Caspian J. Env. Sci. 2013, Vol. 11 No.2 pp.161~176

CJES
Caspian Journal of Environmental Sciences

[Research]

Impacts of Forest-Based Activities on Woodland Characteristics in a Forested Watershed of Southern Zagros, Iran

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(Received: Apr. 25.2012, Accepted: Sep.10.2012)

ABSTRACT

The purpose of this study was to investigate the impacts of forest-based activities on the conditions of the Ganaveh woodland in the southern Zagros, Iran, and to suggest strategies for improving the implementation of forest resource management plans. Woodland inventory data was gathered in 2003, accompanied with data from interviews in 2008, were used in this study. The results show that there is forest degradation in terms of a lack of forest regeneration and a relatively high incidence of bad quality trees. These defects in the woodland attributes reflect the effects of the traditional management on vegetation cover, and are the causes of concern regarding the sustainability and conservation of the woodland. Overgrazing, seed gathering, and drought in some years are probably the main reasons for the poor natural regeneration in the area. Forest activities over the last decades could be the main causes of the relatively high rate of bad quality oak trees and the high rate of oaks in coppice form. Some efforts to gain acceptance from the woodland users for protecting the preserved areas from animal grazing and seed gathering for a period could be a better alternative for woodland rehabilitation than seeding.

Key words: *Oak forest, overgrazing, seed gathering, participation, Zagros, Iran*.

INTRODUCTION

Zagros forests, as primary oak forests, stretch along the Zagros Mountains in western Iran from north to south. The Zagros forests, with an area of around 5 million ha, account for almost 40 % of the country's forests (Sagheb-Talebi et al., 2004). These forests provide a home and livelihood for approximately 10 % of Iran's population (DoE/GOIRI, 2004). The Zagros forests have a semi-Mediterranean climate (Boudru, 1961 cited in Jazirehi and Ebrahimi, 2003) and are classified as semiarid forests and sometimes referred to as the Zagros woodlands. Average annual precipitation in these forests varies between 350 mm and approximately 1000 mm (Ghazanfari et al., 2004). These woodlands may be considered as pastoral ecosystems, which are natural ecosystems that have been exposed for thousands of years to grazing by domesticated livestock in numbers large enough to influence their structure and function (Hoekstra and Shachak, 1999). More than 90 % of the Zagros forests are in coppice form and have canopy cover less than 30 % (Sagheb-Talebi *et al*., 2004; Ghazanfari *et al*., 2004). The main species in the Zagros region are oak (*Quercus* spp.), wild pistachio (*Pistacia mutica*), *Crategus* spp. and *Pyrus* spp. (Ghazanfari *et al*., 2004). Based on the differences in oak species and climatic conditions, the Zagros vegetation zone is divided into two distinct regions, with the southern Zagros region with less humidity than the northern region (Jazirehi and Ebrahimi, 2003; Sagheb-Talebi *et al*., 2004). The southern Zagros is the exclusive site for Persian oak (*Quercus persica* or *Q. branti* or *Q. branti var. persica*) (Sagheb-Talebi *et al*., 2004) and pure stands of Persian oak contribute up to 69 % of the forest areas in this sub-region (Jazirehi and Ebrahimi 2003). The stands of Persian oak are represented by dry open forests with low trees awarding the landscapes a park-like

look (Menitsky *et al*., 2005). Current forest utilization practices in the Zagros are traditional to support subsistence livelihoods, and vary locally (Ghazanfari *et al*., 2004; Pourreza *et al*., 2008). The most important of these practices are animal grazing, cutting of either oak branches for use as fodder or whole trees for use as construction material, collection of other non-wood products of oaks consisted of acorn, manna, and galls, collection of fuel wood and seeds and extraction of sap from pistachio trees (Sagheb-Talebi *et al*., 2004; Ghazanfari *et al*., 2004; Pourreza *et al*., 2008; Arekhi *et al*., 2010). Since 1962, more than 1.7 million ha of these forests have been deforested. Studies indicate that the increasing population, the low level of development, and the high dependency of local communities on the forests for their primary livelihood appear to be the main reasons for this decline (Ghazanfari *et al*., 2004; Pourhashemi *et al*., 2004). According to Pourhashemi *et al*. (2004), there are no commercial-sized trees left in Zagros.

Forests and rangelands in Iran are under the supervision of the Forest, Range, and Watershed Management Organization (FRWO). Since 2000, FRWO has developed new long-term programms for the preservation, conservation, and sustainable use of the Zagros forests. It is perceived that the improvement of forest resources, which is one of the main objectives of FRWO programms, could be an outcome of improved forest-based livelihood strategies. Improved forest management requires attention to the livelihoods of people living in forests because of the links between their livelihoods and the forests (Sunderlin *et al*., 2005). Forest-based activities such as fuel wood and seed gathering, animal husbandry and pastoralism, seeding, plantation and so forth are potential components of rural-livelihood strategies (Ellis, 2000). They generate an income for households and have determining influence on changes in the status (quality and quantity) of forest landscapes. Establishment, composition, growth, structure, health, and quality of forests are silvicultural attributes that refer to how forests can meet the diverse needs and values of the many stakeholders (Nyland, 2002). To improve the implementation of FRWO programms, the impacts of the livelihood strategies indicated by the forest-based activities of the local communities on the forest attributes should be analyzed. This should help decision makers responsible for rural development and forest management to plan and implement effective strategies for poverty reduction, livelihood improvement, conservation, and sustainable resource use (Vedeld *et al*., 2004; Debnath and Dasgupta, 2006). Since the 1960s, concern has been evident regarding environmental degradation in arid regions (Latorre *et al*., 2001). The Ninth world forestry congress in Mexico (1985) revealed the importance of "dryland forestry" as an emerging strategy in sustainable development (Ffolliott *et al*., 1995) and after that research on dryland forestry has generated numerous publications about forest management and forest-based livelihoods. Nevertheless, such studies on the Zagros forests are relatively rare (e.g., Ghazanfari *et al*., 2004; Pourhashemi *et al*., 2004; Pourreza *et al*., 2008; Salehi *et al*. 2008; Salehi *et al*., 2010; Soltani *et al*., 2012).

