



RESEARCH PAPER

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Effect of physiographical factors on tree regeneration in the Northern Zagros Forest (Case study, Marivan, Kurdistan Province)

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Abstract

Zagros ecosystem is considered as one of the most important forest biological sites in the IR-Iran. This research was investigated in the Zaribar Lake Basin forest in Marivan region, northern Zagros forest, and western Iranian state of Kurdistan province. Zaribar Lake Basin forest are located in west of Marivan city and three village conventional territory including Kollan (east of Lake), Kanisanan (west of Lake) and Domalle (south of Lake) was selected. Physiographical factors concluding altitude, slope and aspect divided to three classes. Completely Randomized Block Design (CRBD) for three treatments of species variety, form of forest, and aspect with three altitude classes was used by three circular plot of 1200 m² to collect data and measure forest variables. Within each macro plot, five micro plots of 2×2 meter for studied of regeneration layer and recorded the number and regeneration form (coppice or seedling) was designed. Results show that the maximum of forest regeneration accrued in the coppice form. Overall results showed that the maximum of regeneration observed in the 1400 to 1600 meter altitude, 0 to 20 percent slope and west aspect classes. This study emphasis the effect of physiographical factors (slope, altitude and aspect elements) on the regeneration conditions in the Northern Zagros forest.

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Introduction

Regeneration and forest durability guarantee is one of the most important aspects of forest sustainability and it should be placed in forest plans priority. So, due to important role of Zagros forests, comprehensive investigation about regeneration crisis becomes an increasing necessity (Shakeri *et al.* 2009). Islamic Republic of Iran is located in the North Temperate Zone from 25° to 40° latitudes and 44° to 63° longitude; with a total area approximately 1,650,000 Km². Large sections of interior and also great climatic variability are characterized by arid basins in Iran. The main variation is between the dry, desert interior region and humid Caspian coastal region (Haidari *et al.* 2012b). With due to attention to climatic conditions of Iran, 65% area including arid and semi-arid and degradation rapid of the north and the west, because of degradation of natural resources will cause to degradation agricultural lands and human activity (Dastmalchi, 1998). The forests of Iran cover about 12.4 million ha and constitute 7.4% of the total area of the country. The Zagros forests, with an area of around 5 million hectares, account for almost 40% of the country's forests (Sagheb-Talebi *et al.* 2004; Askari *et al.* 2013; Parma and Shataei, 2013). The forests provide a home and livelihood for approximately 10% of Iran's population (DoE/GOIRI, 2004). Zagros is typically characterized by a semi-humid climate with extremely cold winters and annual precipitation exceeding 800 mm.

The main species in this region are *Quercus* spp. (oaks), *Pistacia mutica* (wild pistachio), *Crataegus* spp and *Pyrus* spp (Ghazanfari *et al.* 2004). More than 1.7 million ha of the Zagros forests have been deforested since 1962, and studies indicate that the increasing population, the low level of development, and the high dependency of local communities on the forests for their primary livelihoods appear to be the main reasons for this decline (Ghazanfari *et al.* 2004).

Zagros forests are currently considered as degraded forests. The lack of regeneration in these forests because of increased grazing pressure on regenerating

trees is a major concern and there are no commercial-sized trees left in Zagros (Jazirehi and Ebrahimi 2003; Ghazanfari *et al.* 2004; Pourhashemi *et al.* 2004; Sagheb-Talebi *et al.* 2004). Conflicts between various users of these resources are increasing as they are diminishing (Bellefontaine, 2000). Overharvesting of forests, overgrazing and land clearance for agriculture reduce numerous functions and services previously provided by semiarid forests. These are being threatened not only by deforestation, but also by the reduction of biodiversity that affects the subsisting tree cover formations (Siren, 1986; Bellefontaine, 2000). The major element of Zagros forest destruction include: grazing, farm operation in forest (agriculture in forest), fuel wood and timber, mining, semi-parasite plant and non-wood forest production (Jazirei and Ebrahimi Rastaghi, 2003). Increasing population, low level of development and high dependence of local communities on forests for their primary livelihood needs, are the main reasons of this destruction (Fattahi, 1994). In the Zagros region several study accrued on the effect of physiographical element on forest and regeneration include: The researcher showed that the Oaks species higher density in the northern and western aspect (because has higher soil moisture), but this species observe in the total of aspects directions and the suitable altitude range for the establishment of Iranian Oaks is 1000 to 2000 meter (Jazirei and Ebrahimi Rastaghi, 2003).

