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## Marginal Effect of Forest Road on Alder Trees (Case Study: Darab Kola Forest, Mazandaran Province, Iran)

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**Abstract:** Forest road is one of the most important ways to access the forest and its own activities. It should have some standard qualities and also had the list harm for nature. One of the most important qualities of forest road is limited of two sides to developing of natural forest. Alder tree is the first kind of trees that grows in northern forest of Iran closed to the constructed roads. This research was done in Mazandaran forest (Darab Kola district) to evaluate how Alder grows in the two side margins of roads. Twenty half plot (upper and lower road margins) with a size of 1000 m<sup>2</sup> in one kilometer length of this road was selected and twenty face to face Alder trees closed to the road were sampled to take two cores in a face and back of road at the DBH level. After analyzing the data with a simple variance and comparing annual rings (curves), diameter, height and growth by simple and joint t-test, the results show that there is no significant difference between growing in upwards and downwards of road and also between diameter and height of tree in two sides of road. Most diameter distribution classes of trees were in a 15-20 cm. To consider more about this matter, study of different width and slopes of forest roads in a various forest stands was proposed.

**Key words:** Forest Road, alder, growth, marginal effect, Darab Kola (Mazandaran, Iran)

### INTRODUCTION

Forest is the God's talent and source of blessing for human, from one side non access to the forest surface because of lack of suitable forest road and from the other side there are some harmful effect of road or environment. Wide spread land use in mountainous forested terrain, such as logging, recreation and agricultural operations inevitably require road network (Negishi *et al.*, 2006). Making roads results some problem in upside of road caused tree growth decline may due to absence of oxygen in soil particles (Forman and Alexander, 1998; Forman, 2000; Marvi Mohajer, 2005).

Absence of road for accessing the forest is the main cause about non spread the forestry design to the whole north forest of Iran and also it results some other problem of wood quality. The forest policy management requires a coherence of praises of making with maintenance a fix ecosystem (Musa and Mohammed, 2000). Many of tree species have adapted to the sunlight, high soil fertility and require high energy that are best met in edge environments, it is unclear what role native species and ecosystem structure plays in affecting invisibility in forest habitats (Gilbert and Lechowicz, 2005; Stohlgren and Barnett, 2003).

Ecology of forest roads is very important and if they can't compensate the wood production in forest it will

probable that there won't be any problems. Making roads on the north forest are generally based on emergencies and are depended on the financial support. Without standards, forest ecosystem doesn't need to consider in the best condition and long- term aims. The use of experiences and factors are important and securities factories and protection of different kinds of animals and plants in two road's margins. Nowadays with considering the change of climate we should be cautious regarding natural ecosystem in forest. Basically, we should pay more attention to economical factors (not only wood utilization) in planning of forest roads. Accessing to the different parts of forest, doing management systems, different methods of studying in relation to silviculture, require road network. So, implication to road rehabilitations should be studied (Negishi *et al.*, 2004). In the forest road planning we should try to select the best stand with high volume per hectare and to make a road network with optimum distribution and coverage at the best shape and situation for field (Hruza, 2003).

Miler and his colleagues in Kolorado forest in American study on the subject of forest road effect on natural landscape and pay attention to the topography effect on average mass volume with road density in stands next to the roads and landscape changes. They offer that the road should be the main portion of landscape to improve and to progress the view

(Miler *et al.*, 1996). Forest edges have been long recognized as the first landscape elements to be invaded by alien plant species in forest ecosystem (Punchard and Alaback, 2006). Until now, none study was revealed the tree diameter growth which deciduous tree species naturally regenerated in besides of the roads.

