Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env.Pharmacol. Life Sci., Vol 4 [4] March 2015: 86-95

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804

ORIGINAL ARTICLE

Relationship between Geology and landform classification in southeast of Iran

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ABSTRACT
*In the research aim is to evaluate the Jennes algorithm for landform classification and their suitability for predictive mapping of geology and relationship between landform classification and geology in southeast of Iran. The Jennes's approach uses a multi-scale approach by fitting a quadratic polynomial to a given window size using least squares. In the study used window size of 3*3 and 10*10. Input data for landform classification is digital elevation model (DEM) with resolution of 30 m. After prepared landform classification map for the study area, used geology map. The results show that the evaluated method can be helpful in the predictive mapping of geology. The algorithm of landforms classification proposed by Jennes seems to be the most applicable method.*
Keywords: *landform classification, Jennes algorithms, geology map, digital elevation model.*

Received 26.12.2014 Revised 08.01.2015 Accepted 21.02.2015

INTRODUCTION

Geomorphometric properties have been measured by calculating the geometry of the landscape manually that can be time consuming [4, 10]. Landform classification has been used as basic georelief descriptors in soil and vegetation and land use mapping [5] for a relatively long time. Utilization of automated landform classification started in 1990s [3, 8]. Recently, advances in computer technology, new spatial analytical methods and the increasing availability of digital elevation data have re-oriented geomorphometry [13, 14]. Several papers document applicability of landform classification and relationship with mapping of land use especially in steep land areas [16, 18]. There are new opportunities in this field, resulting from existence of relatively precise global and regional digital elevation models. However, the terms and methods used in different fields of science vary in detail [2, 12]. Landform units can be carried using various approaches, including automated mapping of landforms [12, 15, 16, 17], classification of morphometric parameters, filter techniques, cluster analysis and multivariate statistics [1, 6, 7].
The aims of in the paper is preparing landform map based on Jennes algorithm and determination of relationship landform classes with mapping geology in the southeast of Iran.

MATERIALS AND METHODS

The case areas were selected from ten different locations in Zagros Mountains in north east and east that consist of: Shahoo, Grain, Oshtorankooh, Zardkoh, and Dena mountains. The study area is located at 27º 18′ 00′′ to 29º 53′ 24′′ N and 51º 18′ 36′′to 54º 48′ 00′′ E, with area of 4779.1 km^2. The locations of the case areas are shown in Figure 1. The case area was selected from southeast of Iran (Figure 1 and Table 1). Digital elevation models were include SRTM DEM (30 m resolution). The NASA Shuttle Radar Topographic Mission (SRTM) produced DEM with spatial resolution of 30 m.

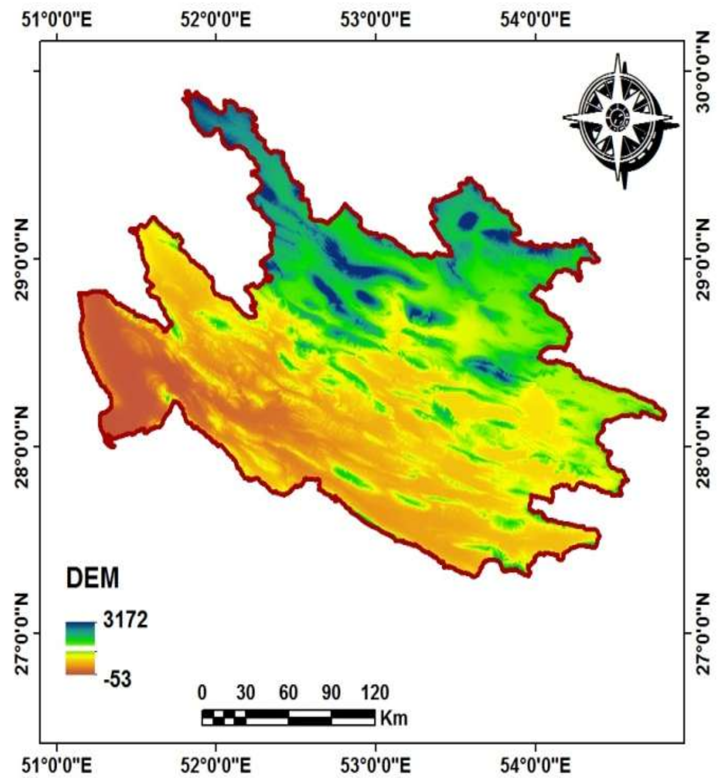


Figure 1: Digital Elevation Mountain (DEM) of the study area

Table 1. Characteristics of the cases study

Name	Elevation (m)			Slope (°)	
Shahoo	Max: 3172	Min: -53	Mean: 1028	Max: 89 º	Min: 0