The researcher showed that the more seed established in the higher altitude (1800 to 2000 m altitude), and coppice regeneration established in the lowest altitude (Mirzaei *et al.* 2004). The study of appropriate site conditions of Oaks forest in the Chaharmahal and Bakhtiari Province showed that the southwest aspect are an appropriate aspect to establishment of regenerations of Oak forests (Talebi *et al.* 2005). The researcher showed that the maximum of seeding regeneration observe in the northern aspects, but maximum of coppice regeneration observe in the southern aspect in the Arghavan protected area in the Ilam forest (Mirzaei *et*

al. 2004). The researcher showed that by increase the slope (%), increase the soil erosion, high drainage, dry soils (more in the southern aspects), non-establishment of seeds and negative effect on the presence of species (Mirzaei *et al.* 2007). Human have a negative effect on the forest and environments. Unfortunately local community in the Zagros forest in the recent years degraded the Zagros forest. The researcher study effect of on the seeding and coppice stands in the Zagros forests and results showed that the seeding stands observed in the farther (more distance from population) distance from village, coppice forest observed in the nearest the village (Namiranian *et al.* 2007). Namiranian *et al.* (2010) revealed that the most coppice regeneration found in the north and east aspect, but most seeding regeneration observed in the south and west aspects. The researcher showed that the highest of diversity and richness observed in the northern aspect and 25 to 65 % slopes in the Ghalage protected area in the Kermanishah province at the Zagros forest (Parma and Shataei Joybari, 2009).

The researcher studied results the most important factors affecting oak regeneration in this region are livestock grazing, fire, acorn collecting by villagers for domestic fodder, summer drought, pests and diseases on acorns and seedlings (Shakeri *et al.* 2009). The researcher showed that the slope have a negative effect on the tree diversity and richness in the Zagros forest and Ilam forest (Mahdavi *et al.* 2010). The researcher study of effective factors on distribution of coppice and high forests in traditional forestry of central Zagros provide the most of coppice stand in gentle slopes, low elevations, north and eastern aspects and near to population centers. Meanwhile, high stand occurs in high elevations, steep slopes, distant from population centers and west and southern aspects. The road had not any role in distribution of stands. In understory farmlands disregard to other factors only high stand may occur (Namiranian *et al.* 2010). The researcher studied the natural regeneration of Yew in Arasbaran forests and results showed that the most of these saplings had seed origin and were classified in height class less

than 30cm with high vitality and health condition. Regarding to the past history of the area, this results show that the protection of area was effective and successful, so a dense and fresh yew stand in the Arasbaran area is expected in the future, if the protection is continued (Ghanbari Sharafeh *et al.* 2010).

The researcher studied Sexual regeneration frequency of forest species in Zagros area in relation to different ecological factors in Ilam province, Results indicated that physiographical, topographical, and edaphically variation have high effects on sexual regeneration frequency in the studied area. The mean regeneration number in elevation class of higher than 1800 m, also in slope class greater than 60% and in the northern and the western directions were higher than other classes and directions (Najafifar, 2011). Haidari *et al.*, (2012) studied on plant biodiversity in grazed and non-grazed areas in the Iran-o-Turanian ecological zones. They showed that in the grazed and non-grazed increase diversity of tree, shrub and herbaceous but in complete protection (non-grazed) area have higher plant diversity compared with the grazed region. The researcher study of vertical and horizontal forest structure in Northern Zagros Forest and results showed that the major problem in Blake forest is lack of the regeneration (Haidari *et al.* 2013a). The researcher studied of tree regeneration in the grazed and non-grazed areas in the Iran-o-Turanian Ecological Zones and results showed Regeneration in non-grazed region was less than grazed region. Overall results showed that the grazing have a negative effects on regeneration (Haidari *et al.* 2013b). The aim of this study was detection the effect of physiographical factors on the forest regeneration in the Northern Zagros Forest around the Zarivar's Lake, Kurdistan province, in the west of Iran.