There is least attention to the marginal effect of forest roads on tree growth (Watkinz *et al.*, 2003). The history about studying forest road marginal effect shows that these studies are more on forest road effect on the forms or clear cutting areas (Pickett and White, 1985; Reed *et al.*, 1996). Scientists investigated the road marginal effects on different areas and their results show that it can change the environment, different kind of trees, temperature, humid, light accessing and wind (Euskriehen *et al.*, 2001; Gysel, 1951; Chen *et al.*, 1995). Techniques effect about progress develop the forest roads show that special mass of dust in some part of the road alter finishing the utilization and non use of some way, for example scratch the field from it width. It reduces the soil bulk density and reduces the water surface following and also increases the white pine diameter growth (Kolka and Smidt, 2004). Effect of road development is a primary mechanism of fragmentation in the northern Grate Lake region removing original land cover creating edge habitat altering landscape structure and function and it is depended on with and density of the road (Saunders *et al.*, 2002). Nearly forest road is 0.8% of whole north forest covered by 1.2 million hectares (Sarikhani, 2002). However the number of north bound forest and forest road built in 8000 km and just it is in 0.8% of forest surface in the north of Iran (Hosseini, 2003) in comparing with the numbers we can pain to 20% of the United States forest (Forman and Alexander, 1998). In this research we pay attention to the Alder tree growth in up and down sides of the forest road in the northern forest of Iran.

## MATERIALS AND METHODS

**Study area:** Darab Kola forest is located on southeastern part of Sari town between 36°28' to 36° 23' North latitude and 52° 14' to 52° 31' East longitude (Fig. 1). Topography map is on a scale of 1:25000 and three main manes sprite Darabkola village to two parts. The roads situation is Naharkhoran mane that is from north to south. This road begins from Darabkola and finished in Soota mane and devides Darab Kola to two eastern and western parts. The general road aspects are northern and north western. The average slope of forest field is about 40% (Min. 5% and Max. 70%), the height of forest area at sea level starts from 180 m and continues till about 800 m.

This forest site has four kinds of soil: 1) non development randzin to washed randzin soil, 2) brown

with alkaline soil pH, 3) washed brown with calsic and 4) washed brown with pseodoglay (Anonymous, 2003). The local Alder tree (*Alnus glutinosa*) in the north of Iran called Syah Toose, Sefeed Toose, Toose, Tooska and Marzdar Tooska. From Astara (Gilan Province) to Goleydaghy (Golestan province) it grows closed to the Caspian Sea, around the rivers and continues to 1000 m ASL. Alder grows in saturated field which is humid and about 6 month a year was flooded. The wood of Alder is used in roof and floor of village buildings, making some man made materials and boxes. This tree species growing very fast, height growth in the best sites is 25-30 m with DBH of 100 cm. It develops naturally in whole Europe, part of Asia; and north of Iran, Africa and Russia. It stands the hand core but likes the sea sides' weathers. It grows better in humid and acid soil. This kind of Alder roots can alleviate the nitrogen.

Characteristics of forest stands growth in the first district of Darabkola forest for 5 parcels (no. 13, 14, 15, 16, 23) were analyzed. Totally 83 plots were randomly chosen to measure diameter, height, tree species, tree numbers and volumes. Measuring the diameter and height in the plots were done by usual method. Forest roads in parcels no. 16 and 23 borders in the first district of watershed no. 74 has selected for measuring. One kilometer length of the forest road was selected and divided to ten sections. The first Ader tree that was closed to the road was chosen. Diameter at Breast Height (DBH), more than 12.5 cm and total height was measured by kaliper and Inclinator (sunto), respectively.

The cores (tree rings) were taken at D.B.H. from front and back of each two trees in each plot that were chosen opposite up and down sides of road. They were selected in rectangular plots. So the nearest true to the center of plot and the thickest one were selected and measured. The area of plots was 400 m<sup>2</sup> (40×10 m), because of even aged stand. Statistical analyze was done in SAS software program in a simple variance design. Mean tree growth in two sides of road was done by simple and joint T test. Front and back mean ring width of each tree and individuals around the road was compared by joint and simple T test, respectively.

After doing sample regression model by testing by different models between diameter as an independent and height as dependent variables of whole sampled trees (353) shows following model:

$$\text{Log (H)} = -0.239397 (\pm 0.01390192) \sqrt{D} + 1.280081 (\pm 0.02677806) \text{Log (D)}$$

The coefficient of variations in the models was 6.8% and coefficient of determination was 0.9955 with  $p < 0.0025$ .

