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Study of forest roads density in Hyrcanian forest (case study: Neka forest, Mazandaran province)

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ABSTRACT
The past, forest road network designing was mainly done for its main goals- management and exploitation. Forest road construction is the most costly operation in forest management. In order to choose the optimal variant with regard to costs and performance, it is necessary to evaluate road variants before construction. The aim of this research are study of forest roads density in Neka forest, Mazandaran province in Hyrcanian forest (north of Iran). For this study used the information of Forest plan (1998-2007) and extract information of forest road include: Road length (m), Predicted road (m), Available road (m), Predicted road density (m/hec), Available road density (m/hec) and total of road density (m/hec). Results showed that if planed and insert Predicted road (m), the total density (m/hec) are 16.64 (m/hec). Researcher in forest engineering science proposed to increase the road density up to 20 m/ha for Hyrcanian forest, This research showed that available forest road density are 7.58 (m/hec) and this quantity is very less the norm of road density in Hyrcaianforst. Overall results showed that the condition of road density in study area are poor and very weak. In base of this results author suggested the increase road density to 20 m/ha.
Key words: forest roads density, Hyrcanian forest, Neka forest, Mazandaran province

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INTRODUCTION

Hyrcanian (Caspian) forest in northern Iran has a richness of biological diversity, with endemic and endangered species, and a diverse range of economic and social conditions. About 45% of the Hyrcanian forests are located in mountainous areas, where forest lands are not readily accessible with ground-based logging equipment's, but cable yarding technologies are still undeveloped in this forest area (Jourgholami, 2012). These forests cover 1.8 million hectares of land area and are none commercial forests of Iran. Approximately 60 percent of these forests are used for commercial purposes and the rest of them have been degraded. They are suitable habitats for a variety of hardwood species such as beech, hornbeam, oak, maple and alder that encompass various forest types including 80 woody species. These forests are known as one of the most basic resources for wood production contributing an important role in supplying wood to the related industries. Commercial logging in the Hyrcanian forests of Iran are accomplished within the legal framework of forestry management plan and annual remove in managed areas (1.2 million hectares) producing one million m^3 per year. The current forest harvesting method in these forests is mainly selective cutting. Chainsaw and cable skidder are two main logging machines for tree felling and timber extraction in these forests. Forest roads are one of the most essential infrastructures for managing forested areas. Sustainable forest road network and preserving construction costs need permanent road maintenance. Road monitoring is key element in road maintenance principles [2]. Forest road networks are essential structures to achieve the forestry aims, but these structures include most implemental and environmental costs [4]. the several study accrued in forest roads in Iran, include: The researcher studied the Cross Drainage Design of Forest Road in Shafarood Basin, Guilan Province and results in this research indicate that, drainage pipe diameter in talwegs could be estimated by considering discharge in talwegs, rain intensity, runoff coefficient, area and hydrological conditions. Pipe diameter for conducting road canal water is determined on the basis of canal bed susceptibility to surface erosion, canal cross section and discharge. Road location on the foothill, slope length, and water

discharge play the main role in determining the distance between pipes, the more the height of road, the more will be the distance between pipes [8].

The researcher studied the planning and technical evaluating of forest road networks from accessibility point of view using GIS and firstly a digital elevation model (DEM) was prepared based on digital topographic maps at the scale of 1:25000 and was used for collecting required data. In the next step, 12 road variants were designed using PEGGER (an extension of ArcView software) and digital contour map, and by taking advantage of GIS possibilities the passing percent of all variants of all gradients and directions were derived. Finally all variants were evaluated from a technical point of view in GIS using TON×KM and a new method called CORRECTED TON×KM and the optimal variant was chosen [2].

