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ORIGINAL ARTICLE

Effect of two Traditional Forest Management Practices (TFM) on the Diversity, Regeneration and Spatial pattern of tree in Northern Zagros Forest, Kurdistan Province, West of Iran

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ABSTRACT
*The emphasis of the traditional Forest Management Practices the important key on the sustainable forest management. In order to investigate of this study Blake forest (Armadreh pattern) and Havare Khol forest (Havare Khol pattern) in the Baneh region, Kurdistan Province was selected. In per site collected 60 square sample plots (20×25m= 500 m²) by randomized-systematic method in the 100×200 Net. In every sample plot this information include the species, number, origin of tree (coppice and Height tree), Diameter of breast height (cm), height (m), Crown height (m) and two diameters of crown was recorded. Regeneration recorded in micro plots 5*5 meter (25 m²). Species diversity index includes Shannon Wiener (H') and Margalef (R_1) was used. To analysis of spatial pattern used the quadrat method and variance /mean ratio, Green, Morisata and standardized Morisata index in the two sites. The means of different between diversity indexes in the two areas were calculated by T-test. To analysis data use the Past, Ecological Methodological and SPSS18 software. Results showed that tree diversity in Havareh Khol pattern higher the Armardeh pattern but species diversity in Havareh Khol pattern has more. Statistical analysis showed significant differences between diversity index and qualitative parameter of tree in the two patterns. In this study two Traditional forest management practices have strong and weakness point and Authors suggested to approach the sustainable forest management used the compact of two Traditional forest management practice.*
***Key words**: Zagros forest, Blake forest, Armardeh Pattern, Havare Khol Pattern, diversity, spatial pattern*

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INTRODUCTION

With due attention to climate conditions of Iran that 65% area includes arid and semi-aired and degradation rapid of north and west, because of degradation of natural resources will cause to degradation agricultural lands and human environmental [1]. Forests cover about 12 million ha in Iran [6], including 5.05 million ha in the mountainous Zagros region. This forest extends from Turkey and Iraq into Northeastern and Southeastern Iran (between Azerbaijan and Fars Province). 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), Crategus spp. and *Pyrus* spp [7]. Most of the forests of Iran involve some kind of conventional ownership, either communal (by villages) or among families within villages. In the Zagros Mountains, especially in the northern areas, the territory of Kurdish people, this kind of conventional ownership and relationships between humans and nature are extremely strong. The major element of zagros forest destruction include: Grazing, Farm operation in forest, fuel wood and timber, mining, semi-parasite plant and non-wood forest production [13]. Near than 1.7 million ha of the Zagros forests has been destroyed since 1962 [3]. 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. The lack of regeneration in these forests is a major concern [3, 13]. Traditional forest management is used in Zagros for the collection

of foliage (fodder) for domestic animal. Individual households manage their privately owned forests as unit. The owners of each section regulate tree growth by pruning the crowns using a method called ″ coppicing″. Harvesting is conducted solely by family members unless the family is small. Households with small families receive help from the community. This assistance is called ″Gale″ (Gala on Kurdish language). In the Kurdistan Province used of the oak tree for liv Estock feed, this tree include: Quercus infectoria, Q. libani and Q.libani leaves.these oaks are used as winter fodder. Galazani (pruning) have been implemented in the September and October (Growth season). Forest management is conducted via ground and canopy level cutting of newly developed branches. Two Traditional forest management practices in the Kurdistan Province are used include: one method: prune tree crowns and regulate yields (Armardeh (Blake Village) pattern). In this method is branch selection: cut lateral seedling growing in branches that are less than 5 cm thick, leaving on branch to grow. The remaining branch will contain a higher concentration of nutrients, making is suitable for future us as lumber. A second method is Prune at the ground level to facilitate regeneration of new saplings (Hvareh Khol pattern). In this method once tree are taller than reach of livestock (above 2 m), maintain at a constant height of 12 to 16 meter for 25 years to allow for strong trunk development. In this condition lateral seeding produce denser leaves, thus inhibiting further branch growth. This several research implemented in Northern Zagros forest in cloud: Ghazanfari *et al* [7] investigated the Traditional Forest Management and its Application to Encourage Public Participation for Sustainable Forest Management in Northern Zagros Mountains of Kurdistan Province and results showed that traditional forest management can offer sustained yield and can be prescribed for sustainable forest management in northern Zagros with some modifications. Heidari [8] used Hopkins index to determine spatial pattern of tree in Zagros forests. He concluded that the trees were arranged in a clumped pattern in his study area. Safari *et al* [19], Investigated Spatial pattern of Manna Oak trees (*Quercus brantii* Lindl.) in Bayangan forests of Kermanshah Kermanshah Province, zagros forest. They used the dispersal indicators such as Green, Morisita, Standardized Morisita, Johnson and Zimmer, TF, TN, Hopkins and C for analysis of the spatial pattern in study area. All of the applied indicators showed a clumped pattern for Quercus brantii. Among the distance indicators, TF, TN and C presented better results than the other indices. Safari *et al* [20], Investigated of spatial pattern of wild pistachio (*Pistacia atlantica* Desf.) in the Bayangan forests, Kirmanshah Province, zagros forest. They used the dispersion indices such as Green, Morisata, standardized Morisata, Eberhart, Hinez, Hopkins and C for analyzed the spatial pattern in the area. All indices related to plot samples indicated the clumped pattern for Pistacia atlantica. Among the distance indices used in this study, Eberhart and Heines indices showed clumped, C index showed regular and Hopkins index indicated random pattern for Pistachio. As a result, the spatial pattern of Pistachio is clumped. this study was carried out to determination the effect of two Traditional forest management practices (Armardeh and Havareh Khol pattern) on the Forest Quantity include: Diversity, Regeneration and Spatial pattern in Northern Zagros Forest, Kurdistan Province and indicate the suitable management solution for this forest.