Methods of classification

The topographic position index (TPI) [9] used in the study area. This method was further developed by Weiss [19] and Jenness [11]. TPI (Eq. (1)) compares the elevation of each cell in a DEM to the mean elevation of a specified neighborhood around that cell. Mean elevation is subtracted from the elevation value at center.

$$TPI_i = M_0 - \sum_{n-1} M_n / n \quad (1)$$

where;

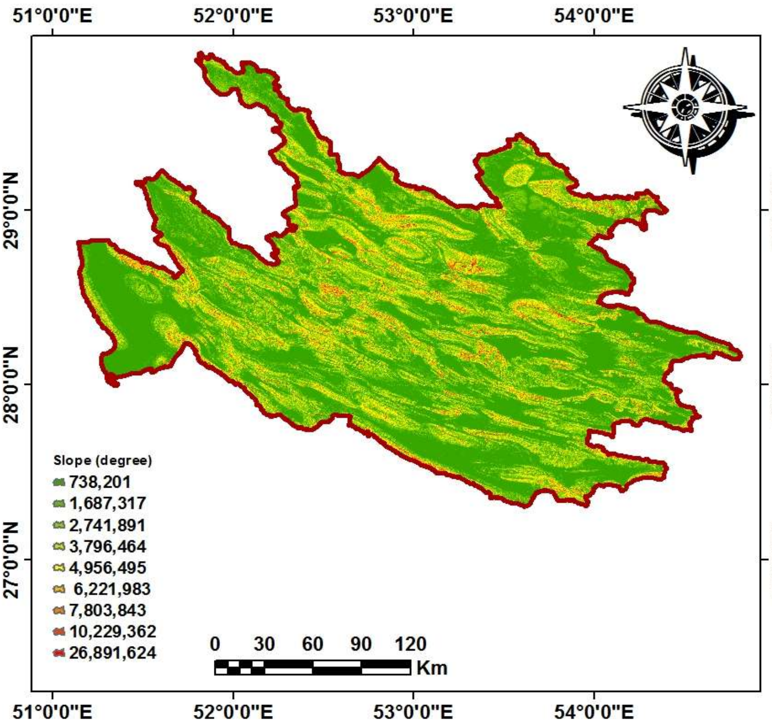
M_0 = elevation of the model point under evaluation

M_n = elevation of grid

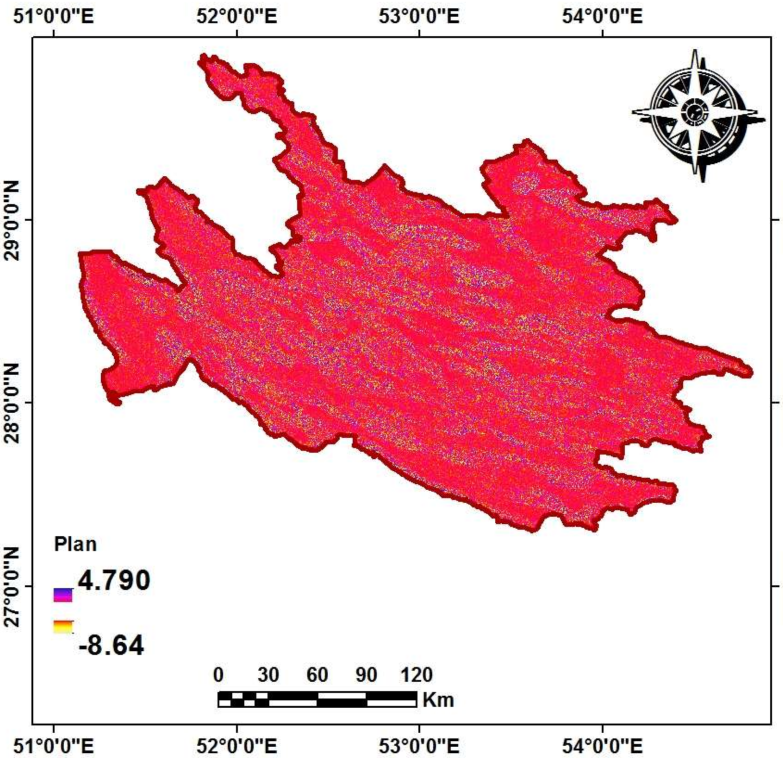
n = the total number of surrounding points employed in the evaluation

