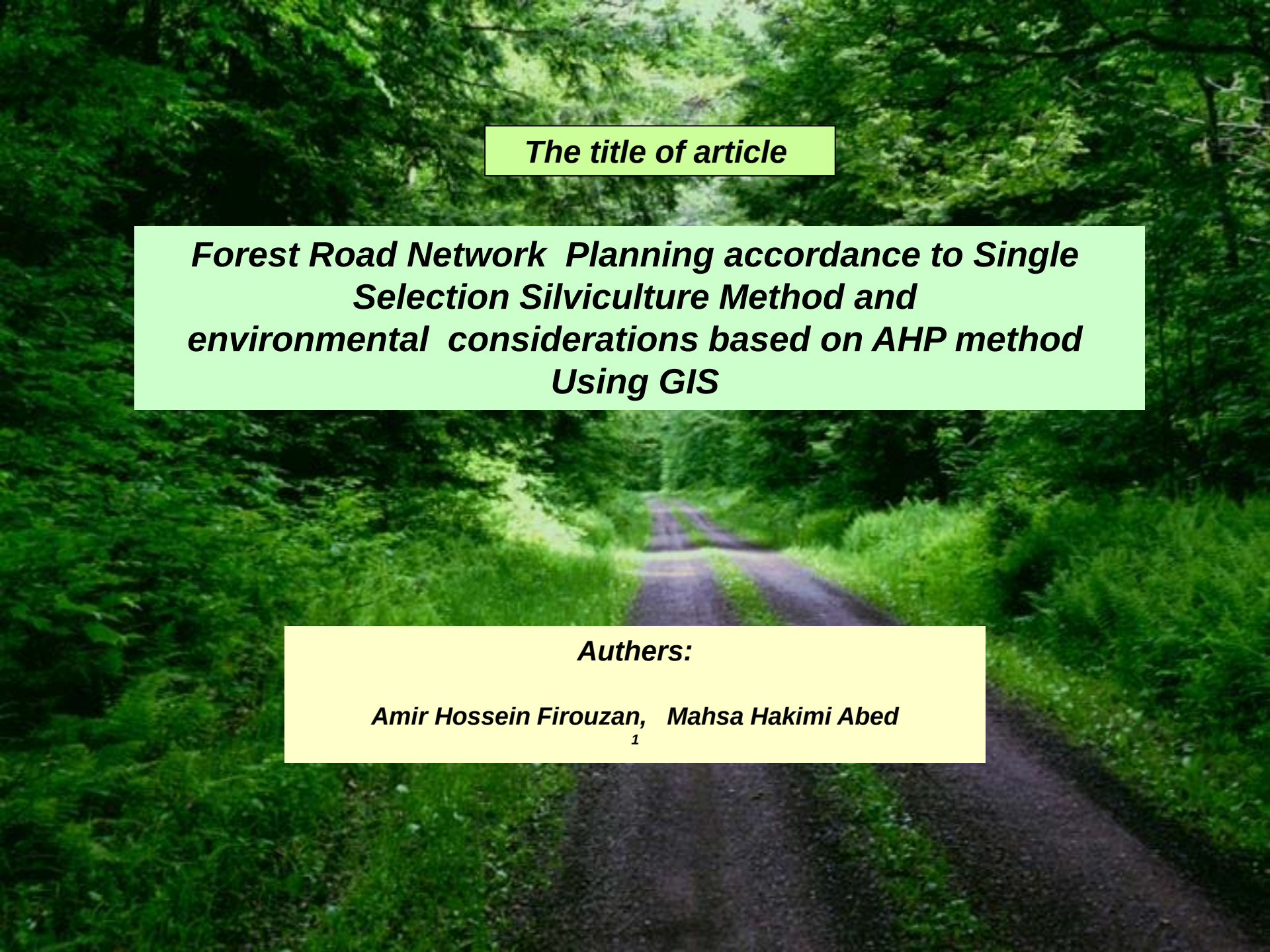

The title of article

Forest Road Network Planning accordance to Single Selection Silviculture Method and environmental considerations based on AHP method Using GIS

Authers:

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Introduction and Objectives

- *Forest roads, just like the public roads have different roles in performing main activities of forest projection. this regard, The forest road network is considered as one of the main keys for economic, protective and development of forestry. One of the most important study steps in construction of forest road is the initial route planning*
- *One of the important points in planning of new methods is to avoid crossing road from ecologically sensitive areas in phase zero studies to prevent environmental damage .*
- *In the other hand the silviculture method is a single selection method in this region , which will lead our forests to be uneven aged, The objectives of this research is creating an appropriate planning in In accordance with the principles of single selection silviculture method and With regard to environmental factors*

Background research

Moretti, (2003) studied at one of the Indian states .he Planned routes with the least cost to exit the forest products using remote sensing and GIS. In this study, the required maps were prepared using IRS satellite data and the river was also considered as an option for transportation.. Finally,The optimum route was planned by preparing the friction map and calculation of economic and cost factors,

.

Sajjadi (2012), in a research on the impact assessment of road construction on environment using GIS, applied two methods of overlapping layers and Leopold interaction matrix which has been modified for Iran. In this study, by overlapping the maps of slope,, elevation, soil, plant communities and canopy density, was obtained the map of environmental units and was used the special ecological model to achieve the optimal route .

Materials and methods

Materials and methods

The study area is located the Shanderman forest region 0f Guilan province in Iran. The Height mount above sea 700 m and 1500 m. Average annual precipitation is 1000 (mm) . After reviewing various resources and according to preliminary visits of the study area, was indentified the effective factors in planning the road .At the first step it was attempted to determine suitable (positive) points such as, natural terraces, schools, etc.) and unsuitable (negative) points (such as slippery and erosion places, etc.) by a GPS device. Then affecting environmental factors were extracted in the form of information layers.

such as slope, aspect, soil stability, favorable areas to timber depot, regenerations and..Among the other factors that affect in the planning of road, We identify regeneration places or hand planted stands in a broad range .

The study area

Friction layer

In planning the road network it is tried to avoid each route passing through some areas, such as Fountain, cliffs, falling and sliding points, mines, very high slopes and generally unsuitable (negative) mandatory points.

For this purpose, a layer was prepared called friction (restriction). So all of the unsuitable (negative) places and points were identified in the form of a raster layer and the were determined map cells with a zero value as the areas with restriction to the cross route

Suitability map

In the next step data were weighted by Multi-Criteria Evaluation method . The most common Multi-Criteria Evaluation method is linear weighting . one of the linear weighting technique is the pair wise comparison method ,In this method, was formed a comparison matrix and was prepared questionnaire form that distribute it between experts. Factors were compared as paired and were calculated their weights using EC (Expert Choice) software. In the next step, coefficient of importance of parameters was involved in layers of information by Arc Gis software and obtained the suitable plan. For ease and accuracy of planning of forest road network, the final map were classified and coded base on the range of values. (Reclassification)

	TYPE FOREST	SLOP	VOLUME PER HECTAR	SOIL STABILITY	FLAT	GEOGRAPHIC ASPECT	GEO	REGENRATION
TYPE FOREST	1	Y						
SLOP	------	1						X
VOLUME PER HECTAR	------	----	1					
SOIL STABILITY	------	----	---------	1				
FLAT	------	----	---------	----	1			
GEOGRAPHIC ASPECT	------	----	---------	----	------	1		Z
GEO	------	----	---------	----	------	---------	1	
REGENRATION	------	----	---------	----	------	---------	----	1

Planning

•*we was used the capabilities of PEGGER software to planning forest road network. So, six variants of road network were planned on the final valuated map so that for all variants, were planned in such a way that the routes will cross from the areas with high-value.*

Environmental assessment of variants Planning

- ***At this step, in order to minimize and further reduce of environment damage, it is necessary different variants were compared in terms of environmental factors. So we calculated percent of road passes of the high class. The road that passes through the highest values it will be with least environmental damage and it was selected as the best option base on environmental factors.***