Material and method

Site description

The Zogros Mountains are divided into two parts: northern and southern. The northern Zagros is consisted of the growing site of *Quercus infectoria* Oliv, *Q. libani* Oliv and *Q. persica* J. & Sp. (*Q. brantii*

Lindl.) species are found in this part. However, the southern Zagros is included *Q.persicas* site which it extended to Fars province (i.e., 29° 5' N). The northern Zagros is wetter and cooler than the southern one (Pourbabaei and Zandi Navgran, 2011; Jazirei and EbrahimiRastaghi, 2003). This research was investigated in the Zaribar Lake Basin forest in Marivan region, northern Zagros forest, and western Iranian state of Kurdistan (Figure 1). Zaribar Lake Basin forest are located in west of Marivan city and three village conventional territory include Kollan (east of Zaribar Lake), Kanisanan (west of Zaribar Lake) and Domalle (south of Zaribar Lake) was selected. The forests are located between 1400 and 2000 m a.s.l, Mean annual precipitation is 909.5 mm, ranging from 590.8 to 1422.2 mm, Mean annual temperature is 13.3° C, and the length of dry season is 4 month (based on embrothermic curve) from June to August. Type of climate is sub humid with cold winters in the basis of Emberger's formula (Pourbabaei and Navgran, 2011).

Field measurement and analysis

In study area physiographical factors concluded to three levels of altitude (1400-1600, 1600-1800, 1800-2000 m asl), slope (0-20, 20-40, 40-60 percentage) and aspect (east, west, south direction). Inventory method designed in the Completely Randomized Block Design (CRBD) and used the circular plot with 1200 m². In each plot, information including altitude, position (x, y), forest type, slope and aspect were taken. Other information in each plot include species, two diameter of crown, forest form (High, coppice and Coppice with Standard forest), height, crown symmetric, tree health and DBH. In each plot designed the five micro plots 2×2 meter for studied of regeneration layer and recorded the number and form (coppice or seedling) of regeneration. We have three treatments (kind of species, form of forest and aspect class) and three repeat (three class of altitude). Group

mean comparisons were done by SNK method. Data analyzing was done by SAS and SPSS18 software's.

Result and discussion

The Zagros regions are as where enough rain falls to support habitation, but humans have degraded the landscape. Agriculture, pastoralism, and woodcutting have caused the loss of natural vegetation. Figure 2 showed that the 1400 to 1600 meter altitude has a maximum quantity of regeneration and 1600 to 1800 meter altitude has a maximum height of regeneration. SNK test showed that the different quantity and height of regeneration in the altitude class was significant. Table 1 showed that the different between the height and species of regeneration in the altitude class was significant. Table 2 showed that the different between the quantity of regeneration in the slope class not significant. Figure 3 showed that the different between the quantity, height and Kind of regeneration in the slope class not significant. Table 3 showed that the different between the height and species of regeneration in the slope class not significant. Table 4 showed that the different between the quantities of regeneration in the aspect class are significant. Figure 4 showed that the west aspect has a maximum quantity and Kind of regeneration and SNK test showed that the significant different between aspect class and height of regeneration not significant different. Table 8 showed that the different between the kinds of species regeneration in the aspect class was significant; but different between the heights of regeneration in the aspect class not significant. Figure 5 showed that the different between the quantity of regeneration in the coppice and seeding regeneration class was significant. Table 6 showed that the different quantity of regeneration between the forest types was significant, but different quantity of regeneration between the altitude and Forest × Altitude not significant.

Table 1. ANOVA of height and kind of regeneration in the altitude class.

Source of Variation	df	Height of regeneration			Species of regeneration		
		Sum of Square	Mean Square	F	Sum of Square	Mean Square	F _{value}
altitude	2	3.2110	1.605	3.21*	4.009	2.004	1.21**
error	209	104.656	0.50075		347.688	1.663	

total	211	107.867	351.698
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*, significant at 5% level; **, significant at 1% level.

Table 2. ANOVA test for compare of quantity of regeneration in the slope class.

SV	df	Sum of Square	Mean of Square	F	Sig.
Slope	2	115.022	57.511	1.92	0.149 ^{ns}
Error	208	6238.76	29.994		
total	210	6353.782			

ns, not significant.

Table 3. ANOVA of height and kind of regeneration in the slope class.

SV	df	Height of regeneration			Species of regeneration		
		Sum of Square	Mean of Square	F	Sum of Square	Mean of Square	F
Slope	2	105.469	0.504	2.38 ^{ns}	0.201	0.1005	0.06 ^{ns}
Error	209	105.469	0.504		351.149	1.681	
Total	211	107.867			351.698		

Table 4. ANOVA of regeneration quantity in the aspect class.