The aim of this study was to describe the socioeconomic situation of inhabitants in Gnaveh region, a forested watershed located in the southern Zagros, and to describe Gnaveh's land cover and participation of its inhabitants in government programms. Moreover, effects of inhabitants on the woody cover of the area would be studied. The results of this study will help forest management planners suggest strategies for improving not only in the Zagros area but also in the other semiarid regions, the implementation of management plans for the sustainable use and improvement of the natural resource-based livelihoods of communities.

MATERIALS AND METHODS

Study Area

The Ganaveh watershed (30°27′N, 50°50′E) is located 15 km north of the city of Dow Gonbadan (Gachsaran), the center of a bourgeoning oil and gas industry, in the province of Kohgiluyeh va Boyer Ahmad, Iran (Fig. 1). The mountainous watershed with steep slopes comprises 6621 ha. Ganaveh village with its agricultural lands, with an area of 133 ha, is located in the center of the watershed. The Natural Resources Bureau of Dow Gonbadan (NRB) is responsible for the implementation of forest projects, supervision, and management of the natural resources in the area. NRB is the representative of Headquarters of the Natural Resources of Yasouj (HNRY), itself under the administration of FRWO.

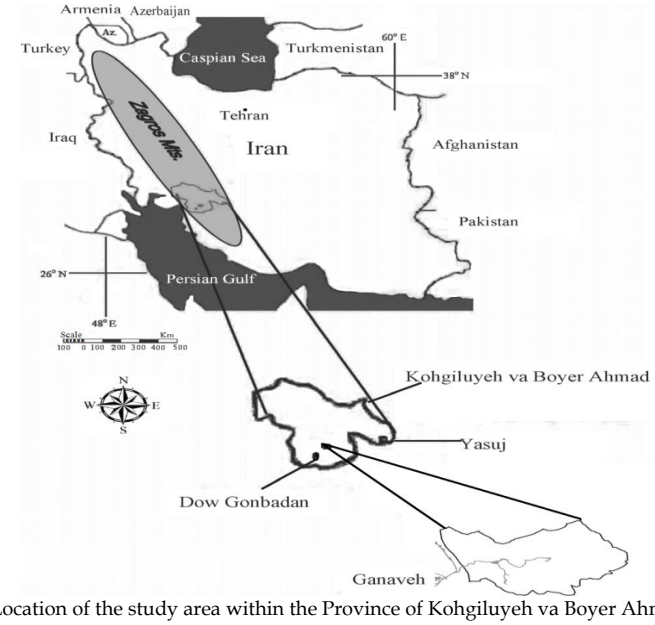

Fig. 1. Location of the study area within the Province of Kohgiluyeh va Boyer Ahmad, Iran.

The vegetation types, which are mainly oak trees and shrubs–bushes, cover 5848 ha, extend between 1200 and 2300 m a. s. l., and are differentiated and mixed in different parts of the area depending on ecological factors. The remaining area of the watershed is covered by rocks and cliffs (data from HNRY). From measurements over a 15-years period (1986–2001), average annual precipitation is approximately 500 mm and the mean annual temperature is 22.5 °C. The mean minimum temperature for January is 5.3 °C, the mean maximum temperature for July is 42.7 °C, and the mean number of days with a minimum temperature of 0 °C or less is nine days (data from HNRY). Soils vary from moderately deep, well-drained sandy loams to steep, gravel slopes with rock outcrops. These soils are classified mainly as lithic leptosols and calcaric regosols (data from HNRY).

Data sources

Data on the socioeconomic characteristics and forest-based activities in the study area were collected from a published data set by Salehi *et al*. (2010). The data were collected by interviewing heads of households in Ganaveh. The focus of the survey was to elicit the woodland use and participation of households in forest-based activities. Some background information about the households, such as household size, age, and education level of members, as well as the numbers of livestock owned, was obtained from the respondents. Moreover, they were asked to report all items derived from the woodland and the activities conducted to derive them. The respondents were also asked to state the relative contribution of sources of annual cash income for the households by using the ranking method (Chambers, 1981).

They were also asked about participatory aspects, such as participation of women and children in forest-based activities, participation with other households in forest-based activities, participation in NRB forest projects, restrictions of forest use, and satisfaction of implementation of NRB forest projects. The intention was to reach all households as the social units in the village, 32 out of 45 households were reached. Altogether, eight households were absent as they were in the village only during the summer and five households refused to answer questions, mainly because the head of the household was absent. The interviews took place in April 2008 over four days, and included an approximately three-hour interview of the members of the village's council about public assets and some external factors, such as institutions, markets, laws, traditions and customs.

Moreover, the local expert of Dow Gonbadan's NRB, who was in charge of the forest conservation projects in the area, was interviewed about the current projects in the area, participation of the inhabitants, and their social acceptance.