Conclusion

Figure .1. Map of classification slop

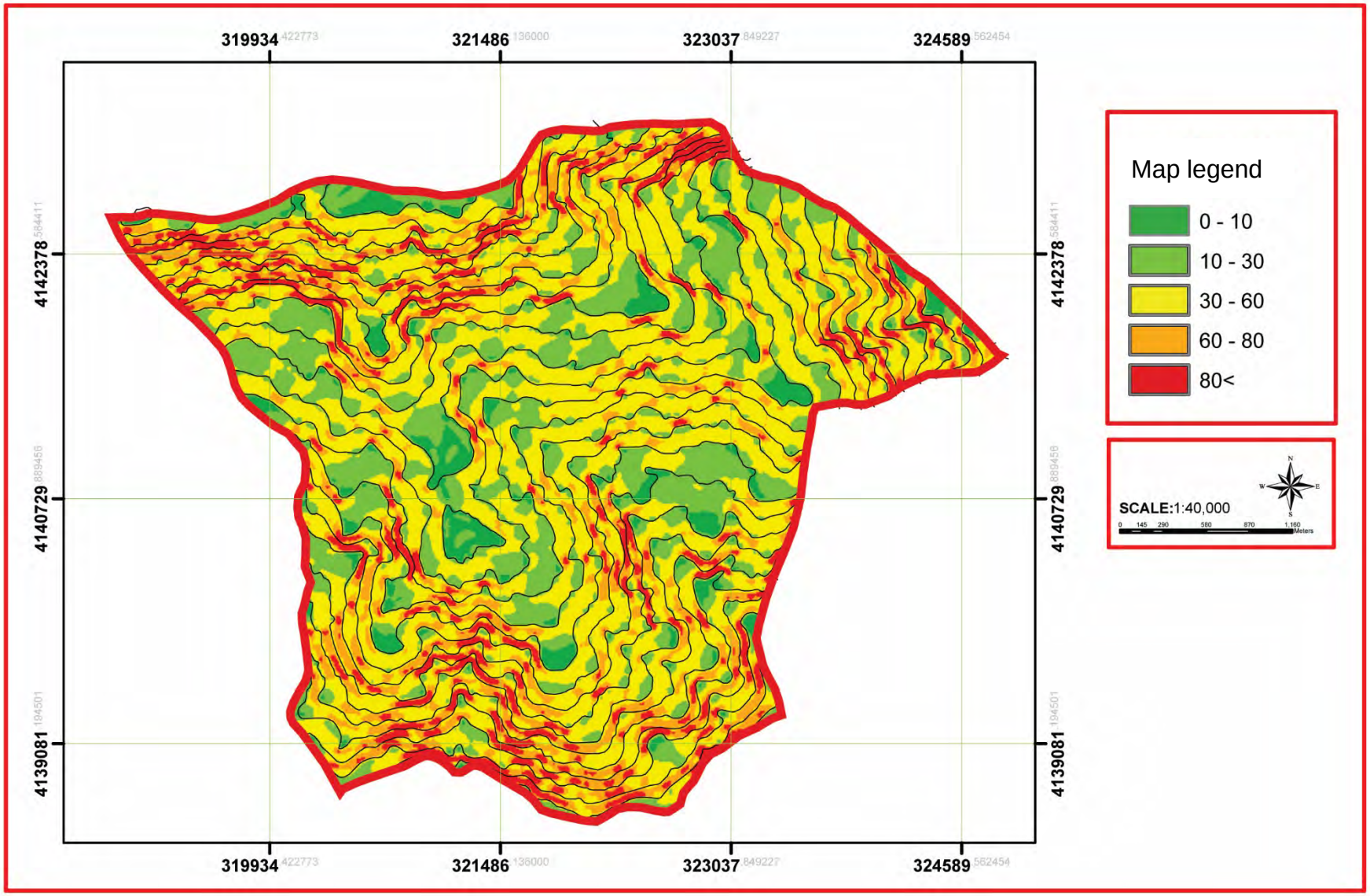


Figure 2. Map of Geografic Aspect