SV	df	Sum of Square	Mean of Square	F	Sig.
Slope	2	514.213	257.0615	9.16	0.0002 ^{**}
Error	208	5839.659	28.057		
total	210	6353.783			

Table 5. ANOVA test for compare of height and kind of regeneration in the aspect class.

SV	df	Height of regeneration			Species of regeneration		
		Sum of Square	Mean of Square	F	Sum of Square	Mean of Square	F
Aspect	2	1.649	0.824	1.62 ^{ns}	14.362	7.18	4.45 [*]
Error	209	106.218	0.508		337.336	1.614	
Total	211	107.867			351.698		

Table 6. ANOVA test quantity of regeneration in the forest type, altitude class, interact effect (Forest × Altitude).

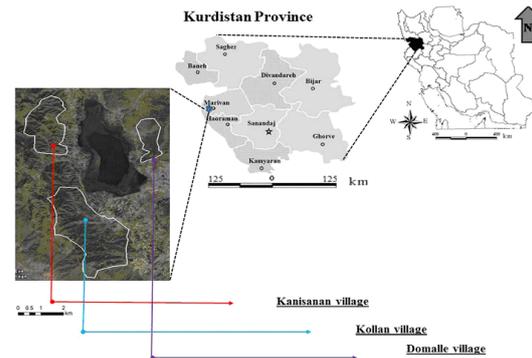
Pr>F	Fvalue	Mean of Square	Sum of Square	df	VS
0.0112 [*]	4.59	127.227	254.453	2	Sites
0.0656 ^{ns}	2.76	76.540	153.081	2	Altitudes
0.4093 ^{ns}	0.72	19.823	39.467	2	Sites × Altitudes
		27.715	5653.96	204	error
			6353.782	210	total

Regeneration and forest durability guarantee is one of the most important aspects of forest sustainability and it should be placed in forest plans priority. So, due to important role of Zagros forests, comprehensive investigation about regeneration crisis becomes an increasing necessity (Shakeri *et al.* 2009). One of the serious threats to most of the Iranian ecosystems is drought, because much of Iran lies in the arid or semiarid regions. The other threats for plants are: overgrazing, fuel wood extraction, conversion of forest and other wild lands for agriculture, road construction, overexploitation, and unscientific extraction of plant resources for medicine, food. Because the Zagros forest located in the mountain area and lack of flat areas for farming, the most area of this forest devoted to the agriculture operations. The gentle slope devoted to the

agriculture operations in the Zagros forests (Talebi *et al.* 2005). To study impact of physiographical factors on the forest regeneration in the Northern Zagros Forest slope, altitude and aspect element divided three classes. Results showed that the different between the height and species of regeneration in the altitude class was significant (Table 1). Results showed that the 1400 to 1600 meter altitude has a maximum quantity and height of regeneration, and different quantity and height of regeneration in the altitude class was significant (Figure 2). Results showed that by increase the altitude the quantity of regeneration reduced and altitude has a negative effect on forest regeneration. Results showed that the slope element not effect on the regeneration condition in the Zagros forest (table 2) and ANOVA test don't showed the significant different of regeneration

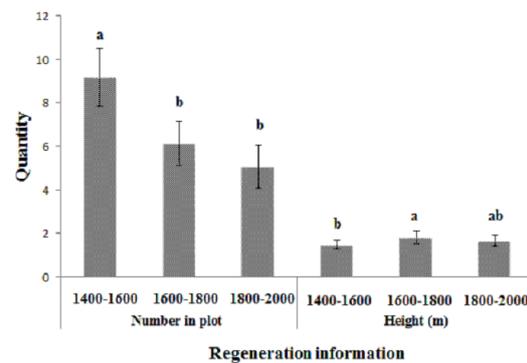
information in the slope classes (Figure 3), but maximum of regeneration (height and quantity of regeneration) observed in the 0 to 20 percent slope classes. Analysis of slope element showed that the regeneration have an inverse relation by increase the slope. Analysis of aspect element showed that the western aspect has a maximum quantity and species of regeneration and SNK test showed that the significant different between aspect class and height of regeneration not significant different (Figure 4). Results showed that the different between the kinds of species regeneration in the aspect class was significant, but different between the height of regeneration in the aspect class not significant (Table 5). This results indicated that the maximum of regeneration showed that in the west aspect (between west, Southwest and east aspect). The aim problems of Zagros forest are lack of forest regenerations. Regeneration in the Zagros forest accrued in the two coppices and seeding forms. Seeding regeneration obtained the sustainable forest development and future of forest. overall results showed that the maximum of forest regeneration accrued in the coppice form and t-test analysis showed the significant different between the quantity of seeding and coppice regeneration in the study area, This result indicated that the human utilization and grazing have negative effect on the regeneration condition and the quantity of coppice regeneration increased and Jazirehei and Ebrahimi Rastaghi (2003) and Namiranian *et al.* (2007) reached our results. Overall results showed that the maximum of regeneration observed in the 1400 to 1600 meter altitude, 0 to 20 percent slope and west aspect classes. This result showed that the physiographical factors (slope, altitude and aspect element) have an effect on the regeneration and Parma and ShataeiJoybari (2009), Mahdavi *et al* (2009), Namiranian *et al* (2010) and Najafifar (2011) reached our results. Forest regeneration has an inverse relation by increase the altitude and slope. This result indicated that the more regeneration in the less 2000 meter altitude are seeding and Mirzaei *et al* (2005) and Jazirehei and EbrahimiRastaghi (2003) emphasis this results. This study emphasis the effect of