To study the characteristics of the woodland, we used data from a systematic sample plot inventory with a random starting point with 0.58 % sampling intensity, conducted by HNRY in spring 2003 on 171 sample plots. The plots were rectangular (40 m × 50 m) with a distance of 200 m × 500 m between plot centers. In each sample plot, data about woody species, diameter at breast height (dbh), height, and health conditions of stems were collected. Dbh was measured only for stems of Persian oak and wild pistachio with a height of more than 2 m. Health conditions for trees with a height of more than 2 m were subjectively defined as "good" or "bad" depending on the quality of stems and branches. "Good" condition indicates a symmetrical crown with a healthy stem while "bad" condition indicates some crucial damage to either the crowns or the stems of the trees. Other data included percentage of crown cover closure (CCC) of trees and shrubs and observed traces of disturbance factors on the woody vegetation cover in each sample plot, such as browsing damage by livestock or wildlife, wind, and snow damage. Numbers of regenerations of woody species were recorded in 100 m^2 (10 m × 10 m) subplots located within the above mentioned sample plots while northeast corner of subplots were matched on the northeast corner of larger plots. Natural regeneration was defined as seedlings less than 0.3 m height.

Methods for data analysis

Frequency of woody species per ha in height classes were obtained as one measure of the structure of the woodland. The woody vegetation was classified into three height classes based on a slight modification of Tomaselli (1977): height ≤ 0.3 m (seedlings), 0.3 < height < 2 m and height ≥ 2 m. Using Pearson correlation, relationships between distances from the center of the village and elevations and slops of sample plots were inspected.

To assess the impacts of the village inhabitants on the surrounding woodland areas, the woodland's attributes were compared within an area close to the village and a more remote area from the village. GIS techniques were used and the geographical coordinates of 99 sample plots, whose coordinates were recorded during the field inventory, were transferred onto a map and their distance from the center of the village was measured. The maximum distance of the centers of the sample plots from the center of the village was 6.5 km. The sample plots were divided into two groups located within two intervals from the village. Sample plots of the first group (59) were located within the first half of the maximum distance of sample plots from the village center (0-3.25 km) while the plots in the second group (40) were located within the second half of this maximum distance (3.25-6.5 km). Geographical coordinates and identity of 72 sample plots (out of 171) were missing in the handled data set From HNRY and it was not possible to reproduce their location by the GIS software (Arc GIS ver9.3) for the above mentioned GIS measurements.

Using descriptive statistics, diameter distributions (stems ha^{-1}) of Persian oak and wild pistachio in 5-cm classes, frequencies of traces of disturbance factors, percentage of oak trees in coppice form, distribution of crown cover closure (CCC)

in different classes (0 %, 1-5 %, 6-10 %, 11-30 %, 31-50 % and more than 50 %) and frequency of bad quality trees in diameter classes were compared in the two above mentioned areas. Moreover, using heteroscedastic T-test, the average value of some forest variables in sample plots within these two areas were compared.

To inspect woodland potential productivity of dead wood, a volume of annual natural mortality of oak per ha in the two areas was estimated and compared with the collected fuel wood reported by households. Whereas, almost since 20 years ago, cutting and lopping of trees have not been practiced to transport fuel wood and charcoal to nearby cities, and even most households in the village have used fossil fuel (Salehi *et al*, 2008), one could assume that, the current diameter distribution of oak reflects the mortality rate for oak. The total volume of annual mortality in diameter classes of oak was calculated as follows:

$$M_V = \sum_{i=1}^{k} n_i * v_i * \mu$$

Where M_v is the total volume of mortality per ha, K is number of 5-cm diameter classes: k varies between 1 and 16. On the way, k equals 1 is as diameter class of 5 cm which comprises trees with diameters between 2.5 cm and 7.5 cm and similarly until k equals 16 which present diameter class 80 cm, which comprises trees with diameters between 77.5 cm and 82.5 cm, it is notable that the class of <5 cm comprise all stems with a dbh less than 2.5 cm and trees, height of which were not exceeded from 2 meters and their dbh were not recorded. The class of <5 cm would not be included in the formula. n_i is the number of stems per ha in diameter class i, and v_i is tree volume for diameter class i, obtained from the volume table of Persian oak (Jazirehi and Ebrahimi, 2003). μ is the mortality rate of oak in the Ganaveh woodland, calculated based on the assumption that the current forest is in steady state and corresponding to 3 % per year (Salehi, 2009). Descriptive statistics were also used to analyze the socioeconomic data.

RESULTS

Socioeconomic characteristics and forest-based activities

Table 1 depicts the socioeconomic characteristics of the village and its households. Ganaveh is a small village with a negative population growth rate, caused by migration of households into urban areas. In 56 % of the households, at least one member had migrated to urban areas. There are several indications of modernization, such as the availability of piped water, electricity, telephone, and asphalted roads, and some literacy level. Besides animal husbandry, collection of fuel wood, seeds, and ground fodder are the other forest activities that take place in the area.

Table 1. The socioeconomic profile of Ganaveh village and some averaged characteristics of the households in 2008

Attributes of the village	Quantity	Attributes of the households	Mean
No. of households	45	Family size	4.9
Households headed by women	20%	Average age of members	35.5
Males	53%	Average of school years	4.2
Females	47%	Annual cash income from woodland (%)[a]	30.0
Total population	185	Annual cash income from other sources (%)[a]	70.0
School	One elementary school	Active agricultural lands (ha)	1.6
School education	72% of population	No. of goats	32.3
Illiteracy	28% of population	No. of sheep	2.7
Availability of piped water	All households	No. of mules	0.8
Electricity available	All households	No. of cattle	0.3
Telephone available	Most households		
Connecting road to the nearest city	15 km (asphalted)		
Population growth rate (2003 and 2007)	–15%		

[a] percentage of the total annual cash income for the households

Animal husbandry, particularly the raising of goats, is the most important activity for providing environmental income to the village's livelihood system. It is practiced by half of the households in the village and is the main occupation of 25 % of the heads of households. The high number of goats is related to the terrain and climatic conditions of the area. These livestock graze in the woodland for approximately nine months of the year. For 47 % of households, the numbers of livestock have decreased over the last five years. This claim is consistent with the 1275 animal units reported in Salehi *et al*. (2008) compared with the approximately 4700 units reported by HNRY in 2003. This was estimated by HNRY with the method of the animal unit month (Pratt and Rasmussen, 2001) to be 2300 animal units more than the pasture carrying capacity in 2003 in the area. No data about carrying capacity of the woodland was available for 2008. A drought and the following shortage of fodder that occurred in recent years, as reported by the respondents, could be the main reason for this decrease. The number of livestock for all households owning animals is far above the stipulations of the current law by NRB regarding animals grazing in pastures around villages. Each rural household is allowed to keep 10 units of grazing animals but, among those owning livestock in the village, the range was between 28 and 212 animal units per household.

