and density of sand dunes in North of the area compared with the central and southern parts of the Erg area in the central and southern parts are reduced to dense sands, sediments in between the hills and sand zone that affect the conduct of the spectral bands. On the other hand, the conduct of the spectral curves varying from South to North and in some bands completely and some other in similar ways is active. Therefore, when spectral curves overlap, bands have a significant correlation.

Considering the northern part, the conduct of the spectral curve bands of 3, 5, 6, has a high reflection because they are separate from each other. While, in the center and south of the Erg area there are high reflections in the realm of bands 3, 5, 6 which are distinct from the spectral curves.

Upon examination of the spectral curves, numerous composite bands such as 653, 356,742.321, and 432,531 have been examined. Among the examining real and false color composites such as 321,742 and 432 are the best composite colors to recognize and identify the Ergs area.

2.2. Integration of Bands

In order to increase the resolution of spatial multi-spectral bands to 15 meters, integration or fusion of panchromatic bands has been done. On the other hand, integration, combination, and composition of spatial information 8 bands of images with multi-spectral images of ETM bands were prepared.

Composite color 472,432 and 321 were used to recover the spatial resolution of multi-spectral bands to reach 15m.This operation has been completed on ER-Mapper using a BROVY algorithm.

A line-contrast moderate histogram method and spatial filtering put-up gradient type or sharpen- 12 were used. Using this method, it was made possible to identify the different landforms of the North, Center, South and sand dunes of certain sections of the Erg in Govkhooni playa (fig.4, 5)

Figure1. *Shows Spatial Vew of Govkhooni Erg by Combing 4, 3, 2 Band*

2.3. Analyzing Main Components (PCA)

In this study, the aim of using PCA technique was to reduce the dimension of the multi-band data to two or three main components. Using this method, it was made possible to identify more geomorphologic facieses. In fact, it could be type of convert for compression of information.

Incidentally, first the base component (PCA l) and composite main components (PCA 123) were used to operating the bands and extract the main components in order to distinguish landforms and Erg facieses.

2.4. Mapping DEM (Digital Elevation Model)

In order to use this method, a topographical map with 1:50000 scale was converted to digital data processing, mosaic and then converted to vector which was completed and then the internal method Digital Elevation Model map was made. The aim of this process was only to display the realm study area with a composite of 4, 3, 2 bands using overlaid Digital Elevation Model.

2.5. GIS Operation

GIS software was used in order to make geometric corrections to the sat light images prepared by Digital Elevation Model, measuring the area, length and width of the Erg area and mapping the geomorphologic map.

2.6. Preparation of Different Composite Bands

The images were cleared and contrast by examining the spectral curves and testing different real and false composite bands such as 432, 742, 731 and321 by enhancing the conduct such as filtering and using the contrast line of the images. By this method it would be possible to identify sand facieses and analyze the geomorphologic realm of the Erg.

2.7. Analyzing the Geomorphology of Erg Using Composite Different Images

Processing the images was performed in order to display the landform of the Erg area. Therefore, some images were made with different composites in the form of colorful and single colors as well as black (Fig 5). By using the result from the base component mentioned in the methodology, three images were made by composites of three components in the form of single bands (PCA1) (Fig, 2-3-6 of third image).
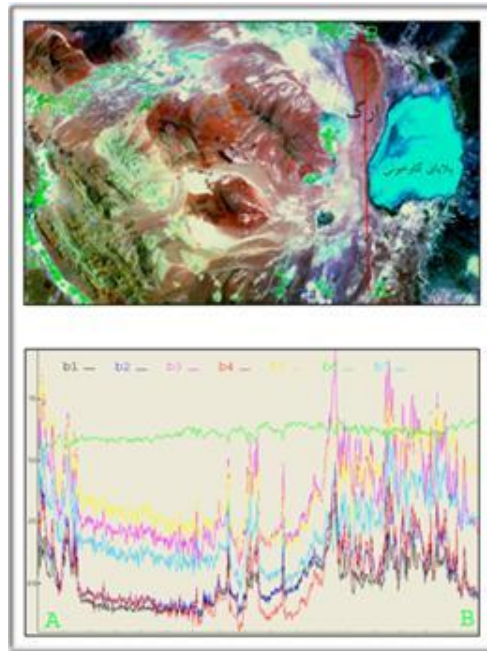