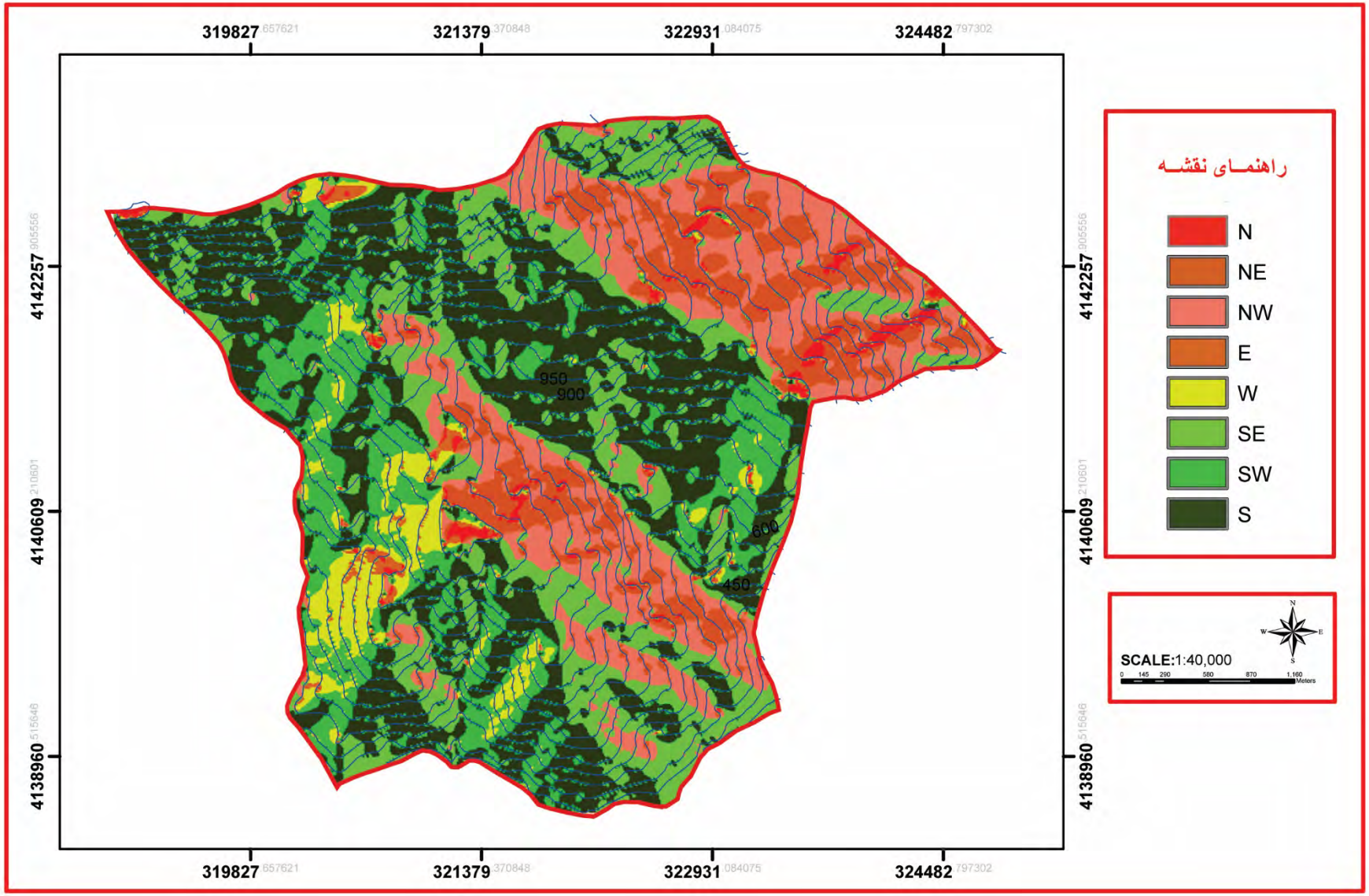


Figure3. Map of soil stability

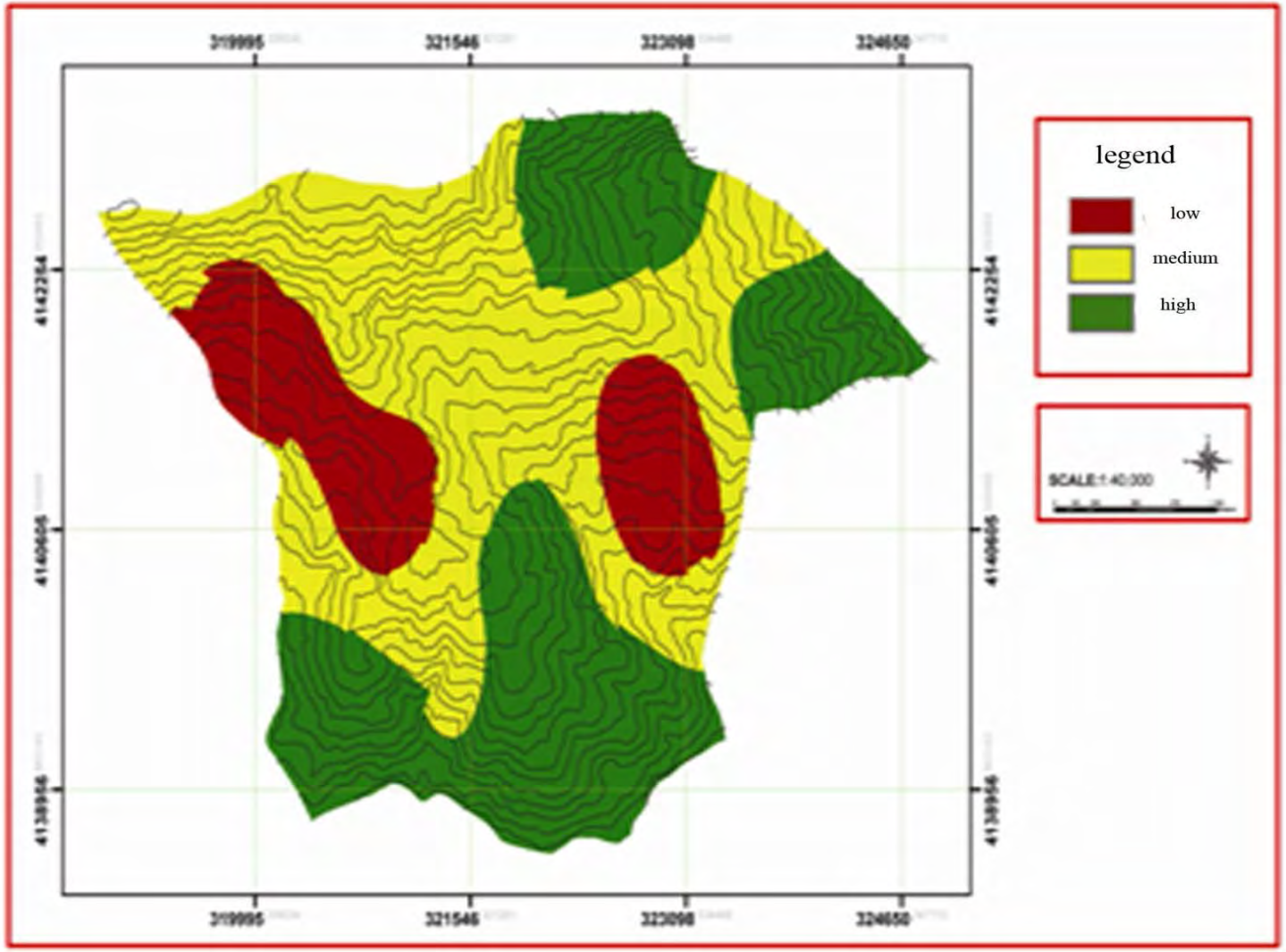


Figure4.Map of volume per hectar