The researcher studied the determination of Correction Factor for Skidding Distances in Mountainous Forests of Northern Iran and objective of this study was to estimate correction factor of skidding distances in Patom district. To do this, first topographic conditions of the field were classified into micro and macro topographic sections and were investigated in the field and all observations were added to the maps. Then skid trails and cable lines were designed on maps with regard to these observations and also skid borders. To assess the trails from practical standpoint, each trail was checked with compass and clinometers in field and any potential modification was corrected in maps. One hundred and eighty nine sample points were selected and theoretical and practical skidding distances were measured. After that using these samples, regression models were determined to convert theoretical distance to practical one. Then significance and reliability of models were tested. The estimated correction factor for study area was 2.03 [1].

The researcher studied the efficiency of Backmund method for evaluation of forest road networks with regard to capabilities of wheeled skidders in ground skidding method and results showed that in order to evaluate the forest road networks from technical point of view with regard to capabilities of wheeled skidders in wood extraction, Backmund method is not precise enough to be the best variant and the limitations of ground skidding should be considered to use this method [6]. The researcher studied the effect of Forest Road Construction on Forest Villages Development and Result showed that Calculated correlation rate was equal to r=0.866 that alluding to direct and meaningful relation was between access to forest roads and village development. Finally this study indicated that the villages by accessing to forest roads for more years and means of communication in long time could be enjoyed possibilities, services and had best situation in respect of rural development [5].

The researcher studied the monitoring the Conditions of Forest Road Network Compared to the Standards and in this study the forest road network of Namkhaneh district was monitored, cross section values of roads were measured and were compared to standard ones. The results showed that all cross section values of existing roads have significant differences with standard valued. In the case of three samples, only running surface and depth of ditches are standard and all other parameters were significantly different compared to standard values. The results of ANOVA revealed that running surface of five segments of the network have significant differences. Average distance of culverts and turnout in the district were 267±25 and 184±25 meters, respectively. Meanwhile, about 99.2% of samples had standard gradient but only 9% of the samples showed standard crown and cross section [2].

The researcher studied the planning road network in mountain forests using GIS and Analytic Hierarchical Process (AHP) and the results of this study illustrated that using AHP and GIS simultaneously can introduce an appropriate and suitable method in the forest road network planning [11].

The researcher studied the possibility of Designing and Evaluation of Forest Road Network Variants Using GIS and Field Investigations and present road coordinate was determined using GPS and was used to plan road network variants. 18 road network variants regarding technical principles and forestry necessities were designed using PEGGER (ArcView extension). All variants were evaluated from a technical stand of view in GIS using Backmund and Segebaden methods. Regarding Backmund proposed variant and management necessities, the variant which was selected as optimal variant was checked in the field. Finally, the changes were applied on it. The results suggest the utility of GIS to improve planning methods [3].

The researcher studied the forest road planning considering road and skidding costs and the study used continuous time studies based on empirical data for this logging method. The resulted regression model is a function of skidding distance. The best solution found by NETWORK 2000 indicated that all proposed roads should be built to minimize the total skidding and road building costs [7].

The researcher studied the forest road network planning based on environmental, technical and economic considerations using GIS and AHP and with review the result of environmental and technical evaluations of 7 variants, the variant with lowest total value in MCE with regard to technical principals

was determined. This variant was evaluated economically, and then was checked by field reconnaissance. The obtained results showed that using GIS and AHP will improve planning methods [10].
The researcher studied the applying Landslide Hazard Zonation in Forest Road Network Design and according to the results, 14.7%, 26.9%, 38.9%, 15% and 4.5% of the district were classified as very low, low, moderate, high and very high hazard, respectively. Finally due to lack of landslide occurrence in slope class of 0-15%, as well as it is suitable slope for road design, this class was suggested as positive control points. The other slope classes that were in low and very low hazard were defined as second priority for road design. Road building in high and very high hazard is possible, if increasing the number of culverts, also biological and mechanical reinforcements of cut and fill slopes [4].
With regard to the theoretical model, the forest road network is consisting of straight line even spaced roads. So the log moves on the shortest path to the nearest road. But these conditions seldom occur in the field [1]. Forest road network is one of the most important forest management projects that play a great role in timber transportation as well as other forest services such as tourism, hunting, etc. Essentially water accumulation on forest roads can be the main reason for road destruction through erosion and decrease of road strength [8]. Road construction in forests absorbs huge resources and imposes highest costs on the forest management. Therefore, various choices should be evaluated and the least costly one with highest technical efficiency should be selected [2].
The aim of this research are study of forest roads density in Neka forest, Mazandaranprovince inHyrcanian forest (north of Iran)