Figure2. *Spectral Response Characteristics of Gavkhoni Erg Sand Faces in Different Bands*

False color images sere made with 742 and 321 bands in order to make a clearer conduct of the spectral curves in different parts of the Erg area. (Fig, 3)
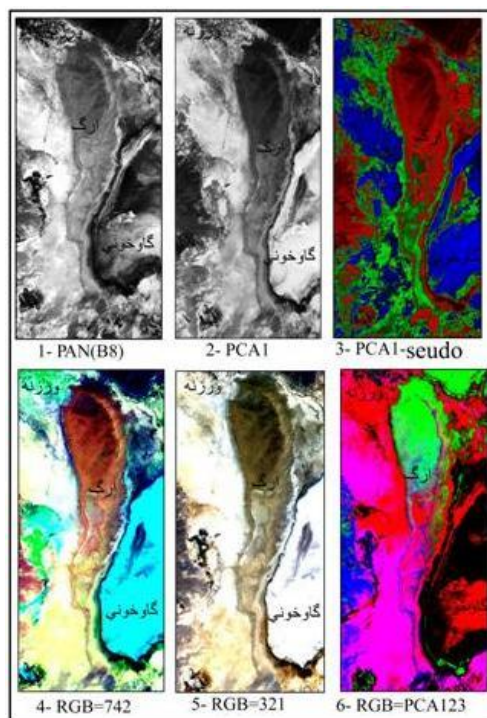

Figure3. *Representation of The Outer and Evolution of Gavkhoni Erg by Various Image Processing Techniques.*

All of the combination and images had positive responses to display the landform of Erg in the western part of the playa and the whole appearance of the area. In the entire combination images, Erg

was shown in long form with North-South direction showing the difference of the origin of the sand in the Erg in North and South of the area (RGB=PCA123). On the other hand, the maximum density sands were observable in the Northern part of the area. To make the entire images, enhancement methods involoving filtering and line contrast were used.

2.8. Analyzing the Landform of Different Parts of the Erg Area by Land Sat Images (ETM)

In order to enhance the different parts of the Erg area, three combination false colors were used. Figure 4 shows 3 images of the different parts of the area in North-Center and South in different colors and combinations. In this study, such parameters as pattern, shape and color were used for investigation of the images.

According to (Fig 4), the density of the sands was decreased towards North to South. The factors of density for sands in the Erg were a high level of groundwater and humidity of soil, numerous sources of sands such as Zayandeh Rood delta, pediments and alluvial fan in the North, flood plain West of the Erg, wind activities and to carry the sands from Segzi plain and North of Isfahan city. On the other hand, in Northwest of the area, for sand to be removed and the place is a dent because of the dynamics and speed of the moving sand by the Westerly wind North of the Erg area. Fig 4 shows the high density of vegetation by combining the false green color (742) in the North of the Erg area.
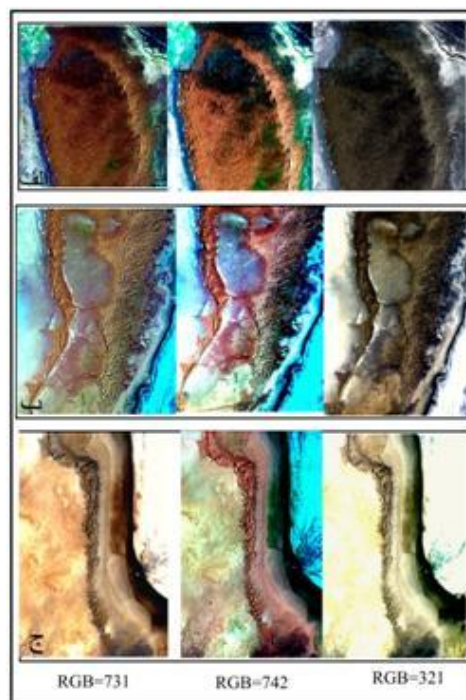

Figure4. *Representation of Different Parts of The Gavkhoni Erg in Various Color Band Combinations that have been Obtained by The Integration of Information a)North b) center C) South.*

Some parts of the area are artificially covered by human activities in the North and Northwest of the area. In order to protect agricultural lands and human activities in Varzaneh from sand storms and in the internal section of the North part of the Erg area and boundary of the Zayandeh Rood Delta, there are wild vegetations because of the high level under the groundwater and wet soil. During field work, in different parts of the Erg area, it was visible that the boundary of Erg had been moved by climatic change in the quaternary period. Continuous sedimentation of sand in pediment, lakes, profile of Ganat and underground wells in Varzaneh and Hasan Abad state shows the movement of the boundary Erg in the Quaternary period. In Holosen, unlike the present time the sand dune in North of the Erg area has been located in the Western as well as the Southern parts of Varzaneh. Traces of sand dune and civilization of Govkhooni playa under sand dune shows the movement and activities of the Erg area during the Quaternary period.