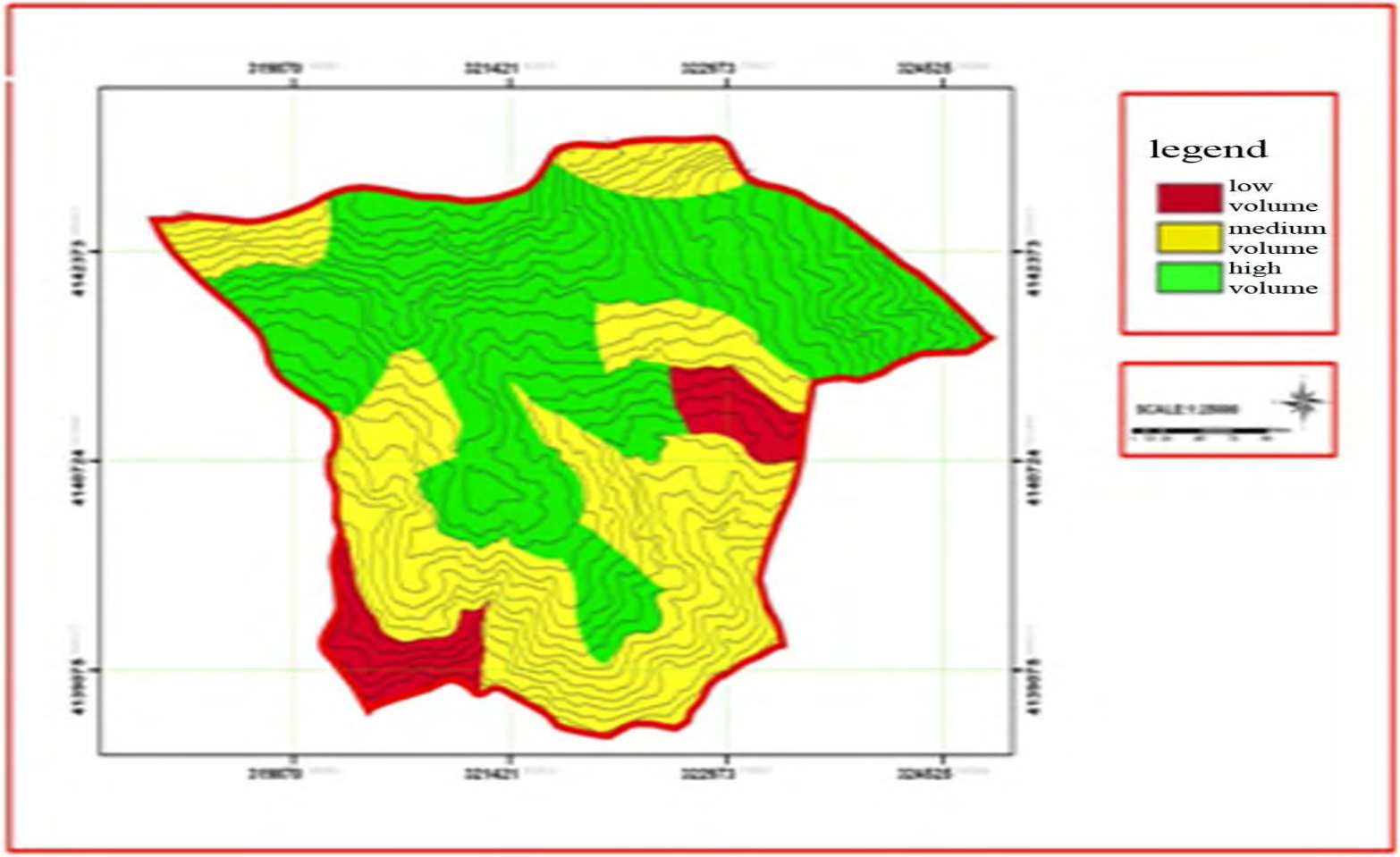


Figure5. Map of Forest type

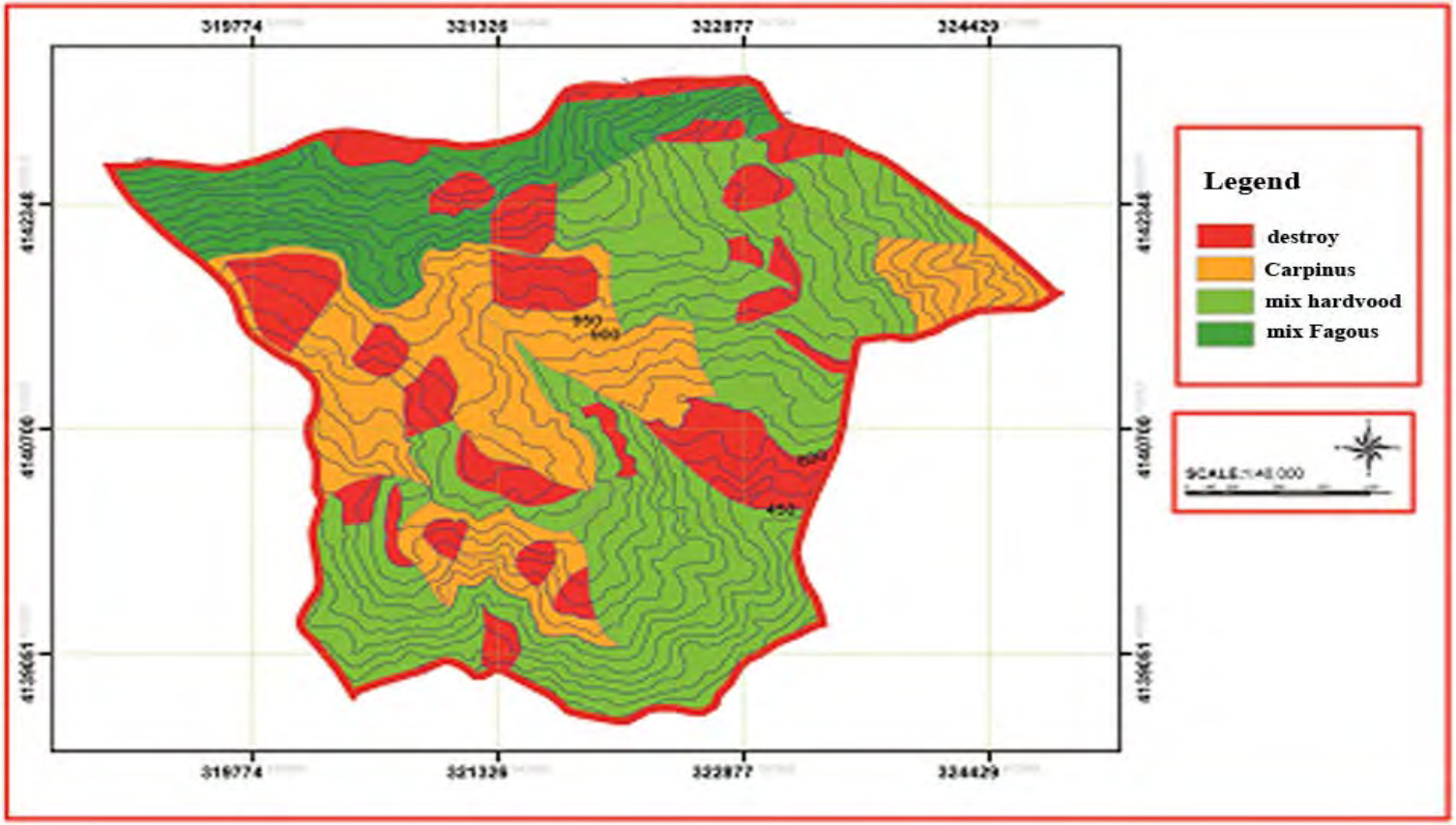
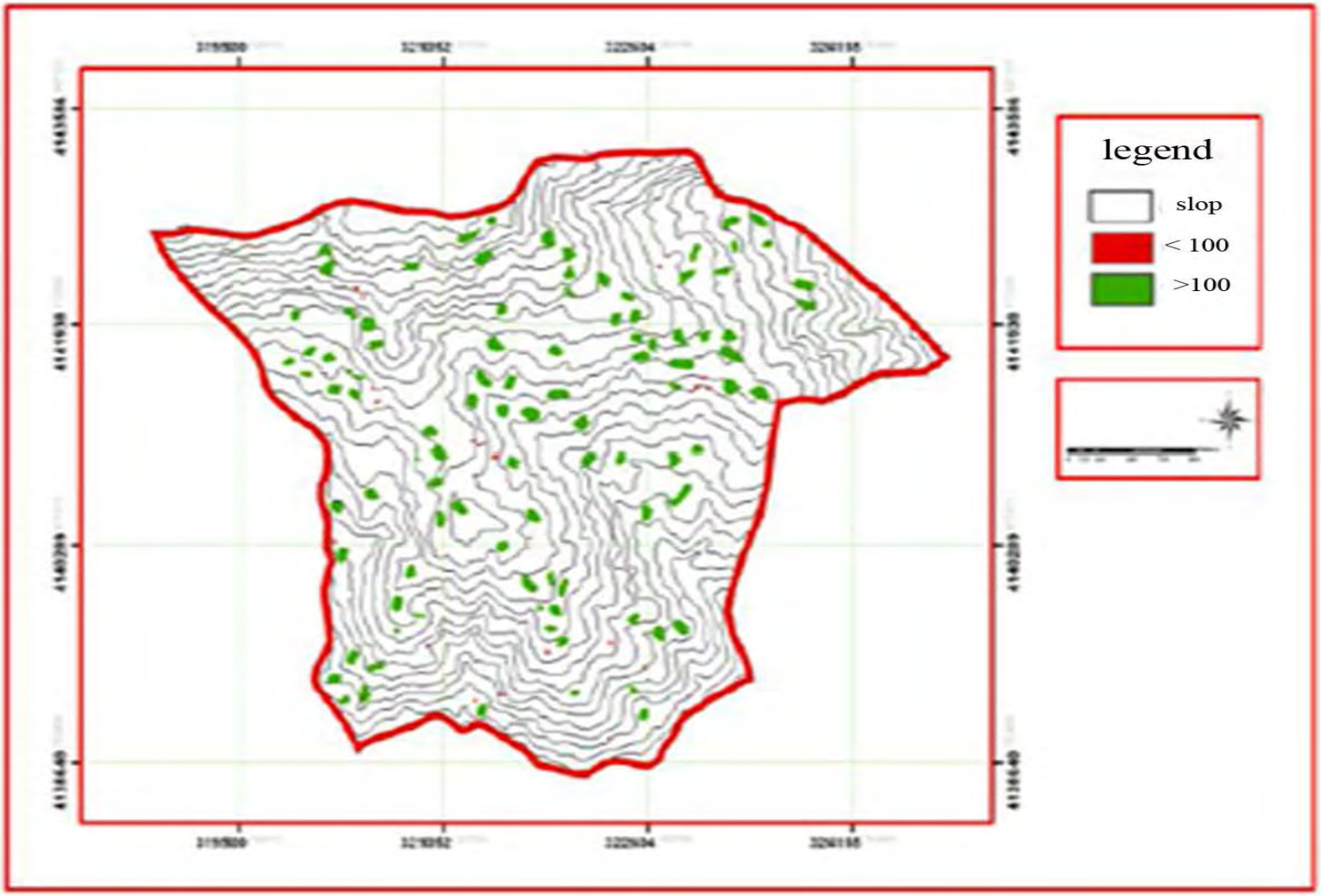