RESULTS

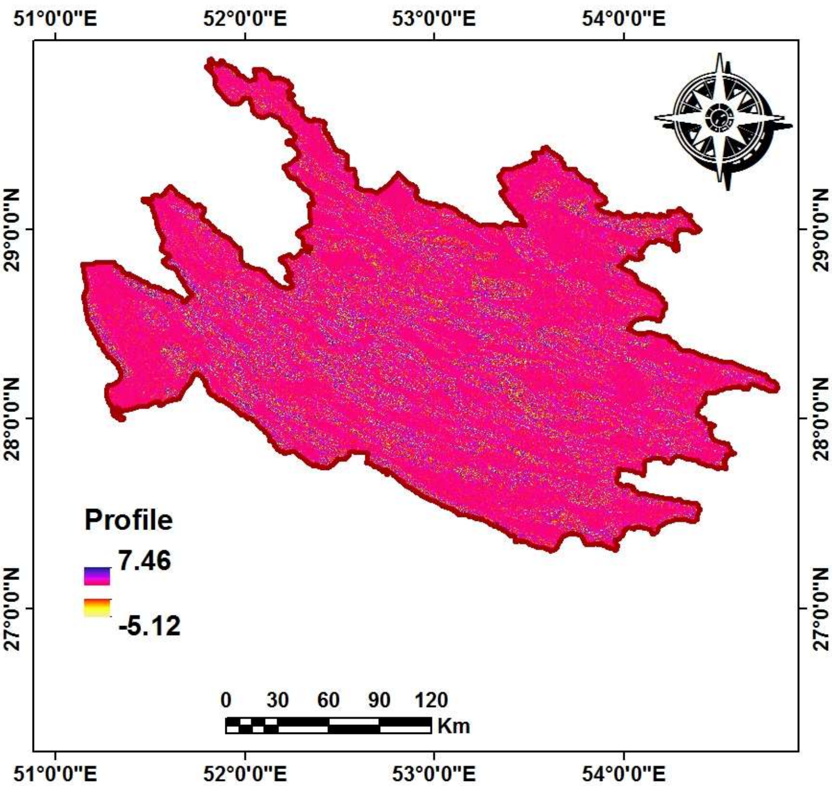
Different values of input parameters (slope, curvature, plan, profile, elevation) (Figure 2) used for preparing landform classification.


51°0'0"E
52°0'0"E
53°0'0"E
54°0'0"E
29°0'0"N
28°0'0"N
27°0'0"N
Slope (degree)
738,201
1,687,317
2,741,891
3,796,464
4,956,495
6,221,983
7,803,843
10,229,362
26,891,624
0 30 60 90 120
Km

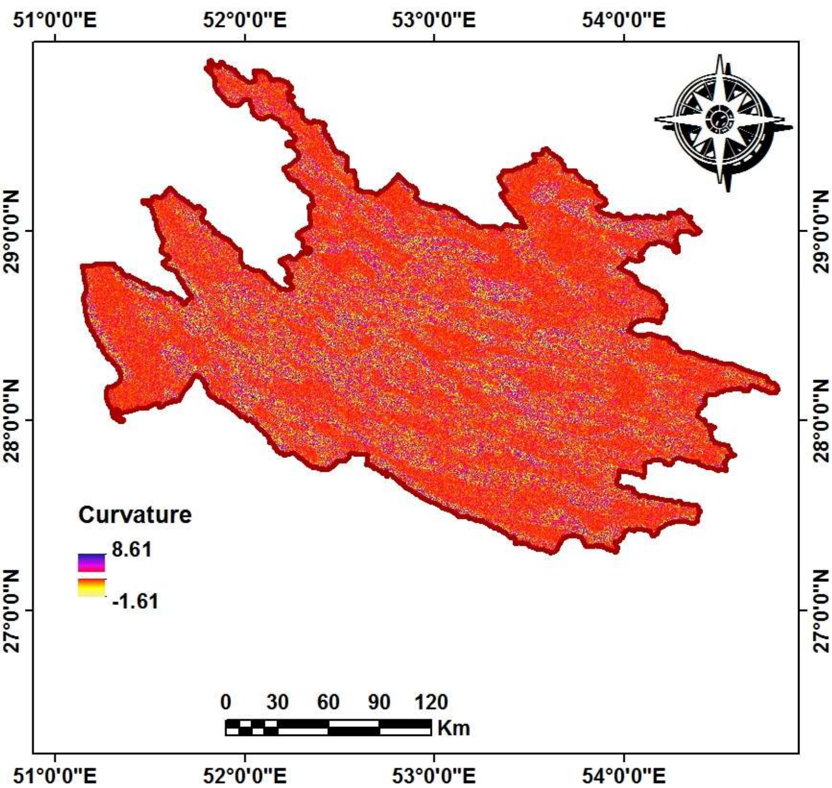
slope


51°0'0"E
52°0'0"E
53°0'0"E
54°0'0"E
29°0'0"N
28°0'0"N
27°0'0"N
Plan
4.790
-8.64
0 30 60 90 120
Km