In the middle part of the Erg area, sand dunes were converted to sedimentation of the hills. Sedimentation of the hills are like geomorphologic facieses involving tiny layers of thick sand made by rainfall and evaporation. This facieses help stabilize the sand which located under the facieses from wind erosion.

Khara Namak road is located in middle part of the Erg area. Sand broads are located in the Southern part of Erg and sand dunes are in the West and East parts of the area. Sand broad helps stabilize blowing of the sand. Some sand broads are located on the boundary of the playa and Erg, the boundary of Zayandeh Rood Delta, North-West of the Erg, Western and Eastern parts of the Erg. Because there is an exchange of sand between the Erg area and playa Evaporation sediments in the middle section of the playa and boundary of the Erg and playa. This broad of geomorphologic facieses has been shown in fig 7. Below are factors of low density and extent of the sediments in between the hills in the south and middle of the Erg area.

There is the proximity of South area to the mountain, alluvial fan, delta and pediplain of playa. There are no sources of sedimentation. Whereas, in North of the area there are positive sources of sand which such as Zayandeh Rood Delta, clay plain, North pdiplain and flood plain from the western part of the Erg area and Segzi plain in East of Isfahan city which is far from the Erg area. The speed and direction of the wind from the southern to the northern parts of the area there are other factors. On the other hand, the direction of the slope playa from the Northeast to the Southwest causes sand broad of the Eastern part of the Erg with playa composite facieses, puff up facieses and clay salty land in the cold and rainy time of the year and the level of water is high in Govkhooni Playa.

2.9. Extraction Patterns and Sand Forms in the Realm of the Erg Area Measurement of the Erg Area Using GIS

The power of spatial resolution is high for controlling the separate spectral spatial images and the size of the sands by enhanced operation. In order to identify the patterns and forms of sands, spatial separating of images (to integrate information of single-band panchromatic ETM+ false- color combination) has reached 15m. As a result, the forms and hills were identified whose spatial dimensions were higher than those of the integrated images. Then, the sand forms of the Erg area were extracted by enhancement operation, filtering and magnification. Therefore, the sand hills of the Erg Govkhooni playa and the main group such as sand broad, sand hills, Barkhan, Saif hills, long hill sand and star hills has been displayed in four forms (Fig. 5). Most of the sand in the area was displayed in a smaller dimension. The largest hills in the North and central section of the Erg area are in the form of Barkhan and are originated from the wind function blowing from the West. The sand broads are located in most parts of the area. The sand hills are located in center and south of the Erg areas with the largest extensions. Star hills are like the second sediment in the center of the area which have been in existence alongside of the intersecting hills and continuous wind function. In the south and center of the Erg area there is some Barkhan in sight. During field work, all of the forms and processed images are tested.
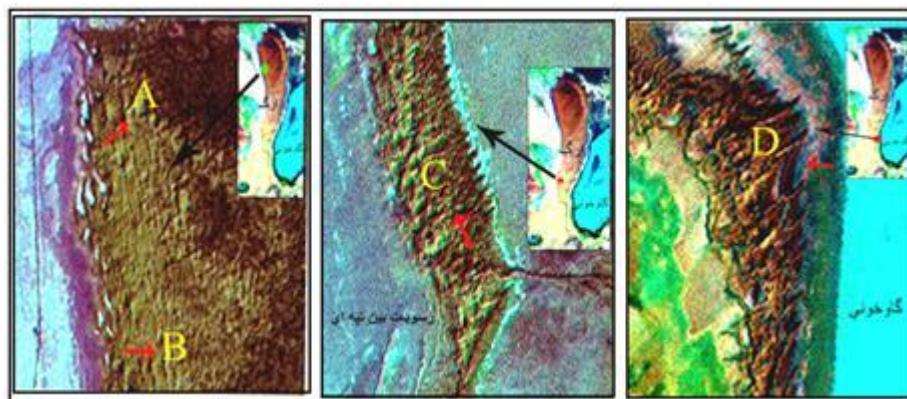