MATERIAL AND METHOD

Study area:

Iranian habitats support about 8000 species of flowering plants (belonging to 167 families and 1200 genera), of which almost 1700 are endemic [5]. These plant species growing on four Ecological Zones (Figure 1). The Zogros mountains are divided into two parts: northern and southern. The northern Zagros is consisted of the growing site of *Quercus infectoria* Oliv. and also *Q.libani* Oliv. and *Q.persica* J. & Sp. (*Q.brantii* Lindl.) species are found in this part. The northern Zagros is wetter and cooler than the southern part [13].

This research was investigated in the Baneh region, Kurdistan Province, Northern Zagros Forest, West of Iran (Figure 2). Havareh khol village (Prune at the ground level) and Armardeh (Blake village (prune tree crowns)) was selected to this research (Figure 3). Havareh khol village is located east of Baneh city and the conventional territory of this village covers 574 ha and includes 345 ha of forests. The forests are located between 1580 and 2100 m a.s.l [11]. Blake Village located in west of Baneh city and 340 hectare of conventional territory of this village was selected. The Blake forests are located between 1280 and 1900 m a.s.l., and the remaining two village territory is comprised of rangelands and agricultural fields [10].

Figure 1. Distribution of four ecological zones of Iran

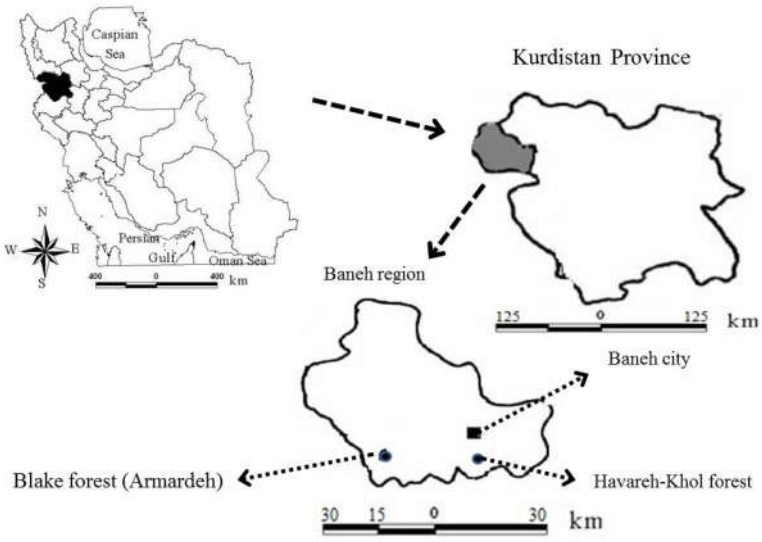

Figure 2. Position of the study area in the Kurdistan Province, Zagros region, West of Iran