Seeds are gathered from Persian oak, wild pistachio, and wild almonds and all are sold to local traders on an opportunistic basis in the village or used for their own consumption. The collection of seeds and acorns is highly seasonal and households participate in this activity in most years. Every two years, oaks might have a good yield of acorns. In 2007, a good acorn producing season, an average of approximately 7 kg/ha acorns and less than 100 g/ha wild almonds and wild pistachios were collected from the Ganaveh area (corresponds to 40450, 470, and 300 kg in total, respectively). Approximately 63 of households in the village were involved in acorn gathering in 2007. In 2005, NRB purchased around 800 kg of acorns that had been gathered by the inhabitants for seeding in some areas in the watershed. The aim was to help the people and to encourage them to participate in the protection of vegetation cover in the woodland.

Fodder from the woodland understory, mostly grasses and herbs, is reaped, dried, and used by 34 % of households to feed their animals in winter. The collected ground fodder from the watershed areas in 2007 was 7600 kg, or 1.3 kg/ha. The fodder was collected from only the vicinity of the village, whereas seeds might be collected from much greater distances.

Fuel wood is gathered as deadwood by 72 % of households and is used by villagers for cooking and heating because it is accessible and cheaper than fossil fuels. Its collection is allowed for the households' own consumption by the forest authority. An average of approximately 16 kg/ha or 0.02 m^3/ha is collected per household (the density of the wood of *Q. Persica* was reported to be 740 kg/m^3 by FRWO). It is not possible from the interviews to determine how fuel wood collection relates to distance from the village.

Collection of food and medicinal herbs is not practiced to a noticeable extent. Cutting of trees is prohibited by the forest authority and no household acknowledged cutting of trees for construction materials or the lopping of oaks to provide fodder for livestock.

Woodland characteristics

Table 2 depicts the composition (%) and numbers of woody species per ha in three height (h) classes: $h \leq 0.3$ m (regenerations), $0.3 \text{ m} < h < 2$ m, and $h \geq 2$ m for the whole woodland. Persian oak is the main woody species in the area.

Table 2. Number of trees and shrubs per ha in height classes, and species distribution within height classes in percentage in the Ganaveh woodland

Species	h ≤ 0.3 m		0.3 m < h < 2 m		h ≥ 2 m	
	No. per ha	%	No. per ha	%	No. per ha	%
Oak (*Quercus persica*)	175.4	61.2	68.7	61.6	132.8	93.5
Wild pistachio (*Pistacia mutica*)	–	–	3.1	2.9	7.1	5.0
Wild almonds (*Amygdalus spp.*)	92.4	32.2	20.8	18.6	–	–
Crataegus spp.	2.4	0.8	9.3	8.3	–	–
Acer cineracens	1.8	0.6	4.0	3.6	–	–
Craeus sp.	14.5	5.2	5.1	4.6	–	–
Others	–	–	0.4	0.4	2.0	1.5
Total	286.5	100	111.5	100	141.9	100

There was no regeneration of wild pistachios in the sample. Furthermore, there was no regeneration in more than 50 % of the surveyed sample plots. Regeneration of oak from seeds was less frequent than regeneration from sprouts (46.2 per ha versus 129.2 per ha).

For trees with h>0.3 m, the most frequent woody species were Persian oak (79 %), wild almonds (9 %), wild pistachio (5 %), and other shrubs (7 %). Wild almonds consist of numbers of *Amygdalus* species of which some species are in shrub form (e.g., *A. lycioides* and *A. orientalis*) and grow widely on the ground with spines and twisted branches that protect regenerations from grazing. *A. scoparia* and *A. orientalis* were the most important species of wild almonds in the area. There were few wild pistachio stems. The average dbh for both Persian oak and wild pistachio with h ≥ 2 m was estimated to be 18 cm.

There was a high correlation between distance from village and elevation of the terrain of the sample plots (r = 0.76), while correlation between these distances and slope of the sample plots was lower (r = 0.40). Fig. 2 and Fig. 3 depict comparison of diameter distributions (stem ha^{-1}) of Persian oak and wild pistachio within the area close to the center of the village and at the remote area, respectively. These show that the numbers of stems ha^{-1} for wild pistachio in all diameter classes are much lower than for oak. For both Persian oak and wild pistachio, the number of stems per ha for most of the diameter classes in the remote area are higher than number of stems in the close area. For Persian oak, within both close and remote areas, there is a lack of young trees in diameter classes of less than 5 cm (0 – 2.5 cm) and 5 cm (2.5 – 7.5 cm) (Fig. 2). For wild pistachio the number of old trees in the close area was higher than old trees in the remote area (Fig. 3).