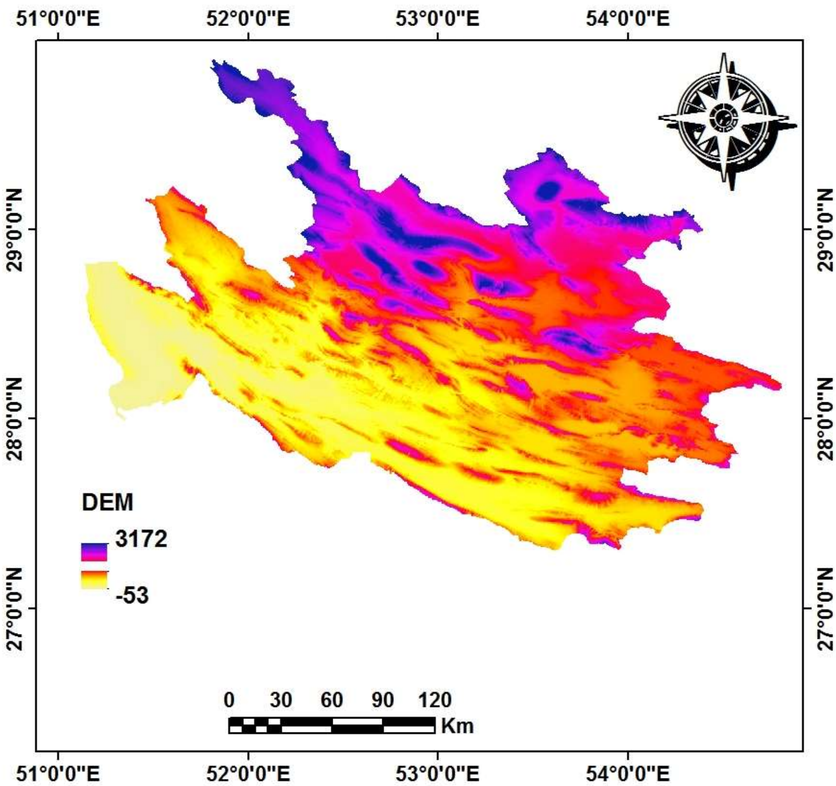
Plan



Profile



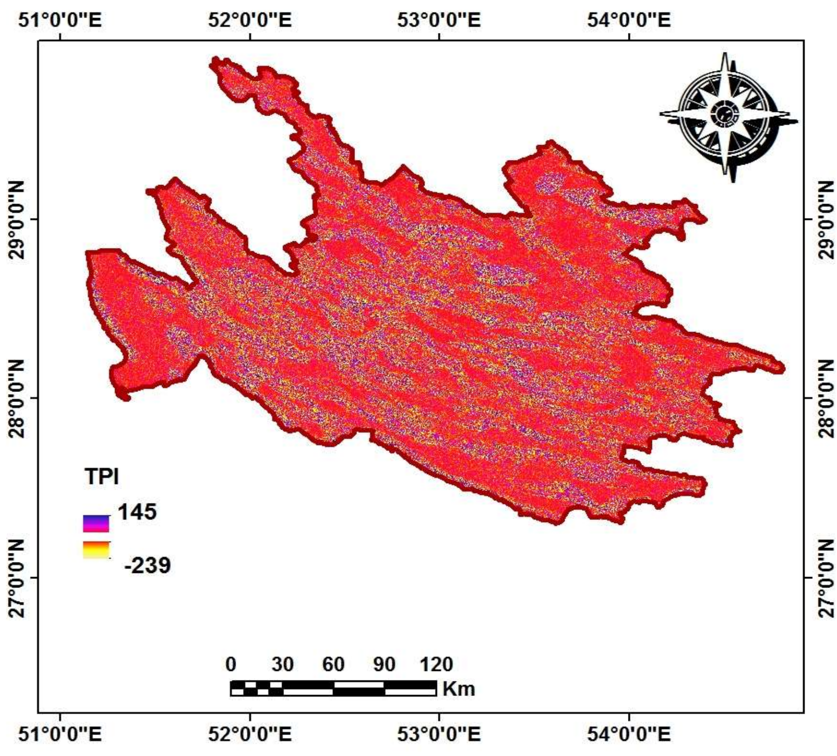
curvature



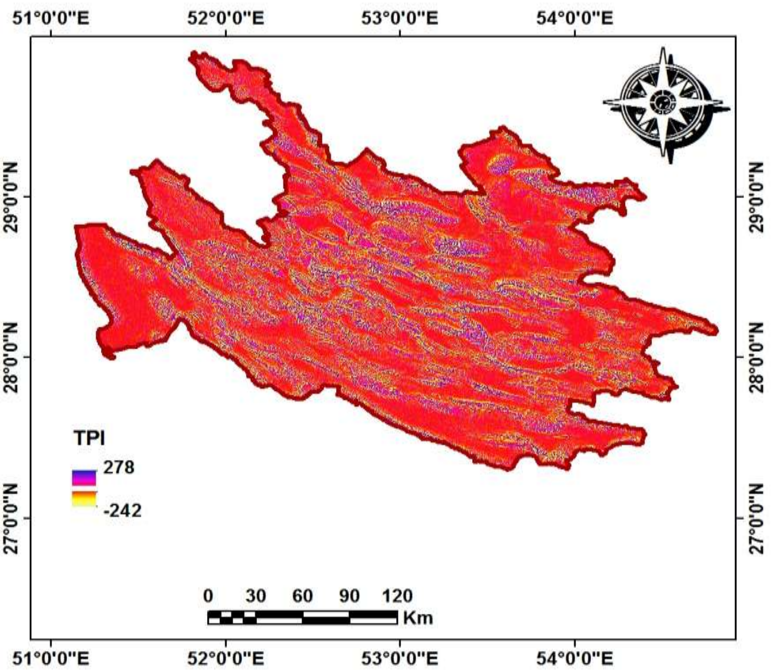
DEM

Figure 2. Input data for landform classification

For landform classification via Jennes algorithm, first of all prepared TPI map for each cases that show in Figure 3. According to Figure 3, minimum and maximum TPI is -239 (red) and +145 (blue) for scale 0f 3*3 and -242 (red) and +287 (blue) for scale of 10*10.



3 * 3



10 * 10
Figure 3. TPI value for the study area

After prepare TPI map for each of the cases study, the landform classification map were created (Figure 