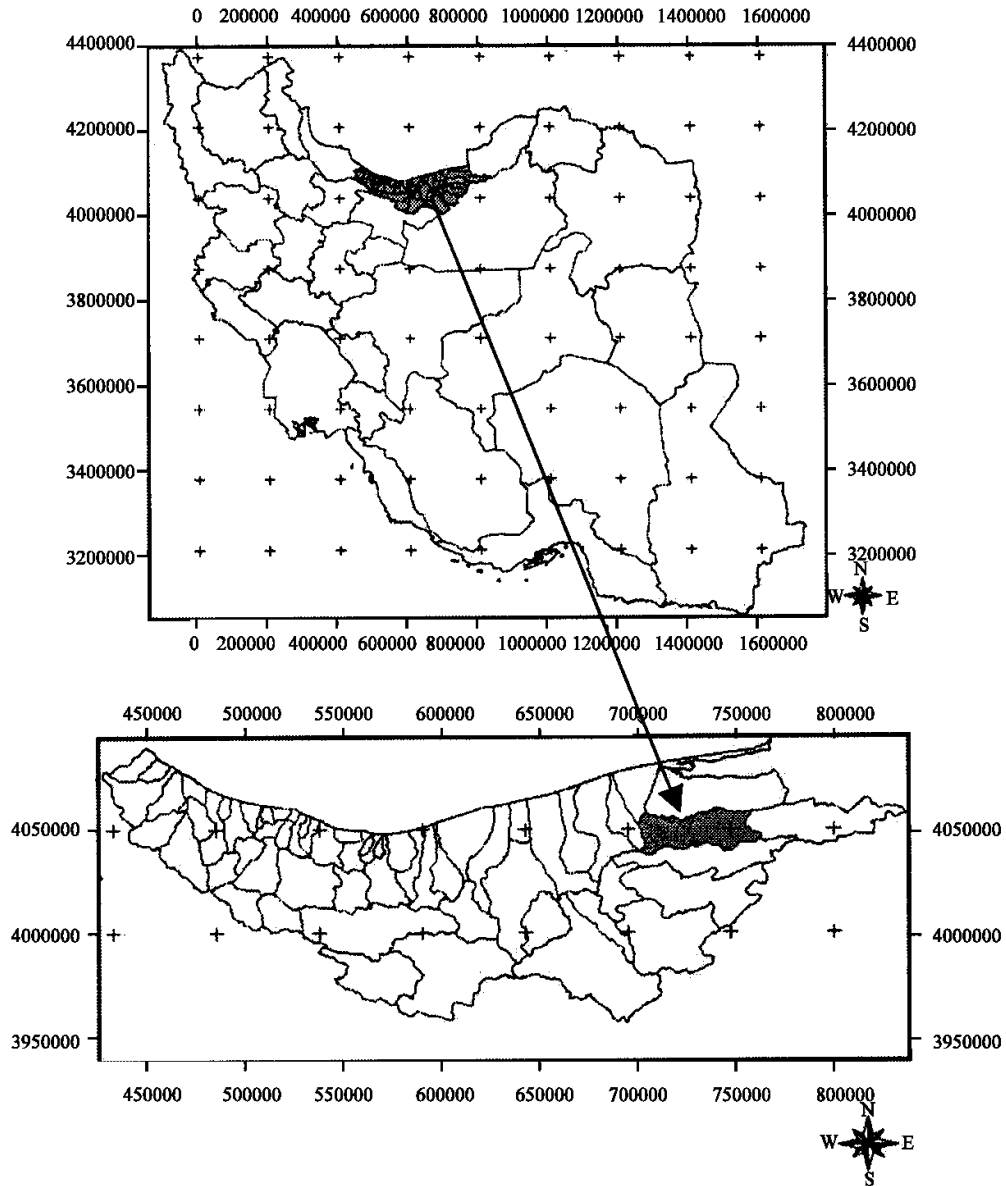


Fig. 1: Map of the Study area (watershed No.74- Mazandaran province)

### RESULTS

The most distribution of tree number in diameter classes was in 15-20 cm. The condition was reducing shape for tree number per hectare and reducing more in the stand. The site is generally young and in middle age (Fig. 2). These were 383 m<sup>3</sup> volumes in each hectare up diameter crooked on the down diameters and it's the reason that shows the trees are young and middle aged in this forest (Fig. 3).