physiographical factors (slope, altitude and aspect element) and human utilization on the regeneration conditions in the Northern Zagros forest. Human have a negative effect on the forest and environments. Unfortunately local community in the Zagros forest in the recent years degraded the Zagros forest. Relationship between the physiographical elements and plant community increment is an important role to sustained forest (Carmean, 1977).



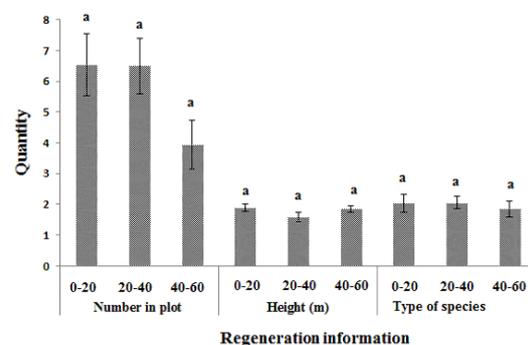
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g. 1. Sites location in the Kurdistan Province, Zagros region, Western of IR-Iran.



Fi

g. 2. Compare mean of quantity and height of regeneration in the altitude class.



F

ig. 3. compare mean of quantity, height and Kind of regeneration in the slope classes.

Our results showed that the maximum of forest regeneration accrued in the coppice form and t-test analysis showed the significant different between the quantity of seeding and coppice regeneration in the study area. Overall results showed that the maximum of regeneration observed in the 1400 to 1600 meter altitude, 0 to 20 percent slope and west aspect classes. This study emphasis the effect of physiographical factors (slope, altitude and aspect) and human utilization on the regeneration conditions in the Northern Zagros forest.

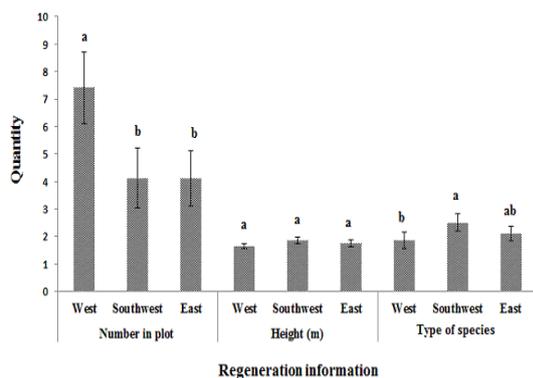


Fig. 4. Compeer mean of quantity, height and Kind of regeneration in the aspect class.

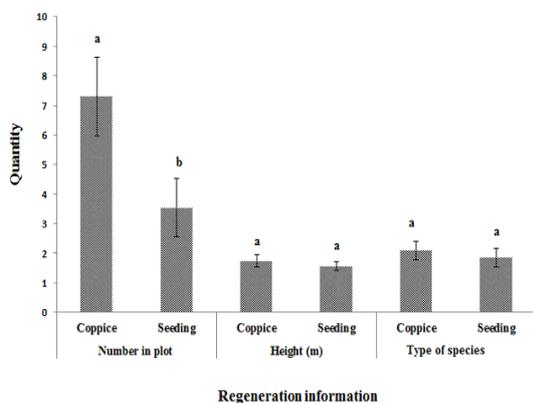


Fig. 5. Compeer mean of quantity, height and Kind of regeneration in the regeneration class.

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