MATERIALS AND METHODS

This study was carried out in a temperate mountain forest district (District 2. Neka- Sari) covering 1351 ha of Mazandaran province in northern Iran. The area is located between 53°20'27" and 53°27'10" (E) longitude, and 36°32'52" and 36°37'13" (N) latitude. Ground skidding is the dominant method of harvesting and accounts for approximately 60% of the log volume in this forest (Naghdi et al 2008).

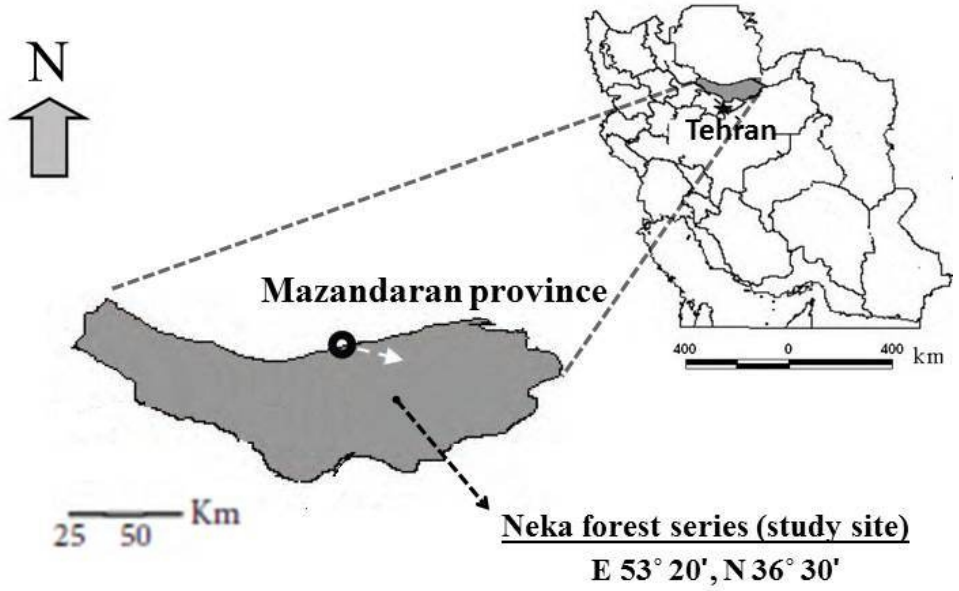

Figure 1: location of study area in Mazandaran province in Hyrcanian forest (northern of Iran)

Methods

For this study used the information of Forest plan (1998-2007) and extract information of forest road include: Road length (m), Predicted road (m), Available road (m), Predicted road density (m/hec), Available road density (m/hec) and total of road density (m/hec).

RESULTS

Forest roads as the first basis of land organization in forest management units have an undeniable role. With appropriate planning of road network, performance can be highly increased while the extra costs decreased [3].