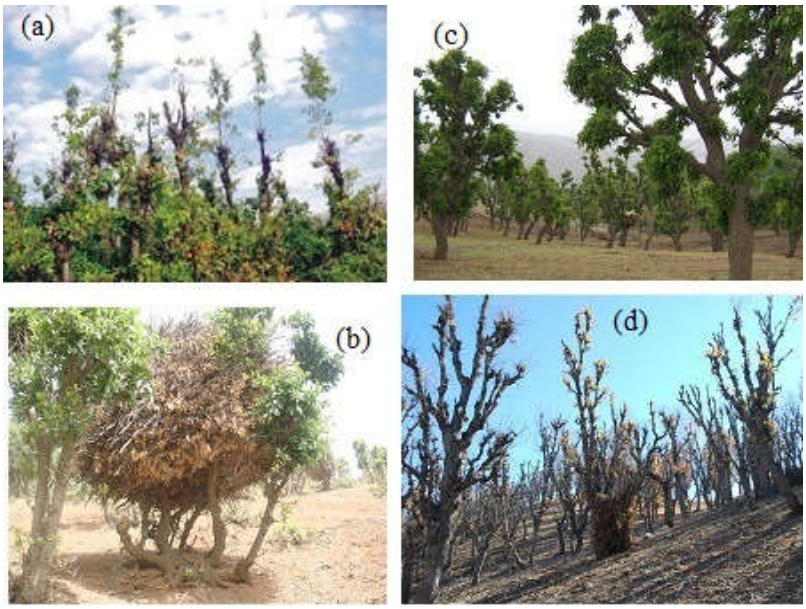

Figure 3. Havareh khol Pattern (Prune at the ground level): (a) and (b) and Armardeh Pattern (Blake village (prune tree crowns)): (c) and (d).

Methods

In per site collected 60 square sample plots (20×25m= 500 m^2) by randomized-systematic method in the 100×200m Net. In every sample plot this information include the species, number of tree, origin of tree (coppice and high tree), Diameter of Breast Height (cm), Height (m), Crown Height (m) and two diameters of crown was recorded. In this sample plot designed the micro plots 5*5 meter (25 m^2) and recorded regeneration information (coppice and seed provenance). Frequency of species in the two sit diameter classes (5 cm) was calculated. Species diversity index includes Shannon Wiener (H′) and Margalef (R_1) was used to evaluate plant diversity in each sampling plot. To analysis of spatial pattern used the quadrat method and variance /mean ratio, Green, Morisata and standardized Morisata index in the two sites. The means of different between diversity indexes in the two areas were calculated by T-test. To analysis data use the Past, Ecological Methodological and SPSS18 software.

Table 1: Biodiversity and spatial pattern Indices used in this paper

Indices	References	Equation
Shannon′s (H′)	[17]	$H' = \sum_{i=1}^{S} pi \ln(pi)$
Margalef (R_1)	[2]	$M = \frac{S-1}{\mathrm{Ln}\ (N)}$
S: the total number of species in the sample	pi: the proportion of individuals in the its species	
variance /mean ratio [18]	S^2 = Variance of number of tree in per sample plot; $\bar{X}$ = Means of number of tree in per sample plot	$I = \frac{s^2}{\bar{x}}$
Green [18]	X= number of tree in per sample plot; S^2 = Variance of number of tree in per sample plot; $\bar{X}$ = Means of number of tree in per sample plot	$IG = \frac{\left(s^2/_{\bar{x}}\right) - 1}{\left(\sqrt{x}\right) - 1}$
Morisata [14]	$\sum x$ = Sum of tree in sample plot; $\sum x^2$= Sum Squares of number tree in sample plot	$I_d = n\left[\frac{\sum(x^2) - \sum x}{(\sum x)^2 - \sum x}\right]$

RESULTS

Table 2. Comparison of (Diameter at Breath Height), Height, Crown height, crown area, Canopy density and Density in the Armardeh and Havareh Khol forest

Sig.	Havare khol forest		Armardeh Forest (Blake village)		Parameter
	Standard deviation	means	Standard deviation	means	
0.012*	1.8	8.2	4.5	28.5	Diameter at breast height (cm)
0.034*	0.40	2.45	1.4	6.2	Height (m)
0.032*	0.22	2.2	0.98	4.2	Crown height (m)
0.045*	1.12	5.6	1.91	7.1	Crown area (m^2)
0.001**	4.6	35.8	2.5	21.3	Canopy density (%)
0.000**	22	640	9	301	Density (N/ hectare)

The results of table 2 showed means of Diameter Breath Height), Height, Crown height, crown area parameter in the Blake forest have higher the Havare khol forest but means Canopy density and Density in the Havare khol forest higher the Armardeh Forest.