It is important that the curve passes from the axis in which  $\log(h)$ , the whole height logarithm,  $\sqrt{D}$  the second root of the width diameter and  $\log(D)$ , the

logarithm of diameter is equal to the trees height in Darabkola forest. The regression between the heights and the diameter of trees show that in research forest, logarithm to height with the second root of the diameter and logarithm of the diameter can determine the best estimation of the growth. The estimation of the model with the real logarithm inputs shows that there is no difference between the estimation and the real data. There is no significant relationship between the diameter and the height of Alder tree in two sides of the road. The result shows the correspondence of the estimation with the real data (Fig. 4).

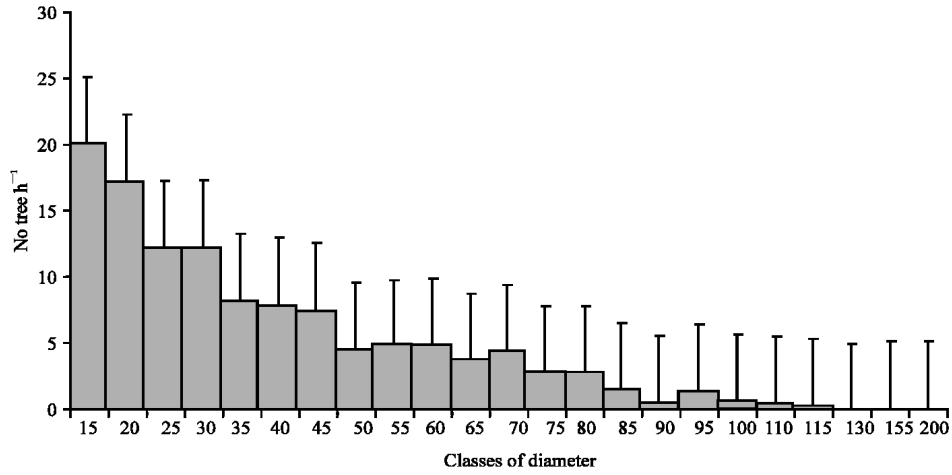


Fig. 2: Number of diameter classes for all species (Parcels Number 13, 14, 15, 16, 23)