Figure6. Suitable places to Timber depot



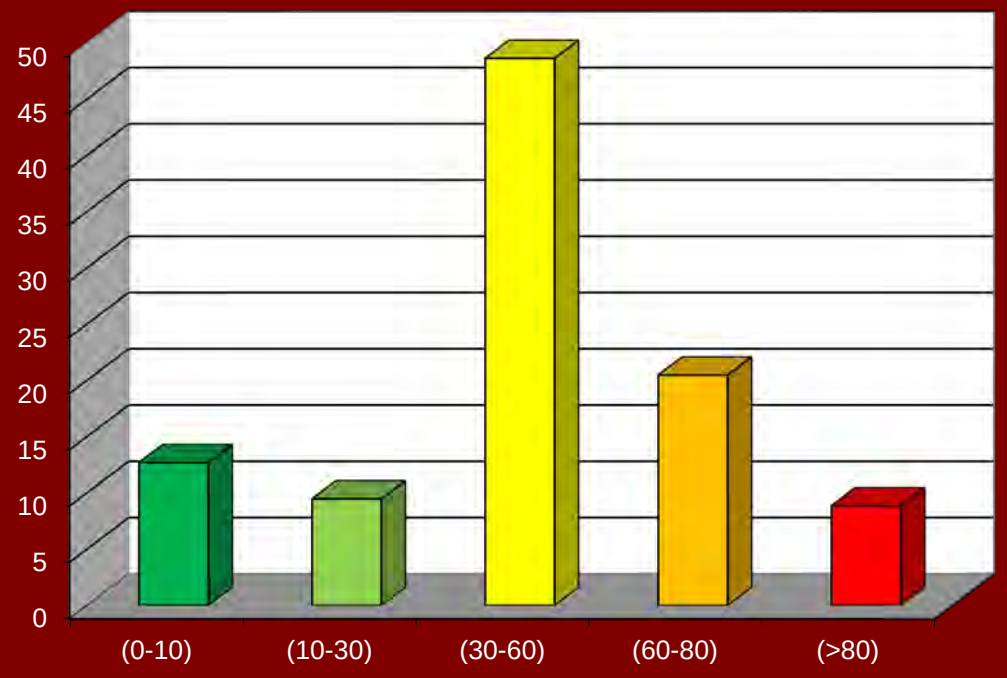


Figure 7. The percentage of classes of slope

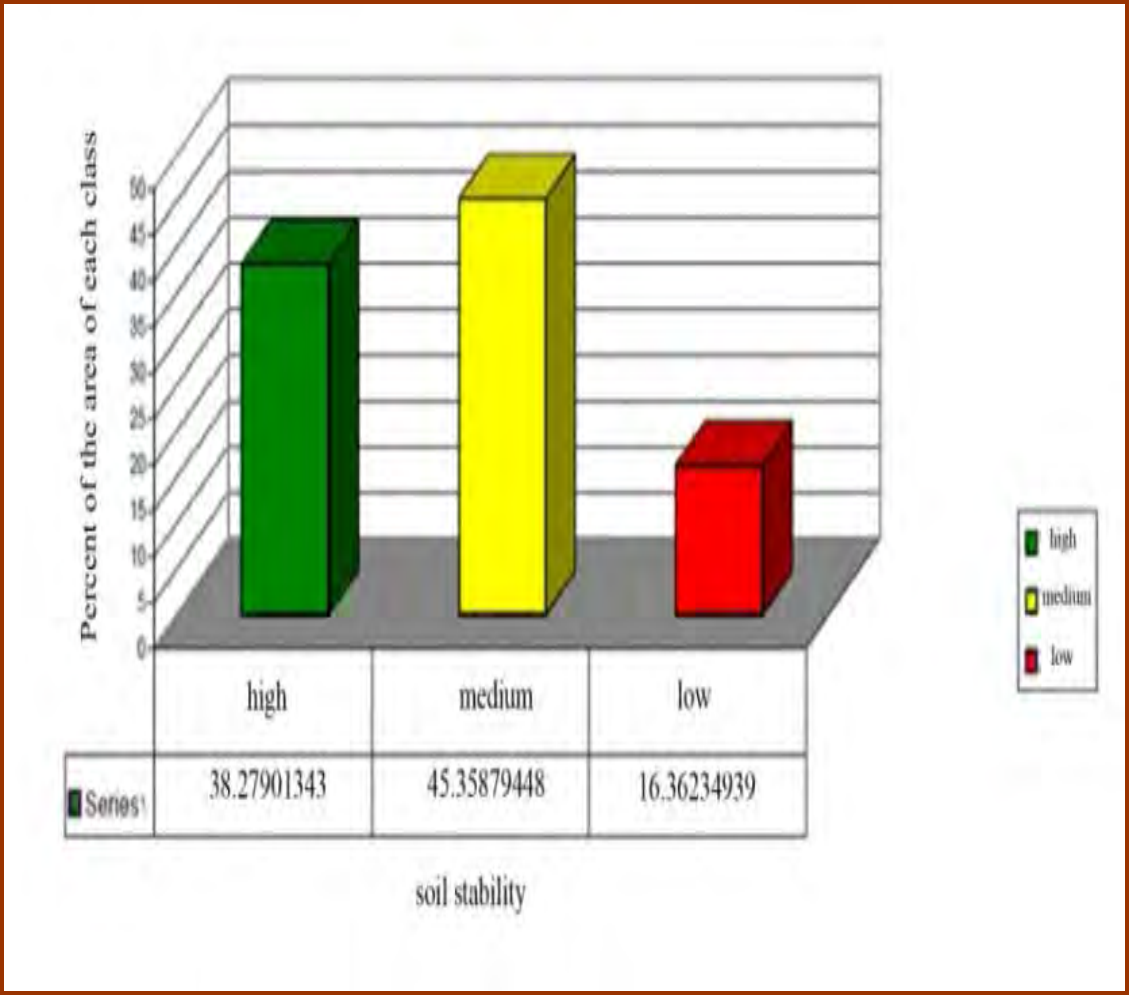
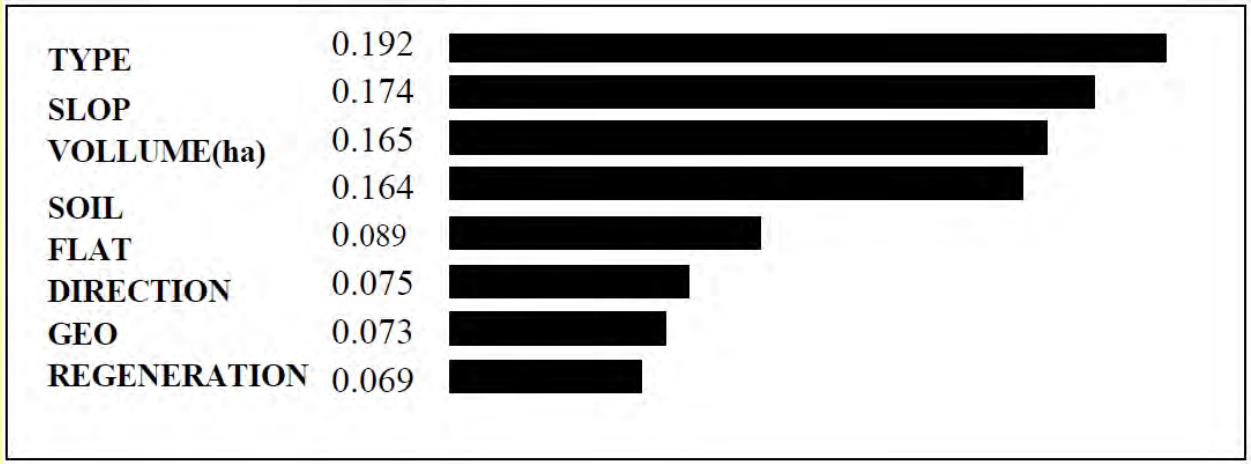