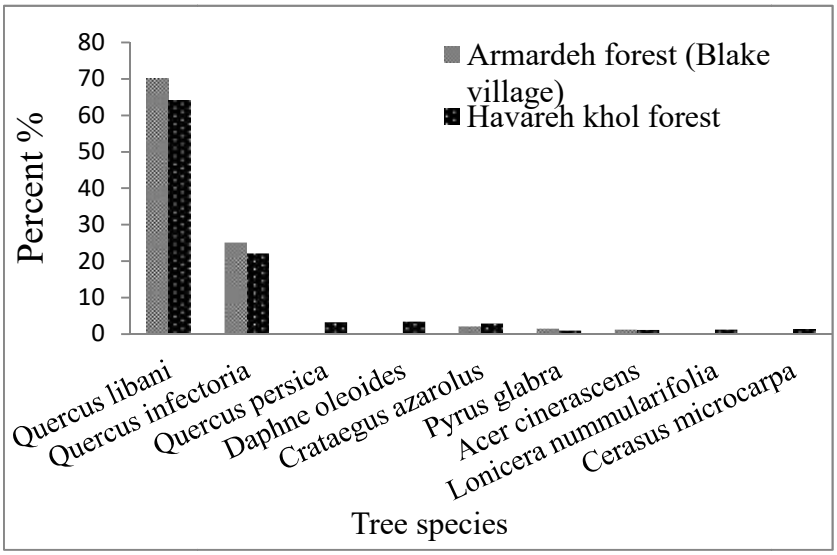

Figure 4: Frequency (Percent) of tree species in Armardeh and Havareh Kohl forest

Figure 4 showed the number of tree species in the Havareh Khol forest by 9 species more Armardeh forest by 5 species

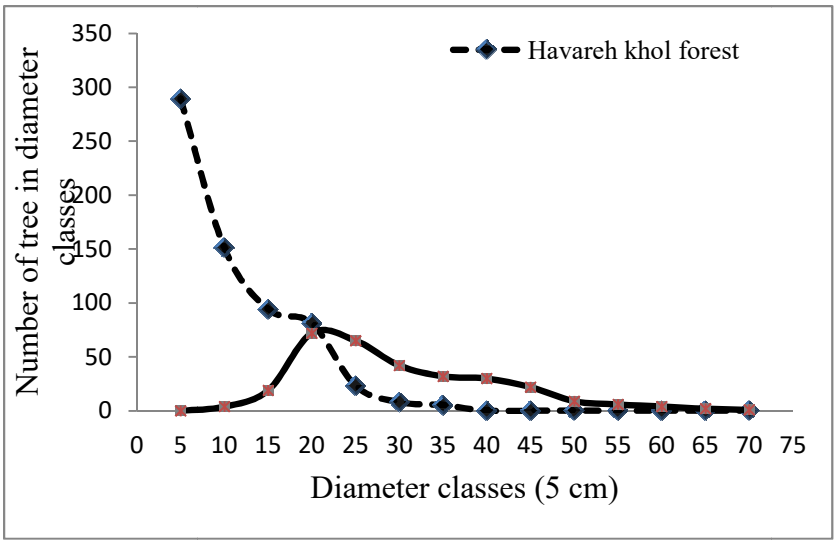

Figure 5: Number of tree in diameter classes in the Armardeh and Havareh Kohl forest.

Diameters of trees in the Havareh Kohl forest were measured at breast high and recorded in 5 cm classes. We measured trees ranging from 0 to 40 cm in this pattern and in the Blake forest 5 to 65 cm.

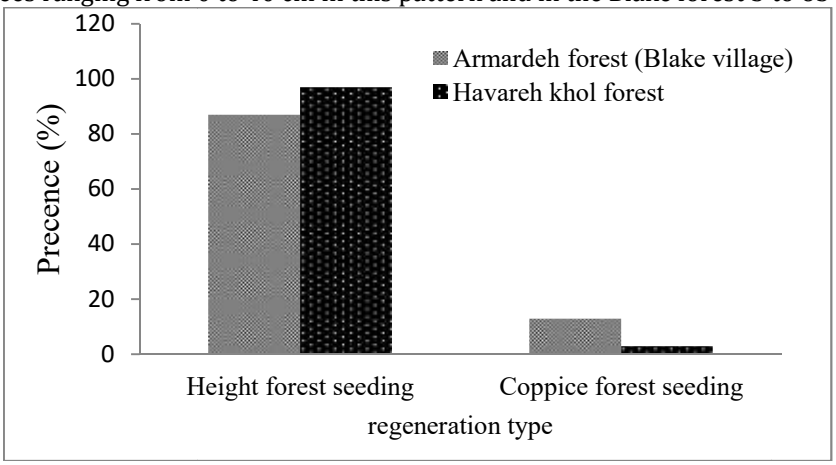

Figure 6: comparison of tree regeneration in the Armardeh (Blake forest) and Havareh Khol forest.