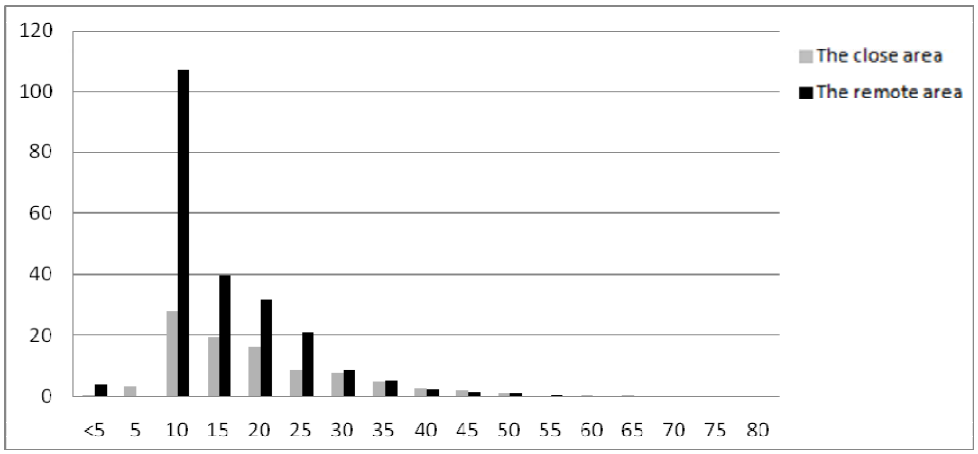

Fig. 2. Diameter distribution (stems ha^{-1} per dbh class) for Persian oak within the area close to and the remote area from the Ganaveh village.

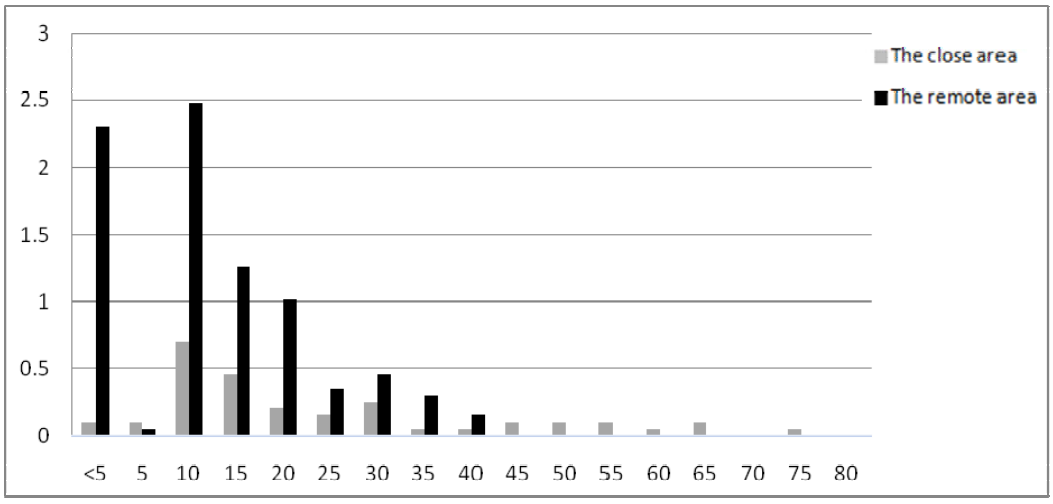

Fig. 3. Diameter distribution (stem ha^{-1} per dbh class) for wild pistachio within the area close to and the remote area from the Ganaveh village.

Browsing on regenerations by livestock was the most important disturbance factor in both areas (Table 3); grazing occurred over most of the area. In some plots, traces of more than one disturbance factor were reported. Grazing impacts were higher within the close area. Impacts of natural disturbance factors within the remote area were much higher than that within the area close to the village (Table 3). Within the close area, approximately 61 % of the oak trees were in coppice form while approximately 54 % in the remote area. The average CCC for the whole region was 18 %. Most of the surveyed sample plots for both close and remote areas were in the class of 11–30 % of percentage of crown cover closure (CCC) of trees and shrubs (Table 4). Table 3 depicts that proportion of the land with CCC higher than 10 % is much more intensive for the remote area than the close area to the village.

Table 3. The relative number of plots (%) in different traces classes of disturbance factors in the close and remote area relative to the Ganaveh village

	No. of plots (%)[a]	
Disturbance factors	Close area	Remote area
Grazing	95	75
Natural factors (snow, wind, etc.)	7	38
Fire	3	0
Agriculture	2	2

[a] In some plots, traces of more than one disturbance factor were reported.

Table 4. The relative number of plots (%) in different classes of distribution of crown cover closure (CCC, %) in sample plots in the close and remote area relative to the Ganaveh village

	No. of plots (%)	
CCC classes (%)	Close area	Remote area
0	10.2	5.0
1–5	25.4	5.0
6–10	22.0	17.5
11–30	32.2	30.0
31–50	6.8	27.5
> 50	3.4	15.0

Fig. 4 depicts the comparison of percentage of bad quality oaks in different diameter classes for the close and remote areas of the village. In the close area there is a high percentage of bad quality trees in diameter class of 5 (cm) as well as in the bigger diameter classes. Within the close area, 34 % of oak trees with dbh ≥ 5 cm had bad quality with broken branches or decayed stems while at the remote area approximately 10 %.