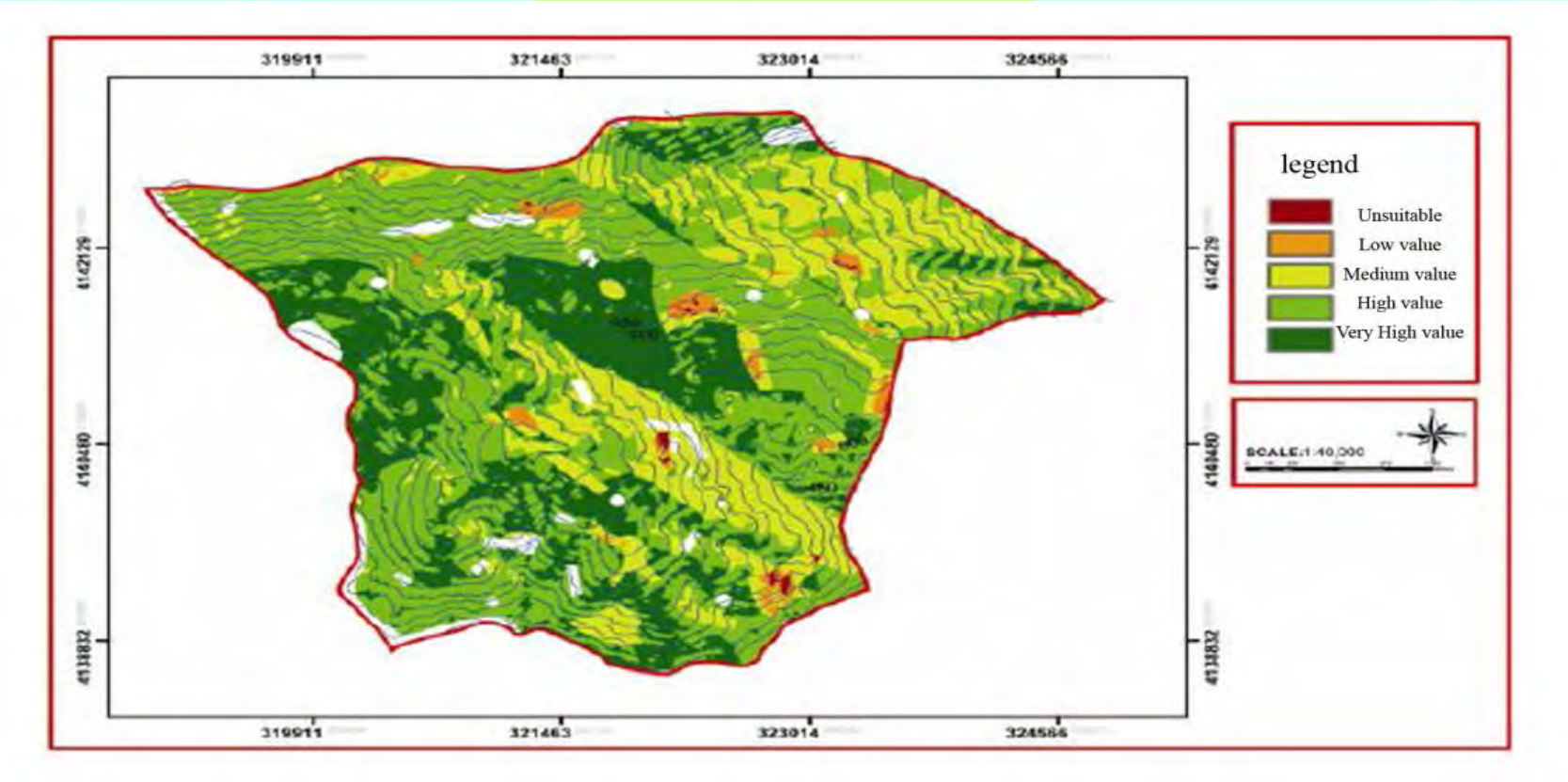
Figure8. Percentage of soil satbility in different classes

Figure9. The results Multi Criteria Evaluation



the calculation of characteristics weights based on expert opinions .

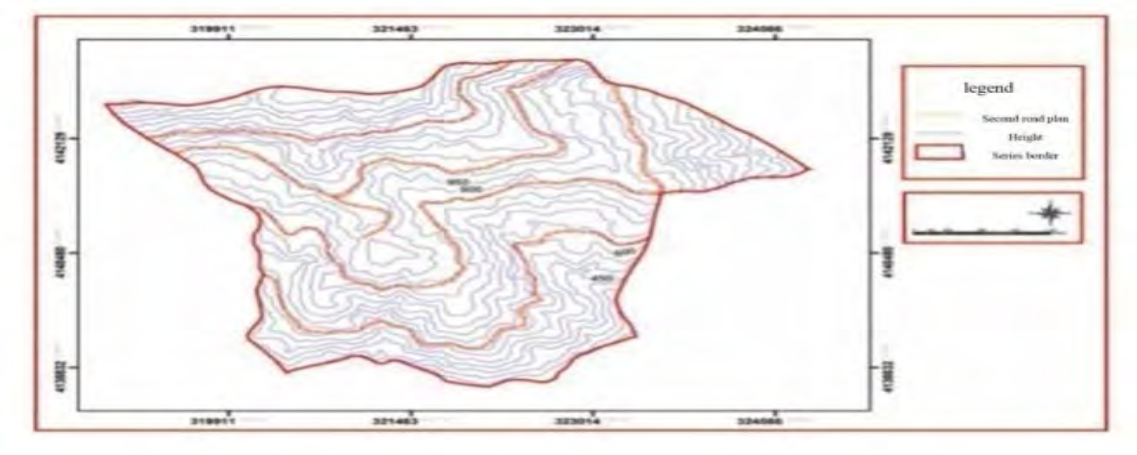
Figure7. Suitable Plan



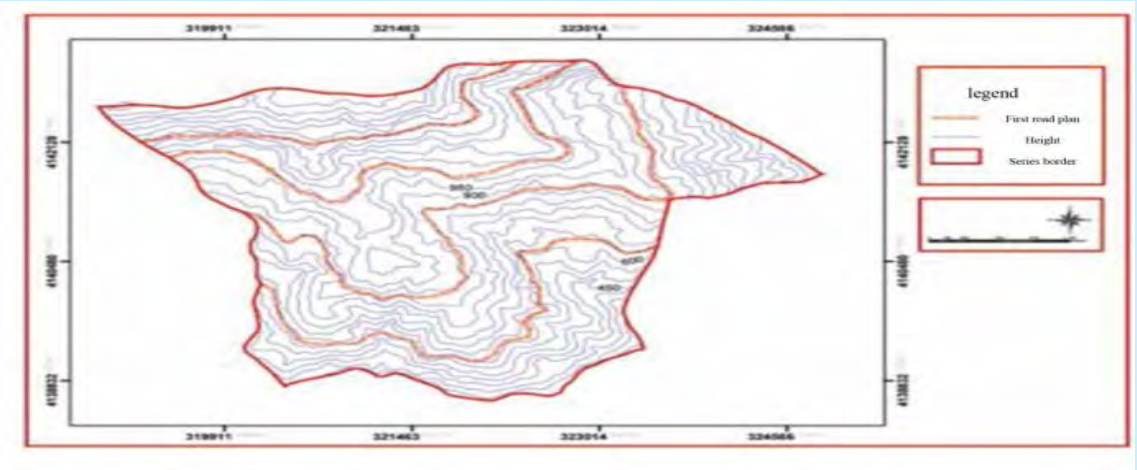
This map was resulted with overlapping the layers base on the value domain that was given to the final map(suitability).The final map shows that 74.35% of the area is classes with high values .Areas with the highest value is shown in green color.