The results of Figure 4 showed that the computed regeneration type is as follows: mean Height forest seeding: 87%, 97% and coppice forest seeding 13%, 3% in Havareh Khol and Armardeh (Blake forest).

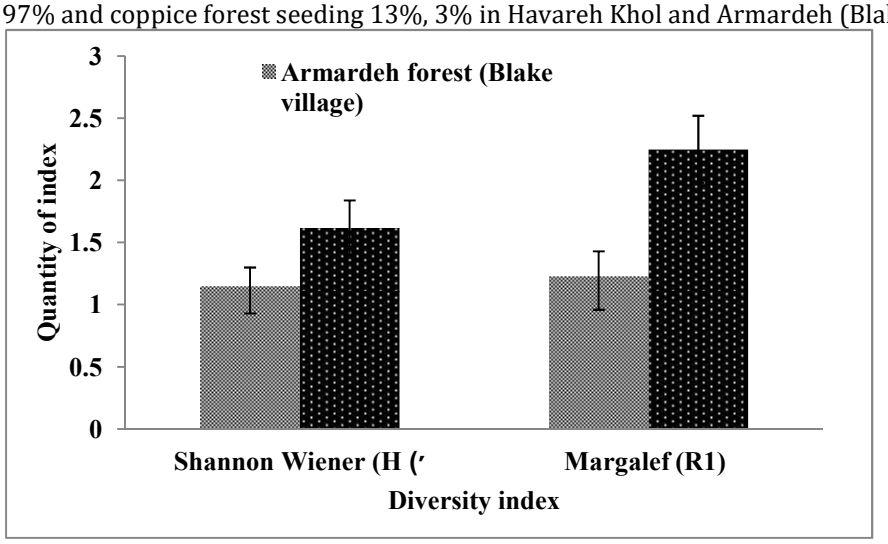

Figure 7: comparison of diversity indexes in the Armardeh (Blake forest) and Havareh Khol forest.

The results of Figure 5 showed that the computed tree species diversity index is as follows: mean species Shannon wiener (H′) index: 1.62and 1.15 and Margalef (R1) index: 1.23and 2.25 in Havareh Khol and Armardeh (Blake forest).

Table 3. T-test to compere the means diversity index in the two Traditional Forest Management Practices

Sig.	F	df	Biodiversity index
0.014*	5.332	118	Shannon
0.0011*	6.615	118	Margaleff

Statistical analysis showed significant differences between Shannon wiener (H′) and Margalef (R1) index in Armardeh and Havareh Kohl forest and means of tree diversity in Havareh Kohl forest more Armardeh forest.

Table 4. The means of regeneration (per hectare) two Traditional Forest Management Practices

Armardeh forest (Blake village)		Havareh kohl forest		
seed regeneration	Coppice regeneration	seed regeneration	Coppice regeneration	
9.9	231	130.6	6214	Number of regeneration per hectare
				total

The results of table 4 showed that the computed number of regeneration is as follows as: mean seed regeneration: 9.9, 130.6 and Coppice regeneration: 231, 6214 (N/Hectare) in the Armardeh (Blake forest) and Havareh Khol forest.

Table 5: comparison of tree spatial pattern index in Armardeh (Blake forest) and Havareh Khol forest

Armardeh forest (Blake village)			Havareh kohl forest			Index of Dispersion
Spatial pattern	Quantity of chi-square	Quantity index	Spatial pattern	Quantity of chi-square	Quantity index	
uniform to random	46.02	0.78	Clumped pattern	240.1	4.069	variance /mean Ratio
uniform to random	-	- 0.0002	Clumped pattern	-	0.0019	Green
uniform to random	45.416	0.984	Clumped pattern	238.712	1.117	Morisata
uniform to random			Clumped pattern			Spatial pattern

The results of table 5 showed all of the applied indicators have a clumped pattern for Havareh kohl forest and all of the applied indicators have a clumped pattern for Havareh kohl forest and Havareh kohl forests have all of the applied indicators showed a uniform to random pattern for Armardeh forest (Blake village).