4 and Table 2). Landform classification maps generated based on the computed TIP values are shown in Figure 4. For this method, the classes consist of canyons/ deeply incised streams, midslope drainages/ shallow valleys, upland drainages/headwaters, u-shaped valleys, plains small, open slopes, upper slopes/mesas, local ridges/hills in valleys, mid slope ridges/small hills in plains, mountain tops/high ridges.

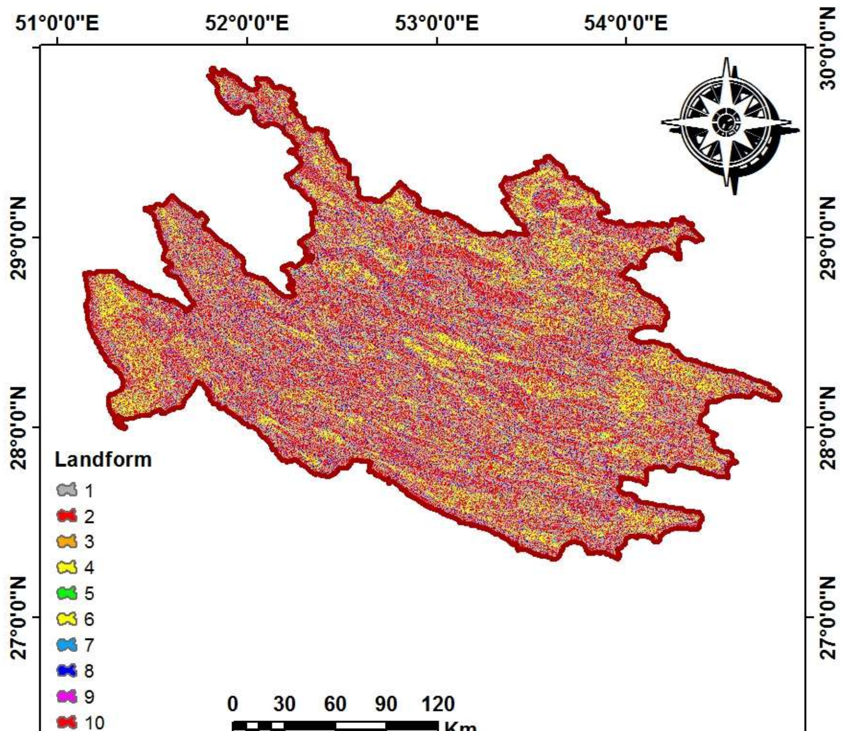


Figure 4. Landform classification map

The area for the each of classes show in Table 2 and Figure 5.

Table 2. Areas of features for the landform classification maps in Figure 4.