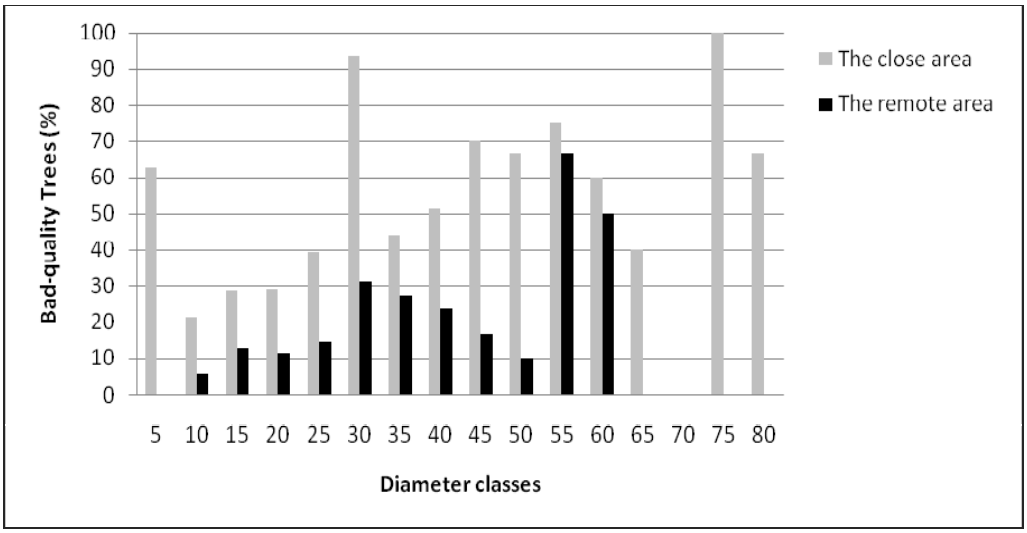

Fig. 4. Distribution of bad quality oak trees (%) per dbh class within the area close to and the remote area relative to the Ganaveh village.

Table 5 presents the influence of distance from the village on some silvicultural attributes of the woodland.

The differences between the average values of the all presented attributes for the two areas were significant at the 95 % level.

Table 5. The average value of some forest variables (per plot) within the close and the remote area relative to the Ganaveh village

Silvicultural attributes	Av. for the close area	Av. for the remote area	P-value[a]
No. of regenerations	0.39	2.25	0.000***
Bad quality trees (%)	33.58	7.30	0.000***
Average diameter at breast height (cm)	24.62	16.97	0.000***
No. of total woody species	25.97	102.13	0.000***
Crown cover closure (CCC; %)	14.29	27.55	0.000***
No. of wild pistachio	0.73	2.24	0.023*
No. of wild almonds	0.88	3.97	0.000***
No. of oak	18.26	40.14	0.000***

[a] Results of *t-test* for coefficients:***P<0.001,*P<0.05

The calculated volume of annual natural mortality for Persian oak was 0.58 and 0.67 m^3 $ha^{-1}$for the close and the remote area, respectively. The difference reflects the fact that there are more trees in the remote area (Fig. 2). Whereas the number of used sample plots in each distance group was statistically good enough for the analysis, deficit of data of missing sample plots cannot affect dramatically on the obtained results.

Participation and government programs

Locals graze their animals and collect seeds, ground fodder, and fuel wood in the watershed area based on the abundance of available resources and without recognizing any territorial limits to their activities. Exceptions are for seeded areas, fenced areas, and similar areas announced by NRB. In 60 % of households, women and children participate in deriving income from woodland resources, mainly

from seed and acorn gathering. Fuel wood gathering and livestock management are mostly the responsibility of the men. Of the households, 88 % engage only family members in these activities, whereas the remainder includes the participation of other households.

Participation in seeding and fencing projects was a connection point between inhabitants and the forest authority. After the forest inventory in 2003, a decision was taken by the forest authority to seed and fence some areas in the watershed. The aim was to conserve and improve the vegetation cover of the woodland. Villagers were engaged in these activities either by seasonal contracts or by being paid wages. In this way, a total of 320 ha in six areas of the watershed was seeded with indigenous woody species consisting of oak, wild almonds, and wild pistachios. This practice took place in some areas even under mother oak trees, which produce seed. Because of livestock grazing and drought in some summers, regeneration in these areas has not been very successful, despite efforts by local rangers to prohibit grazing. For example, only 30 % of 96 ha of the areas seeded in 2004 had survived to 2006.

The interviews showed that, excluding the two local rangers, only six households (approx. 19 %) had participated in NRB projects (seed gathering, seeding, and fencing some seeded areas). However, altogether 40 % of households had some connection with NRB for obtaining different types of permissions (e.g., increasing animal yards). The remaining 60 % of households had no connection with NRB at all. Our inquiry also showed that, excluding the two local rangers, only five households (approx. 16 %) were satisfied with the performance of NRB in the area, three households (approx. 9 %) were dissatisfied, and 22 households (approx. 69 %) had no idea about the performance of NRB. Two of the dissatisfied respondents had participated in NRB projects. Only three respondents, of which two were local rangers, had participated in any training course on the management of natural resources.

In the opinion of 85 % of respondents, living conditions in the village had improved during the last five years. A programme for the distribution of fossil fuels to rural households was initiated by NRB in 2006 with the objective of lessening the dependence on fuel wood while concerns relating to the livelihood situation involved fuel problems, shortages of water for agriculture, and the lack of middle and high educational levels of the school.

DISCUSSION

In arid lands, it is common for animal grazing to occur non-uniformly. This is because it depends on other elements of spatial variability (Hoekstra & Shachak, 1999). The pattern of distribution of water sources to which animals must return at regular intervals to drink could also influence the impact of grazing on woodland regeneration (Hoekstra & Shachak, 1999). Pourhashemi *et al*. (2004) reported a case study in northern Zagros, which found that the quality and density of trees improved with distance from the village in the study area as grazing intensity declined. The fact that grazing declines as the distance from dwelling points increases is a well-established fact in the international literature dealing with grazing in arid and semiarid areas (Ringrose *et al*., 1996; Wezel & Bender, 2004).