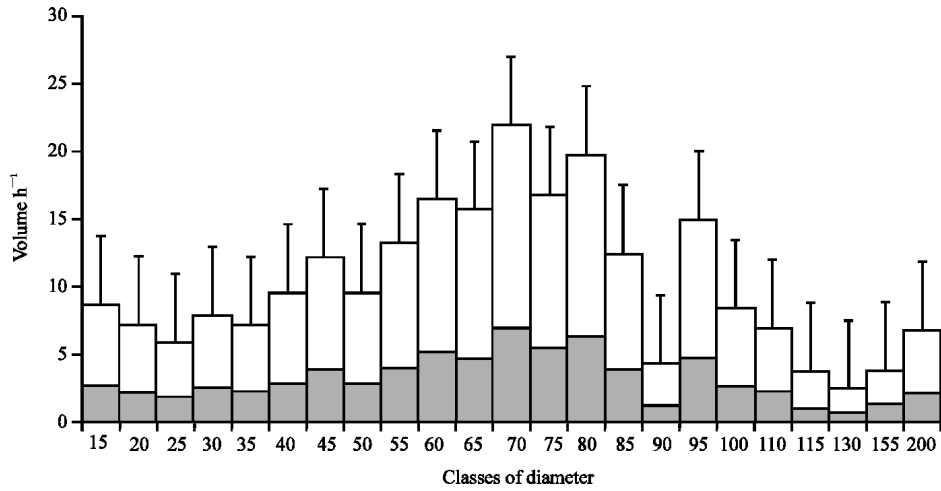


Fig. 3: Volume of diameter classes for all classes

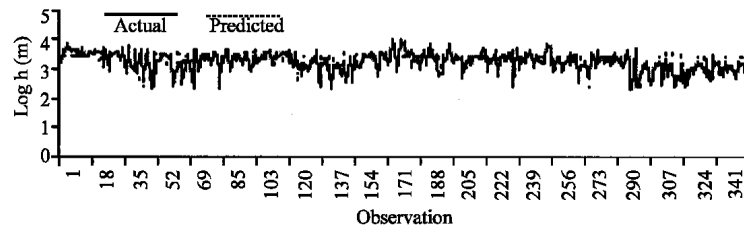


Fig. 4: Transformation of height growth of observation and prediction model

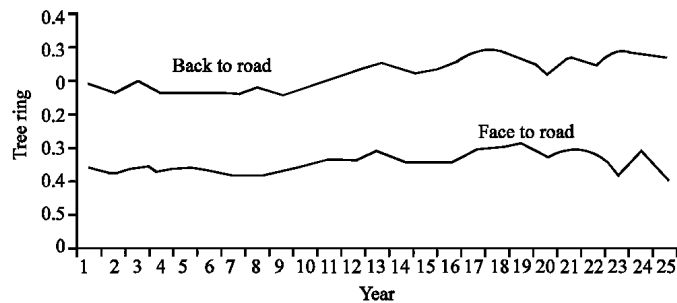


Fig. 5: The growth of trees width in back and front of the road from 1979 to 2002

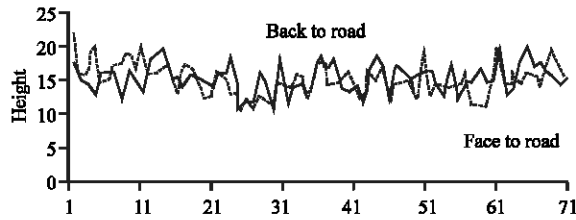


Fig. 6: Relationship between height of upside road and downside road Alder trees

The growth of DBH as tree rings, in the back side of the road had greater in compared with those which were in front of the road since 1979. But in different years, the growth in tree curves in the both cases (back and in front of road) didn't show so much difference (Fig. 5). There was no difference for the height of trees in the downside and upside of road (Fig. 6).

### DISCUSSION

Alder tree is one of the most important species that appear in edge of road after construction. That species will be grown at the road sides because of highlight nutrient or energy requirements and the soil moisture in edge environment (Stohlgren and Barnett, 2003; Gilbert and Lechowicz, 2005). The relationship between logarithm of height as a related indignation and the logarithm and the square root is equal to the width of the trees on the both sides of roads that was defended by Avery and Burkhardt (2002) tree growth model. This model shows a suitable correlation coefficient between the diameter growth and the height, so a good growth relationship process with considering the age of Alder in the study area.

With considering the growth of the tree crown to the road surface, Alder has a greater growth compare to the stand in the closed canopy. But the result of the research rejects above imagination. It seems that the soil compaction because of wood trucks transportation after road building will cause the decrease of soil pores and developmental tree growth toward the road margin (Godefroid and Koedam 2004). Kollka and Smidt (2004) in their research studied effect of improvement and amelioration techniques of the roads on the soil bulk density and edaphical characteristics after forest soil incrustation they concluded that in some parts of road the procedure of soil scratching would decrease the surface water flood and as a result it would increase the growth of white pine diameter. Much study was done in different

compaction of soil and the impact of them on the growth of trees was reduced (Brais and Camire, 1998; McDonald *et al.*, 1998; Kozlowski, 1999; Heninger *et al.*, 2002; Rab, 2004). It seems because of lack of forest road maintaining and repairing operations in suitable periods and the over normal and as tracks traffic, the soil compaction increased and as a result the tree growth around the roads had decreased (Angold, 1997).

The some aspect and slope in the two sides of the forest roads, has on equal effect on the height growth of Alder. The Alder trees which are grown often road construction because of the some age and in the same environment there is no meaningful difference between them. It is advised that more studying required and generalization to all surface of Mazandaran forest. This study should be continued with more different slopes and more examples to be able to know the suitable width of road in mentioned condition. So researches in other countries showed that in the design of roads goods, their planning, the measure of the limits is very important to cost least and to produce most usefulness (Musa and Mohammad, 2000). The effects of the forest road margin can change the natural environment, different types of plants and animals, the temperature, the amount of moisture and light (Euskriehen *et al.*, 2001).

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