Code	Classes	Area
1	Canyons, Deeply Incised Streams	18889.12
2	Midslope Drainages, Shallow Valleys	858.85
3	Upland Drainages, Headwaters	1959.46
4	U-shaped Valleys	3421.09
5	Plains Small	11.67
6	Open Slopes	3207.10
7	Upper Slopes, Mesas	1572.59
8	Local Ridges/Hills in Valleys	2069.62
9	Mid slope Ridges, Small Hills in Plains	1294.90
10	Mountain Tops, High Ridges	14368.59
	Sum	47653

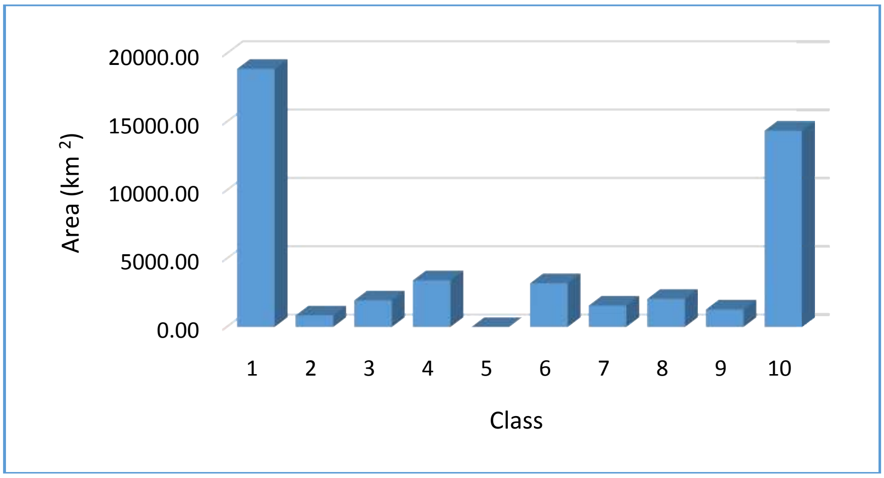


Figure 5. Area for each of classes

Also the geology maps (Figure 6) and relationship with landform maps was prepared for the study area. The results of the geology maps shown in Figure 7 and Figure 8.

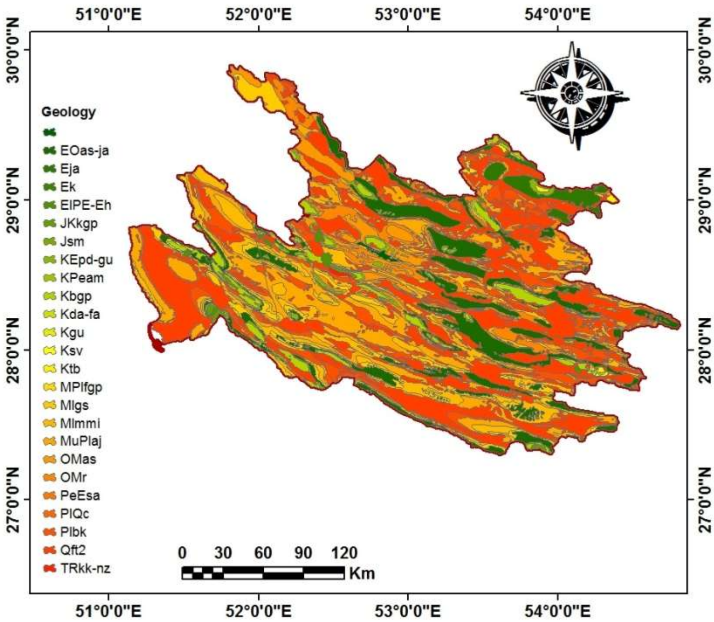
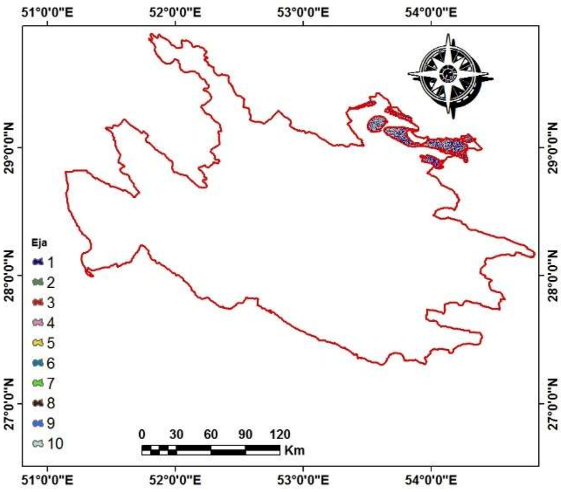
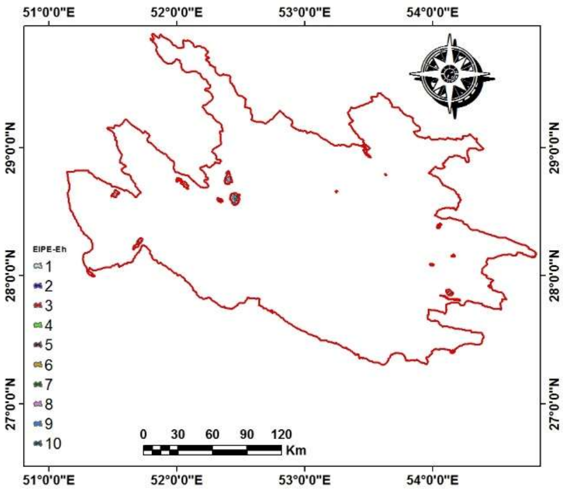