Figure10. Planning Roads

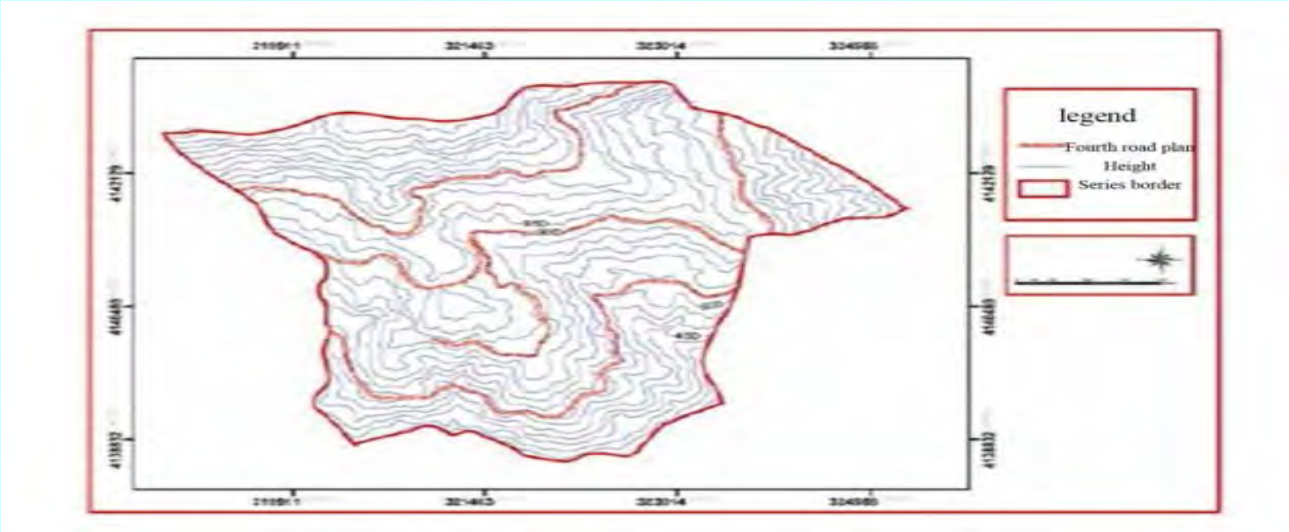
Variat1



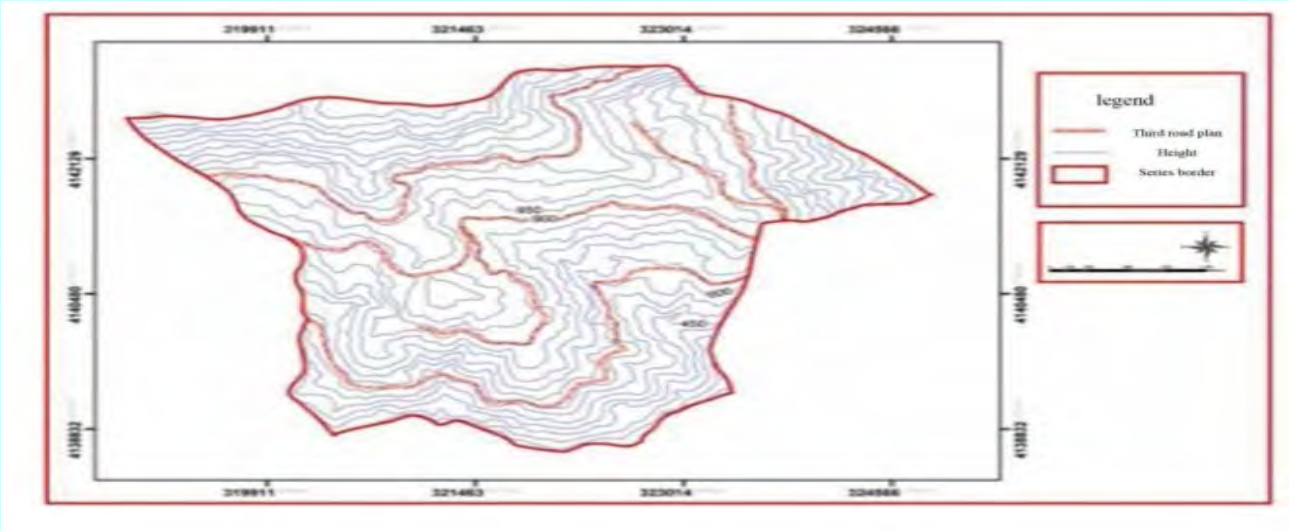
Variant2



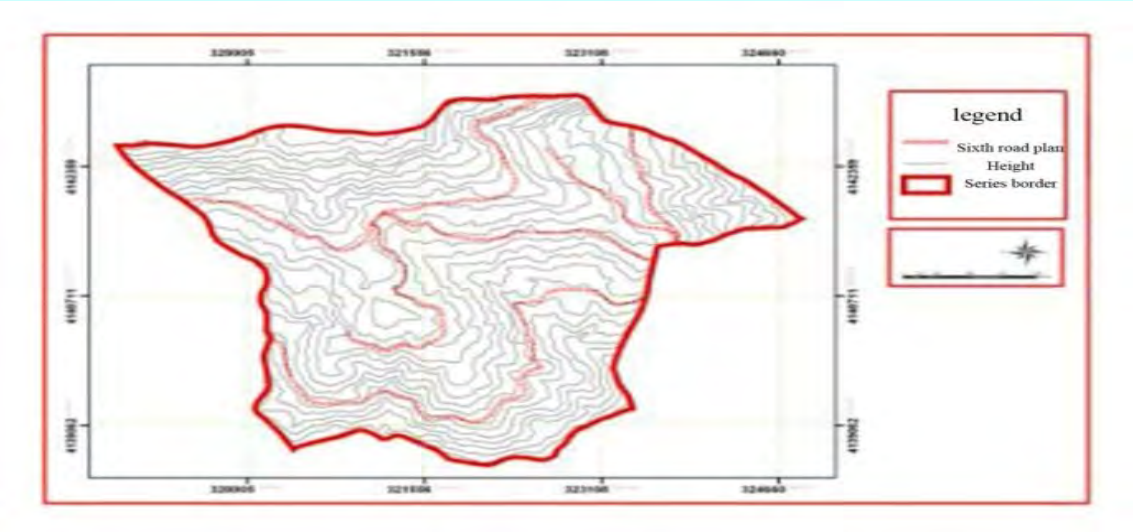
Variant3



Variant4



Vriant5



Vriant6

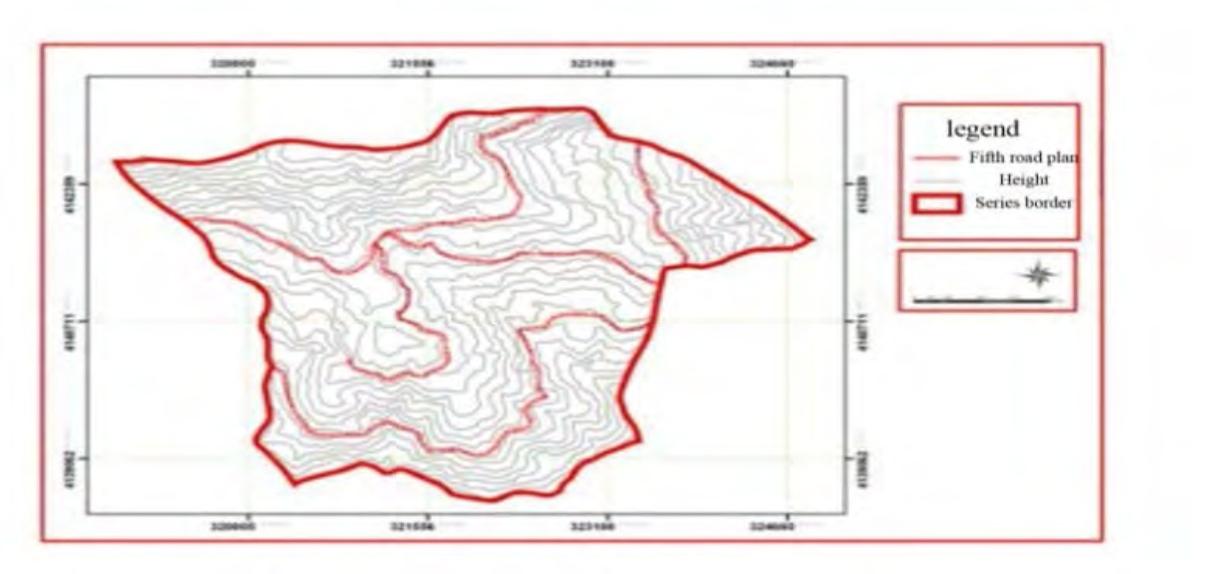
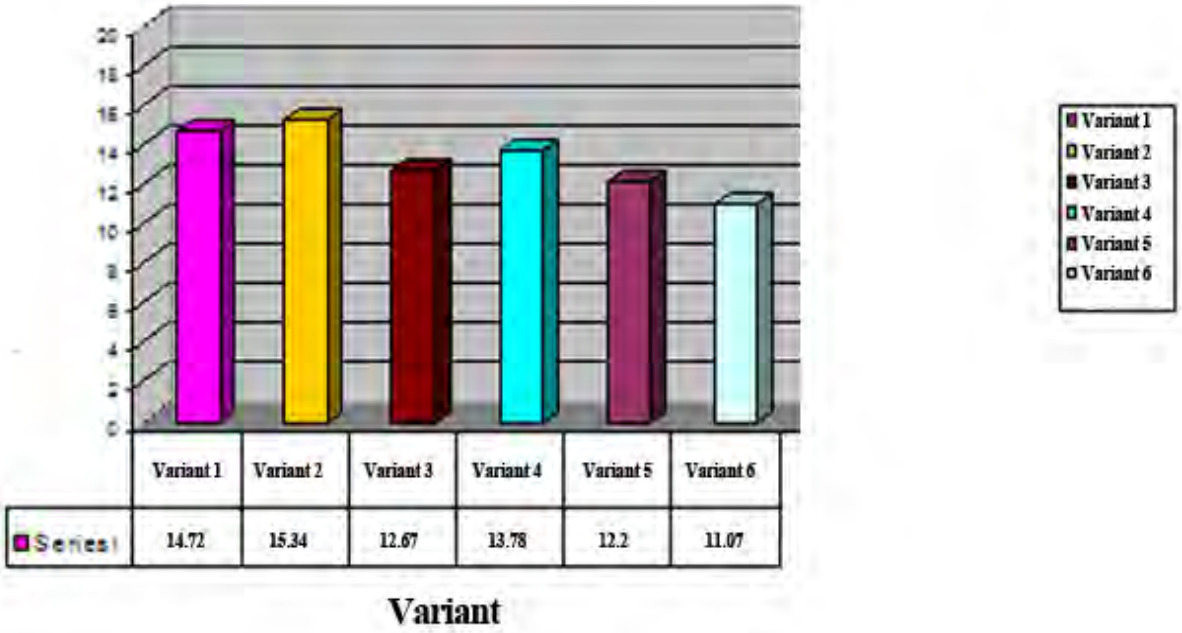