Evidence of overgrazing from an overpopulation of livestock has been implicated by the assessment in 2003 while there is a decrease in animal numbers in 2008. In dryland regions, the amount of forage produced in a year varies greatly with changes in rainfall patterns from year to year. Because of inflexibility in stocking rates by livestock owners, there is one of either overstocking during dry periods and drought or under stocking during wet periods and favorable conditions (Ffolliott *et al*., 1995). On the other hand, the recent rural depopulation and socioeconomic development in the area (Soltani *et al*., 2012) could be the cause of a general decrease of the livestock population, which in turn could contribute to the woodland conservation (Salehi *et al*., 2008).

There is no direct evidence indicating that seed collection alone, particularly acorn, would cause the lack of natural regeneration in the area. This is because oak, as the most frequent woody species in

the area, regenerates most in coppice form. Regarding the less frequent number of seed regeneration rather than sprout regeneration of oak, one can assume that seed collection associated with animal grazing in the area could aggravate the lack of natural regeneration. Because mostly grasses and herbs are collected as fodder, there should be no relevant impact of that activity on the sustainability of the woodland. At least, as long as fodder collection is conducted properly without cutting or damaging seedlings.

The average collection of approximately 0.02 m^3 fuel wood $ha^{-1}y^{-1}$ in the watershed could be compared with estimated volume of annually natural mortality for oak per ha of more than 0.5 m^3 $ha^{-1}y^{-1}$ in both the close and the remote area. The woodland has thus sufficient potential to provide the needed quantities of fuel wood from deadwood. Moreover, mortality volume of the other woody species in the region as an additive volume to this estimated quantity. Although it is not possible to determine how fuel wood collection is related to distance from the village, it is reasonable to assume that the exploitation rate of fuel wood increases, on average, the closer one gets to the village. Nevertheless, the impacts of fuel wood collection on the sustainability of the woodland should be limited. The relative abundance of fuel wood also support the claim that fuel wood is mostly gathered as deadwood and rarely are trees cut for fuel wood. The increase of crown cover density of the woodland during the period from 1969 to 1993 also attests this fact (Salehi *et al*., 2008). Table 6 depicts a summary of the assumed impacts on the sustainability of the woodland of the forest-based activities as components of the inhabitants' livelihood strategies. A successful rural livelihood strategy is one in which the quantity, quality, and mix of assets are such that adverse events can be withstood without compromising future survival (Ellis, 2000). Therefore, uncontrolled grazing and seed gathering could be critical issues for the sustainability of these resources.

Table 6. The assumed impacts of current forest activities on the sustainability of the Ganaveh woodland

Activities	Likely impacts on sustainability of the woodland
- Livestock grazing (overgrazing)	- General shortage of regeneration - Increasing vulnerability on the growth of seedlings - Biodiversity degradation of woody species
* Seed and acorn gathering (overgathering)	* General shortage of natural regeneration * Biodiversity degradation of woody species
♦ Fodder collection	♦ Not so relevant
• Fuel wood collection	• Not important
○ Seeding	○ Could improve the sustainability of the woodland but it is not important at the moment

The inventory data of the composition of woody species indicate that the woodland is species-poor and that Persian oak is the most frequent woody species (79 %). This is in line with the report by Jazirehi and Ebrahimi (2003) that state that pure stands of Persian oak contribute up to 69 % of the forest areas in southern Zagros. This high percentage of Persian oak makes a poor species diversity for the woodland.

Referring to Fig 2, number of stems per ha in diameter classes of more than 5 cm at the remote areas from the village are higher than number of stems in these classes at the area close to the village. These differences could be interpreted as a more intensive long-term impact of the forest-based activities on the vegetation cover within the area adjacent to the village. There is also a general lack of young oak stems in the

diameter classes of 5 cm and less than 5 cm for the whole region. For Persian oak in diameter of 2.5 cm to 12.5 cm (5 cm and 10 cm diameter classes), a range of age between 10 and 30 years is estimated (Jazirehi & Ebrahimi, 2003). This means that the regeneration problem occurred in the region during the last decades.

The low number of oak stems with dbh less than 5 cm (<5) (Fig 2) could be referred to an intensive animal grazing and browsing which is worse in close area to the village. The high percentage of observed traces of animal grazing, as a disturbance factor in the surveyed sample plots, indicates that livestock grazing could be the principal factor for the poor regeneration in the study area. Degradation is most severe for wild pistachio for which natural regenerations ($h \leq 0.3$ m), are totally lacking. Moreover, there was no regeneration of any species in more than 50 % of the surveyed sample plots.

The relatively high percentage of bad quality trees in the class of 5 cm at the area close to the village (Fig. 4) could also be related to the impacts of animal grazing on seedlings and saplings. The lack of regeneration in Zagros forests is a major concern (Jazirehi & Ebrahimi, 2003; Ghazanfari *et al*., 2004; Pourhashemi *et al*., 2004) and factors likely to decrease regeneration in these forests include overgrazing, absence of desirable seedbed, lack of seeds because of seed gathering, decreasing the forest canopy and drought (Pourreza *et al*., 2008). Of these, overgrazing is the probably most important factor (Sagheb-Talebi *et al*., 2004; Pourreza *et al*., 2008; Salehi *et al*. 2008). Moreover, it is possible that drought could reinforce the detrimental effects of foraging (Papachristou & Papanastasis, 1994). Pourreza *et al*. (2008), from another woodland in the southern Zagros, reported that the decline in regeneration of wild pistachio began at least 50 years ago. The shortage of seed-regenerated trees (oaks) is also a cause for concern in the sustainability and conservation of biodiversity of the woodland.

There are also a larger percentage of oaks in coppice form in the area close to the village. However, being in coppice form is an inherent characteristic of oaks. Although natural damage could stimulate the reproduction capacity of oaks through shoot regrowth (Rackham, 2001), forest activities from earlier decades (Salehi *et al*., 2008) could also be a cause of the prevalence of coppice oaks.