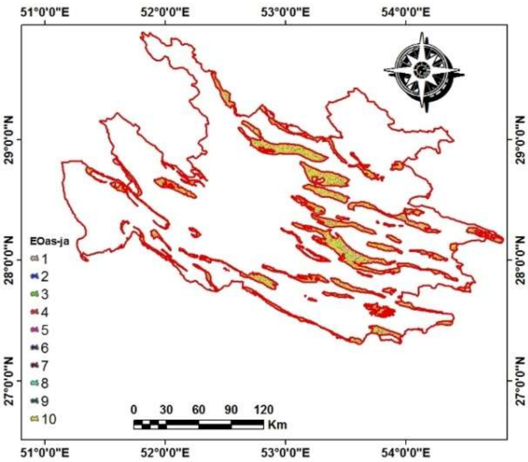
Figure 6. Geology map for the study area



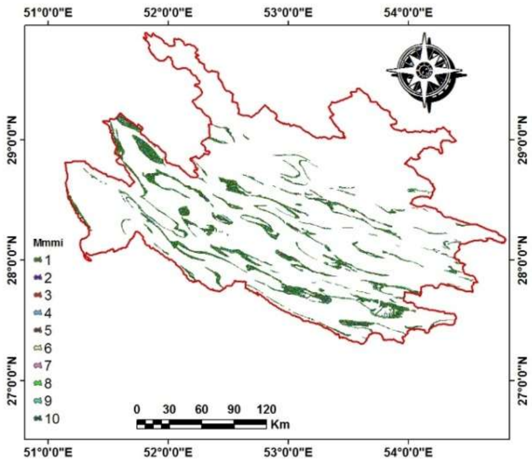
Eja



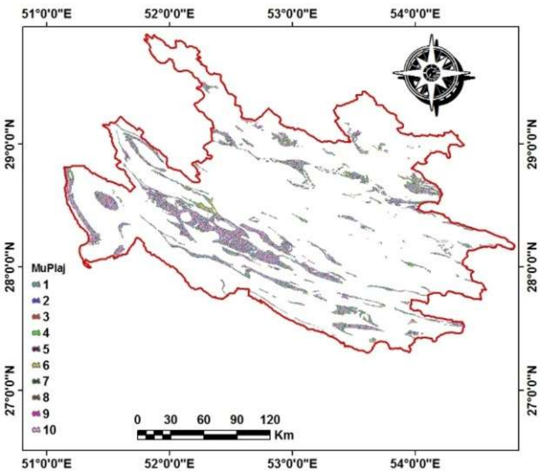
ElPE-Eh



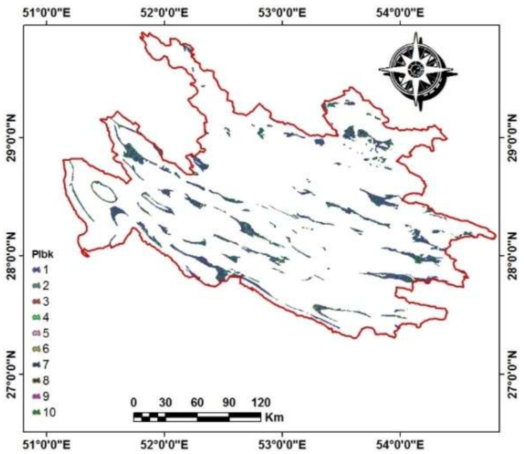
EOas-ja



Mmmi



MuPlaj



Plbk

Figure 7. Geology units that located in landform classification

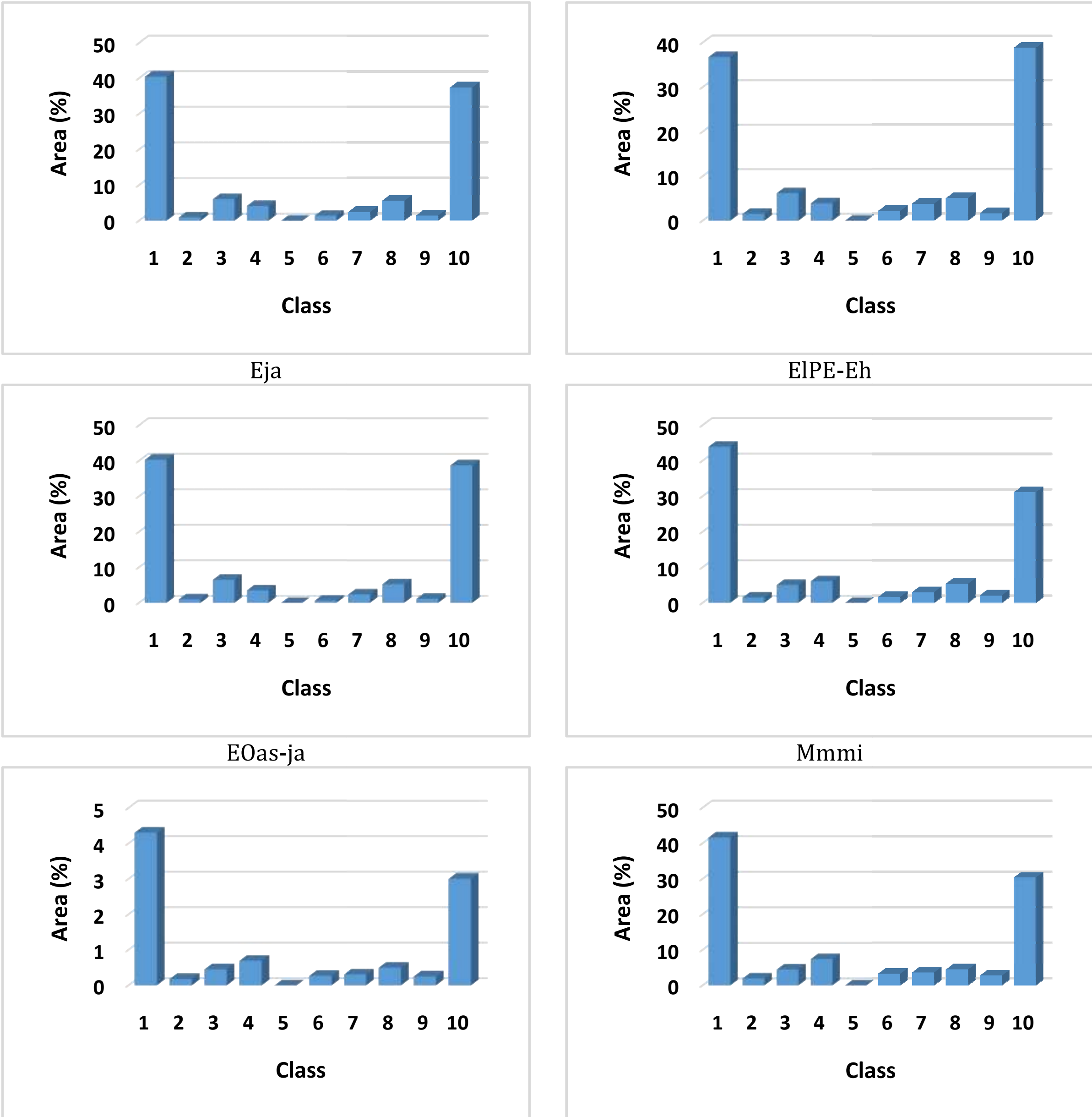


Figure 8. Area of each of geology unit that located in landform classification

Table 3. Area of the each of geology units for the study area

	plbk1	muplaj	mmmi	eoas-ja1	elpe-eh	eja
1.00	41.71	4.31	44.00	40.36	36.83	40.51
2.00	2.01	0.18	1.55	1.05	1.59	1.00
3.00	4.53	0.46	5.09	6.56	6.23	6.14
4.00	7.46	0.70	6.13	3.56	3.96	4.21
5.00	0.00	0.00	0.00	0.00	0.01	0.00
6.00	3.22	0.27	1.63	0.68	2.10	1.47
7.00	3.57	0.31	2.96	2.45	3.75	2.35
8.00	4.44	0.50	5.40	5.31	5.01	5.52
9.00	2.70	0.26	2.07	1.20	1.60	1.33
10.00	30.35	3.01	31.18	38.82	38.92	37.47

CONCLUSIONS

The map of landforms, based on DEM, can significantly help in predictive mapping of geology. Method of Jennes is the most promising algorithm for classification of landforms for agriculture lands predictive mapping. It is highly configurable and this increases its applicability in different types of relief. A terrain classification is one of the methods which can significantly help in boundary delineation of agriculture land. It is clear that the landforms themselves, without information on other landscape components, cannot successfully predict distribution of specific agriculture land. It is necessary to incorporate other characteristics of environment (e.g. geology) and other characteristics of georelief itself (elevation, slope and aspect with respect to solar radiation, wetness index and other).

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CITATION OF THIS ARTICLE

Marzieh Mokarram. Relationship between Geology and landform classification in southeast of Iran. Bull. Env.Pharmacol. Life Sci., Vol 4 [4] March 2015: 86-95