Figure5. *Representation of Sand Forms and Forms of Citadel with Information Integration and Image Processing Techniques. A) Dune b)Steep hills C) Hills D) Barkhan.*

2.10. Geomorphologic Mapping of Erg and Govkhooni Playa Area

Upon processing of the images and combination of the different colors, the study area was checked by field work. The next stage was a combination of color and bands to recognize the landform and geomorphologic facieses of Erg and Govkhooni playa. The combination of colors was 432 and 742. By using magnification operation and putting the processed images as background, the subject layer was extracted from all of the facieses and the sand landform by visual the interpretation method and monitoring of the draw method in the IL WIS software environment and then the layer was converted

to a vector layer in the GIS environment (Fig 6, 7). Once the format was converted to a vector of the images, polygons of the Erg fancies and sand landforms were measured in the Arc view environment. Depending on the operation, the area of the Erg (without sand broad is 145 km and with sand broad is 180 km). The length of the Erg area is 40 km (with sand broad) and the width is 20 km in the North and 5 km in the South.
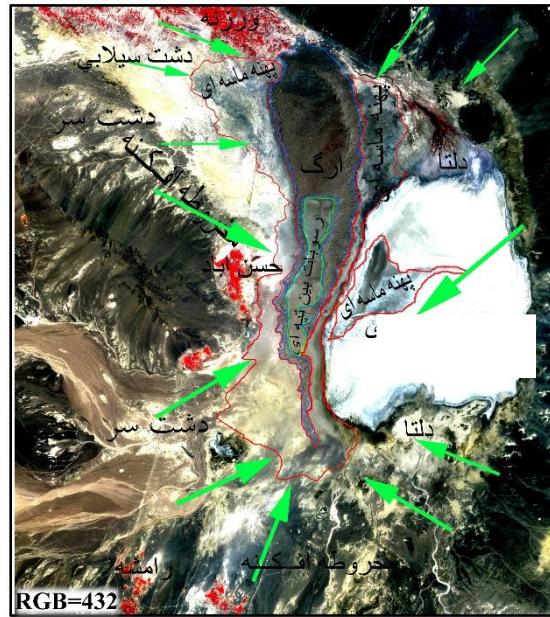

Figure6. *Differentiation of Different Facies of Gavkhoni Erg and Its Outlines on the Analyzed Image with False Color Combinations 4,3,2 Bands.*

The variety and contrast of the forms and facieses are the results of a variety of geomorphic shortage, river and wind functions.

Therefore, the geomorphologic facieses of the Erg area including the flood and clay plain from Northwest and West, clay and sand broads from the East side (the common boundary of the Erg and Govkhooni playa), sand broads of the West side of the Erg, and salinization of Govkhooni playa in the East side. All of the facieses were tested in the course of field work.

3. CONCLUSION

In this study, an important wind density geomorphic form of Govkhooni playa was recognized by processed land sat images (ETM). The sand area is a heritage of the dry climatic Quaternary period of the Eastern part of Isfahan. The remote sensing technique plays an important role in the study of the Ergs and in the identification of the boundary and realm of the Erg area. Such parameters as arrangement of the Erg, dimensions and forms of the sands and power of the spatial separation of the spectral images affected the efficacy of satellite images for enhancement and recognition of facieses and sand hills forms. The integrated operation of the panchromatic bands with a combination of 742 which is the best false color has a positive response to the separate facieses and Erg landform. To apply the technique of the base spectral (PCA), the combination of images has responded to the landform and sand forms of the Erg area. The Erg of Govkhooni playa is the long Erg with Northsouth direction in the West of Govkhooni playa which because of the high humidity of the underground and volume of the sands decreases from North to South. Based on the analyses made from the land sat images, the Erg area has been divided into three parts: North, Center and South. The sands of the Erg area of the Govkhooni playa are of four forms: Sand broad, sand hills, Barkhan, Star hills and Saif. The geomorphologic map and facieses of Govkhooni playa was drawn for the first time. The Erg area is the largest center for wind erosion in Govkhooni playa with some potential occurrence of such materials as minerals, tourism, near human activities area and dynamic energy. Therefore, it is essential to focus more attention and planning on management.

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