Table 1: information of road information in Neka forest

Parcel information		Road length (m)		Predicted density (m/hec	Available density (m/hec	total
No	Area (hec)	Available	Predicted			
121	43.7	50	650	1.14	14.87	16.02
213	14.8		75	0.00	5.07	5.07
214	30.5		250	0.00	8.20	8.20
216	27.3		435	0.00	15.93	15.93
217	33		320	0.00	9.70	9.70
218	60.1		540	0.00	8.99	8.99
219	29.7		80	0.00	2.69	2.69
220	27.5		650	0.00	23.64	23.64
221	26.5		370	0.00	13.96	13.96
222	52.5		620	0.00	11.81	11.81
223	29.7		200	0.00	6.73	6.73
224	42.2		545	0.00	12.91	12.91
225	21.9		185	0.00	8.45	8.45
226	27.3		310	0.00	11.36	11.36
228	5		175	0.00	35.00	35.00
229	9.4	65		6.91	0.00	6.91
230	47.8	660	870	13.81	18.20	32.01
231	37.5			0.00	0.00	0.00
232	34.4		315	0.00	9.16	9.16
233	23.4		180	0.00	7.69	7.69
234	42.9		440	0.00	10.26	10.26
235	31.6	50	160	1.58	5.06	6.65
236	41.6	760		18.27	0.00	18.27
237	41	1220	165	29.76	4.02	33.78
238	41.8	180	415	4.31	9.93	14.23
239	36.7	580	260	15.80	7.08	22.89
240	26.6	640	175	24.06	6.58	30.64
241	21.1	670		31.75	0.00	31.75
242	35.9	1025		28.55	0.00	28.55
243	39.4	100		2.54	0.00	2.54
244	15.6		180	0.00	11.54	11.54
245	34.5	670	330	19.42	9.57	28.99
226	25.4		340	0.00	13.39	13.39
247	28.1		200	0.00	7.12	7.12
248	49.5		180	0.00	3.64	3.64
250	29.7		580	0.00	19.53	19.53
251	13.3	930		69.92	0.00	69.92
252	17.9	380		21.23	0.00	21.23
253	19.5	620		31.79	0.00	31.79
254	55.8	1535	27.5	27.51	0.49	28.00
255	12.5	275	22	22.00	1.76	23.76
256	66.4	1830		27.56	0.00	27.56
total	1351	12240	10244.5			

Results showed that the area of this forest plan are 1351 hectare, and total of available road (m) and Predicted road (m) are 1 12240 and 10244.5. if insert predicted road (m) in forest total of Road length are 22484.5 (m).

Table 2: final results of road condition in study area

Area (hec)	1351
Available road (m)	12240
Predicted road (m)	10244.5
Total (m)	22484.5
Mean of predicted density (m/hec)	9.06
Mean of available density (m/hec)	7.58
Total density (m/hec)	16.64

Results showed that the mean of predicted density (m/hec) are 9.06 and mean of available density (m/hec) are 7.58. in other hands the total density (m/hec) are 16.64 (m/hec).

CONCLUSION

Forest managers have to be concerned about road designing and construction more than past because of environmental impacts of forest roads and their cost [15], [14] North- east and east of study area areas with high slope and sensitive hydrographic networks and geological situations are not an appropriate location to design forest roads [13]. Forest road construction is the most costly operation in forestry. Road designing and construction in unsuitable areas may increase construction and maintenance costs and also cause many environmental impacts. Therefore, it is required to pay more attention to forest road design [11].Forest roads play an important role in forest management, protection and rehabilitation in mountainous areas. Efficiency of forest harvesting depends on an appropriate forest road network [12]. Hyrcanian forests are the only forests designated for commercial timber production in Iran. Ground-based skidding is the most common timber harvesting system used in these forests, but due to low road density (1-2m/ha), large parts of the forests are still inaccessible. To facilitate timber harvesting in the forest, it has been proposed to increase the road density up to 20 m/ha [7]. Results showed that if planed and insert Predicted road (m), the total density (m/hec) are 16.64 (m/hec) (table 1, 2). Jourgholami et al [7] proposed to increase the road density up to 20 m/ha for Hyrcanian forest, but available forest road density (m/hec) are 7.58 (m/hec) and this quantity is very less the norm of road density in Hyrcaianforst. Overall results showed that the condition of road density in study area are poor and very weak. In base of this results author suggested the increase road density to 20 m/ha.

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