Figure11. Road density of variant



we calculated percent of road passing of the each class and multiply it in coefficient for each variant . , a number will result so that higher number indicate that the road passes from the highest values of map

Table 1. the preliminary results obtained from environmental assessment (variant1)

Class (code)	Percent of route passing ***for aeach class***	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
2	0.016957775	2	0.033391555
3	18.38222825	3	55.14668475
4	52.94217399	4	211.768696
5	28.6586399	5	143.2932

Table 2. the preliminary results obtained from environmatal assessment for (variant2)

Class (code)	Percent of route passing from each class	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
2	0.292445167	2	0.584890334
3	18.19658	3	54.58976442
4	52.2826969	4	209.130788
5	29.2282697	5	146.1413485

Table 3 the preliminary results obtained from environmental assessment for (variant3)

Class (code)	Percent of route passing from each class	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
2	0.69637883	2	1.39275766
3	21.64743335	3	64.94230005
4	48.9658002	4	195.8615201
5	28.6908078	5	143.454039

Table 4 the preliminary results obtained from environmental assessment for (variant4)

Class (code)	Percent of route passing from each class	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
2	0.637174586	2	1.274349172
3	27.25286729	3	81.75860187
4	45.80375023	4	183.2150009
5	26.3062079	5	131.53110395

Table 5the preliminary results obtained from environmental assessment for (variant5)

Class (code)	Percent of route passing from each class	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
3	28.62994061	3	85.88982183
4	45.771042239	4	183.0841696
5	25.599017	5	127.995085

Table 6. the preliminary results obtained from environmental assessment for (variant6)

Class (code)	Percent of route passing from each class	Coefficient	Multiplying the percent of road passing from relevant classes in the desired coefficient
3	22.34814143	3	67.04442429
4	49.388.3264	4	197.5521306
5	28.2638593	5	141.3191297

Finally, a number will result from the sum of multiplying the percent of road pass for each class, in desired coefficient for each variant . So that the higher number indicate that the road passes from the highest values of map and the aforementioned variant is selected as the superior variant in terms of compliance with environmental factors.

Variants	Total of multiplying the percent of route crossing ***from relevant classes in desired coefficient for each valuated class***
1	410.2424962
2	410.4467912
3	405.6506168
4	397.7789915
5	396.9690764
6	405.9156845
Available in series	399.2902866

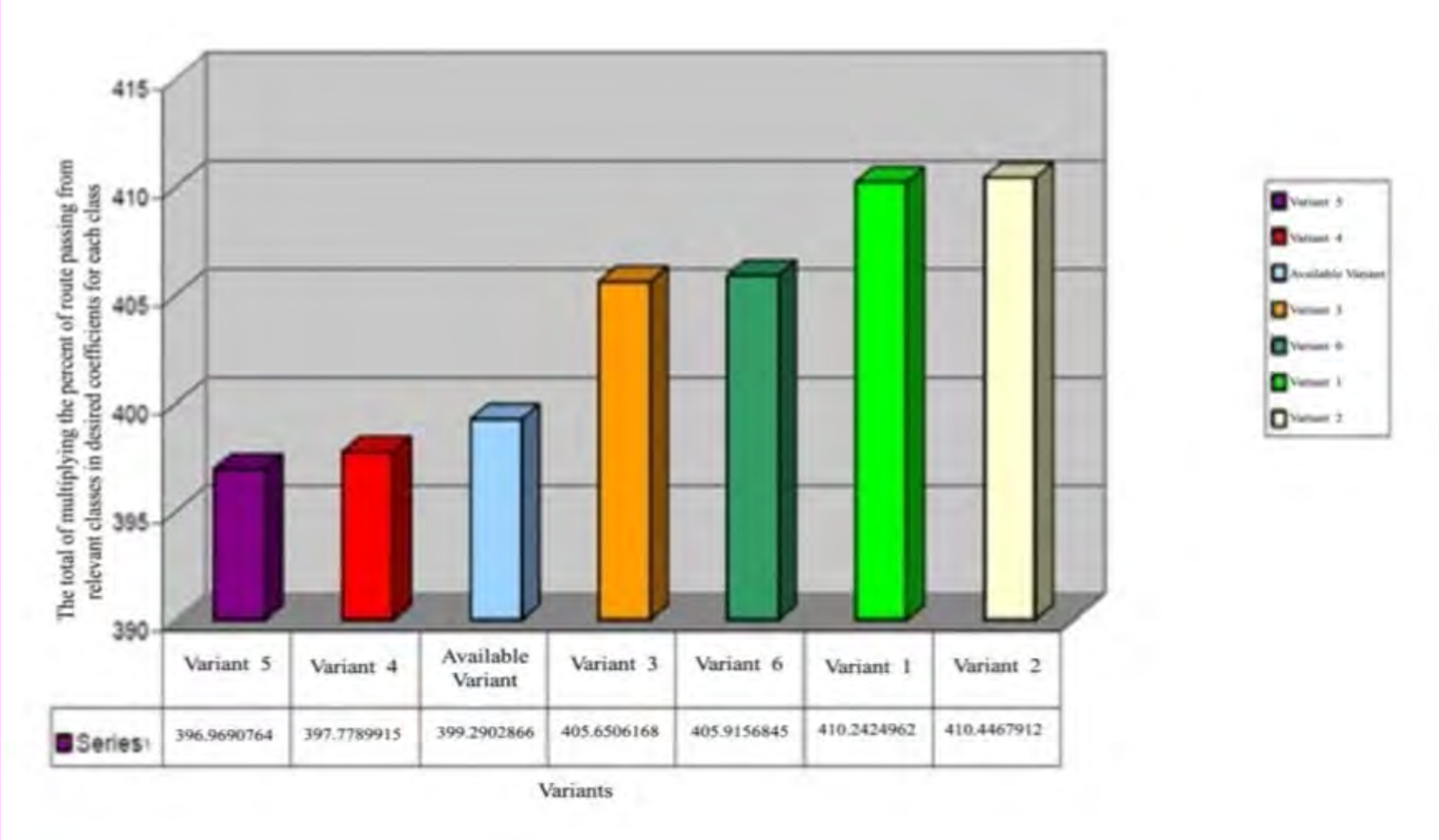


Figure12. Prioritizing the variants based on the environmental assessment

Discussion and Conclusion

Lack of attention to environmental issues and attention to economic issues and excessive exploitation of forest caused that this projects does not have necessary standards in terms of environmental issues. In this study it has been tried the road passes from area with high value according to the environmental issues. Cutler et al., (2006) in their used AHP method to identify the priorities of factors for road maintenance . In the end it was concluded that AHP method is a suitable framework for quantitative measurement of environmental factors and was used for modeling and algorithms planning

Abdi (2013) in his studies for the road planning with the least environmental costs and Huang (2003) for the road planning with minimal security risk have used Multi-Criteria Evaluation Process and planned optimal route just base on economic factors.

The results showed ***this area have necessary conditions and stability for road constructioan.. Prioritization of variants regarding the environmental assessment is variants 2, 1, 6, 3, 4 and 5, respectively.. According to the obtained results, variant 2, 1 and 6 is the highest values in terms of environmental assessment , respectively.***

According to the obtained results, variant 2, 1 have the highest values in terms of environmental assessment respectively. Thus, it can be said that these variants pass from very favorable areas for the construction of road and in other words, have the least environmental damages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