DISCUSSION

As traditional forest management practices are rooted in the customary life of local communities, they would appear to have widespread social acceptance, are adapted to local conditions, and have the potential to solve one of the most important problems currently facing forest management in the Zagros region [7]. Zagros forests have a height characteristic in society and economics. People in Zagros regions have dependence to forest in order to grazing and providing forage (Haidari, 2011). The results of table 2 showed means of in the comparison of two traditional forest management practices the Diameter Breath Height, Height, Crown height, crown area parameter in the Blake forest have higher the Havare khol forest but means Canopy density and Density in the Havare khol forest higher the Armardeh Forest. Tree parameter in the Blake forest more the Havare khol forest because the prune tree crowns and regulate yields (Armardeh (Blake Village) pattern) have a positive effect on the tree parameter but has negative effect on the Canopy density and Density (N/Hectare). the number of tree species in the Havareh Khol forest by 9 species more Armardeh forest by 5 species (Figure 3)Diameter distribution of trees within the entire Havareh khol forest and Blake forest are shown in figure 3. Havare Khol Traditional forest management reduces the frequency of old trees. The diameter distributions indicate successful regeneration, with _ 6344 sprouts hectare and therefore not subject to severe grazing damage (Table 4, Figure 4). These data show that traditional forest management as practiced in Havareh khol can regulate diameter distributions as a uneven aged system and could support forest regeneration in spite of the high browsing pressures but Blake forest (Armardeh pattern) Traditional forest management increase the frequency of old trees. The diameter distributions indicate not successful regeneration, with _ 240.9 sprouts ha (Table 4, Figure 4). These data show that traditional forest management as practiced in Blake forest can regulate diameter distributions as an even aged system and could not support forest regeneration. The major problem in Blake forest is lack of the regeneration. Species biodiversity is used greatly in vegetation studies, and environmental evaluation is one of the main criteria to determine ecosystems condition (Mirdavoodi, Zahedi Pour, 2005). Results showed that the tree diversity in Havareh Khol pattern have higher quantity in the compered the Armardeh pattern. Statistical analysis showed significant differences between Shannon wiener (H′) and Margalef (R1) index in Armardeh and Havareh Kohl forest and means of tree diversity in Havareh Kohl forest more Armardeh forest. Armardeh (Blake forest) traditional forest management practices (prune tree crowns and regulate yields) have negative effect on the tree diversity because Density (N/Hectar) and Number of species reduce and lead to reduce the tree diversity. Spatial pattern information for individual trees is increasingly sought by forest managers and modelers as means to improve the spatial resolution and accuracy of forest models and management scenarios [12]. There are three basic spatial patterns as following: clumped, random and uniform [16]. The results showed all of the applied indicators have a clumped pattern for Havareh kohl forest and all of the applied indicators have a clumped pattern and in the Blake forest all of the applied indicators showed a uniform to random pattern for Blake forest (Table 5). Safari *et al* (2010) [19] showed a clumped pattern for Havareh kohl forest and in the front in our study in the Blake forest have a uniform to random pattern but in the front all of the applied indicators have a clumped pattern for Havareh kohl forest. Results of this researches showed Blake forest (Armaradeh Pattern) have negative effect on the forest and degradation of this forest. The emphasis of traditional managers on coppice methods and their focus on certain desired species has caused the decline of non-productive species and loss of gene flow in harvested species [7]. In the Havareh Khol forest shortage of large (30_ 50 cm) and very large (50 cm) diameter classes, and dead trees, in these forests decrease habitat diversity at the stand scale. Further, the tendency of managers to continue harvesting and to maintain uniform spatial patterns of trees across many small, individually owned, areas has resulted in a similar stand structure across different management units and a loss of forest landscape diversity. Participatory forest management needs a new approach in its selection of goals, and local communities should be engaged in goal selection and decision making for forest management [4]. Authors suggested to approach the sustainable forest management used the compact of two Traditional forest management practices. Traditional forest management may be considered a short- or medium-term approach for regional forest management to meet the basic local community needs for fuel wood and livestock fodder as long as people in this region are dependent on these resources for their livelihoods. In the longer term, however, it is hoped that the dependency of local

communities on forest resources will ultimately decrease following full implementation of the National Development Program.

CONCLUSION

In this study two Traditional forest management practices have strong and weakness and Authors suggested to approach the sustainable forest management used the compact of two Traditional forest management practice (Armardeh and Havare Khol Pattern).

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