Another concern regarding woodland sustainability is the relatively high incidence of bad quality trees particularly in the area close to the village. There appears to be heavier impacts of forest-based activities on the woodland characteristics at area close to the village and the forest land cover is more intensive far from the village. This is obviously reflected by the frequency of traces of disturbance factors in sample plots (Table 2), the distribution of crown cover closure of sample plots in different classes (Table 3), the bad quality oak trees in diameter classes (Fig. 4), and the average values of the forest variables (Table 4) for the close and the remote area. Regarding to the correlations between distances of sample plots from the village and their elevations as well as their slopes, the conservation effects of elevation and slope on the vegetation cover of the remote area from the village should not be neglected.

To what extent does the NRB initiated projects answer to these livelihood strategies? One NRB project involved the purchasing of seeds and the subsequent seeding of some areas in Ganaveh. However, there are no indications that the project meets conservation and sustainable objectives. There appeared to be a low acceptance of the need to conserve the seeded areas, causing the failure of seedlings to survive. In addition, the purchase of seeds caused more demand in the seed market, stimulating seed gathering activities. In the end, this could even have had a negative impact on woodland conditions, ultimately resulting in additional costs for NRB. A better alternative to seeding for woodland rehabilitation could be efforts by NRB to reach social acceptance from the woodland users to protect the areas from animal grazing. Fuel wood is an underutilized resource; at least as far as resource capacity goes. Therefore, it seems that giving high priority to the distribution of fossil fuels by NRB to conserve woodland resources is not relevant.

Although woodland resources in Ganaveh are used communally by its inhabitants, the inhabitants mostly practice forest activities individually rather than in partnership with other households or NRB. So far, the participation of inhabitants in NRB projects for conservation of woodland resources has not been effective. To ensure the sustainable use and conservation of the woodland, it is necessary to have a much closer connection between the forest authority and the woodland users. They should share the responsibility of forest management, which could be interpreted as participatory (joint, community) forest management (Kaushal & Kala, 2004; Visseren-Hamakers & Glasbergen, 2007). Community management is seen as an alternative to top-down approaches, which have generally failed to improve natural resource management (Quinn *et al*., 2007, Samari *et al*., 2012). Ghazanfari *et al*. (2004) also suggested the use of participatory management in their study for the Zagros region.

CONCLUSION

The study shows a high relationship between village's livelihood system and the woodland characteristics. Animal husbandry, collection of fuel wood, seeds and ground fodder are the common forest-based activities that take place in the area. Overgrazing associated with seed gathering, and drought in some years, particularly within the area close to the village, causes a deficit of natural regeneration, prevalence of coppice oak and relatively high incidence of bad quality trees in the area. This could be critical issues for the sustainability of these resources and affect on forest- based livelihoods in a long-term.

The NRB project, involving the purchasing of seeds and the subsequent seeding, appears not promote sustainability and has met with low social acceptance. Reaching an acceptable level of social acceptance from the woodland users to protect the areas from animal grazing could be a better alternative to seeding for woodland rehabilitation by NRB.

Although the exploitation rate of fuel wood could be increased in the close area to the village, the woodland can provide the needed quantities of fuel wood, thus questioning the rationality of the high priority given by NRB to the distribution of fossil fuels.

There is limited social acceptance and effective participation of inhabitants in NRB projects. To ensure the sustainable use and conservation of the woodland, it is necessary to have a much closer connection between the forest authority and the rural communities. They should share the responsibility of forest management, which could be interpreted as participatory, or joint, forest management.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Erik Wilhelmsson from the Department of Forest Resource Management, SLU, Umeå, Sweden, for his useful comments and all staff in the office of the Preservation Plan for Zagros forests at the Headquarters of Natural Resources of Yasouj, Iran, for their assistance in gathering data.

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تاثیر فعالیت‌های جنگلداری بر مشخصه‌های جنگل در یک حوزه آبخیز جنگلی در جنوب زاگرس، ایران

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(تاریخ دریافت: 91/2/6 - تاریخ پذیرش: 91/6/20)

چکیده

هدف از این مطالعه بررسی تاثیر فعالیت های جنگلداری بر شرایط منطقه جنگلی گناوه در زاگرس جنوبی می‌باشد که بر مبنای آن بتوان راهکارهایی برای بهبود اجرای طرح های مدیریت منابع جنگل پیشنهاد نمود. داده‌های آمار برداری جنگل جمع آوری شده در سال 2003 و داده های مربوط به مصاحبه از سرپرستان خانوارها جمع آوری شده در سال 2008 در این مطالعه مورد استفاده قرار گرفتند. نتایج نشان دهنده تخریب جنگل بدلیل کم بود زادآوری و وجود نسبتا زیاد درختان با کیفیت بد می‌باشند. این نقص در مشخصه جنگل منعکس کننده اثرات مدیریت سنتی بر پوشش گیاهی منطقه می‌باشد و موجب نگرانی‌هایی در مورد پایداری و حفاظت از جنگل می‌شود. چرای بیش از حددام، جمع آوری بذر درختان، و خشکسالی در بعضی سال‌ها احتمالا از دلایل اصلی برای کمبود زادآوری طبیعی در این منطقه می‌باشند. فعالیت های جنگلداری در طول دهه‌های گذشته می تواند علت اصلی وجود میزان نسبتا بالایی از درختان بلوط با کیفیت بد و با فرم رویشی شاخه‌زاددر منطقه باشد. برخی از تلاش‌ها برای به دست آوردن پذیرش اجتماعی استفاده کنندگان از جنگل جهت حفظ منطقه از چرای دام و عدم جمع آوری بذر برای یک دوره زمانی می تواند یک جایگزین بهتر برای بازسازی جنگل نسبت به جنگلکاری باشد.

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