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Forest management planning to increase biodiversity in woodland (case study: forests of Northern Iran)

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Key words: Sari forests, Biodiversity, forest management, forest protection.

Abstract

This study was done in three forestry villages in Kiasar (one of the cities in Mazandaran province) to design and estimate financial plans of forestry incentive programs. To identify the interests of the people associated with the forest quantitative and qualitative methods were used. Statistical population of the research was 276 households in three villages were surveyed and 76 questionnaire data were used in the quantitative analysis. The main approach in designing incentive programs in this forest is removal or modification of livestock grazing in the forest, eliminate Galazani, reduce or cut firewood and timber harvesting to provide alternative ways. In order to devise the incentive plans with a systematic view and a cause and affect approach to the research area the facilitating factors, the pressure factors, the ongoing conditions, the effects and ultimately the answer (incentive plans) were found for the promotion of conventional management. Then financial incentive program were estimated with using valuation techniques. Harvestable crops or interest of the people from forest were valued. The result of financial evaluation indicated that the financial burden of incentive plans on Galazani elimination and wood collection, known as the major causes of forest destruction in conventional forest management, amounts to 319 dollar per year for each household. Thus, a stimulus plan should at least cover these costs.

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Introduction

Forests cover about 14.2 million ha or 9% of the total area of Iran. Sari forests cover around 6.07 million hectares and account for about 45% of the Iran's forests. Forests provide a home and livelihood for approximately 10% of Iran's population (Department of Environment, 2004). Sari forest extends 1,100 km from north to south, along the Alborz Mountains in a belt of primarily deciduous oak forests (Fig. 1) ranging from 700 to 2,300 m ASL. (Menitsky *et al.* 2005). These forests consist mainly of degraded natural stands of oak and pistachia species.

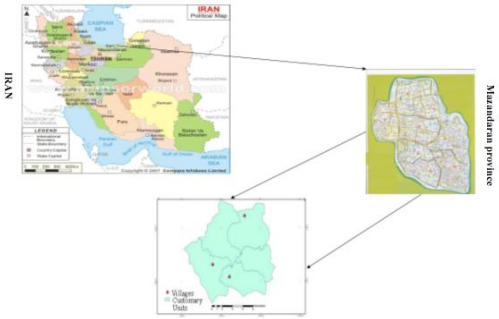

Fig. 1. Location of study area and Sari forests in Iran.

Sari forests are considered as pastoral ecosystems, which are natural ecosystems that have been exposed for thousands of years to grazing by livestock in numbers large enough to influence forest structure and function (Hoekstra and Shachak 2008). For centuries there has been nomadic human occupation with seasonal grazing and a related pastoral lifestyle in this area. In recent decades, a gradual transition to permanent settlement and year-round grazing has taken place, resulting in heavy pressure on the vegetation cover (Jazirehi and Ebrahimi 2003). Studies indicate that the increasing population, the low level of development, and the high dependency of local communities on forests for their primary livelihoods appear to be the main reasons for this decline (Ghazanfari *et al.* 2004). Sari forests are currently considered to be degraded forests. The lack of regeneration in these forests because of increased browsing pressure on regenerating trees is a major concern and there are no commercial- sized trees left in Sari (Jazirehi and Ebrahimi 2003; Ghazanfari *et al.* 2004; Pourhashemi *et al.* 2004; Sagheb-Talebi *et al.* 2004).

All forests and rangelands in Iran are under governmental authority and supervision of the Forest, Range, and Watershed Management Organization (FRWO), and grazing and lopping of forest trees are illegal. But, because forests and rangelands all belong to nobody and to everybody, they are recklessly overexploited. The "first come, first served" concept became a predominant method of natural resource utilization and misuse and mismanagement have resulted in even deeper socio-economic problems, giving rise to more poverty in rural areas. The government and its administrative authorities are investing massively to rehabilitate, protect and manage these forests. Most of the Sari forests in Iran are under some type of traditional ownership. In some areas, this kind of ownership is based on relationships arising from strong, socially accepted norms: people respect the rights of others to land and forest utilization and villagers know the boundaries of their forests. In other areas, this is not the case (Ghazanfari *et al.* 2004).

The aim of forest management by the traditional forest owners in northern Sari is to collect fodder and lop trees as winter fodder for livestock, harvest wood for fuel and construction, and clear sites for under-canopy farming (Fig. 2).

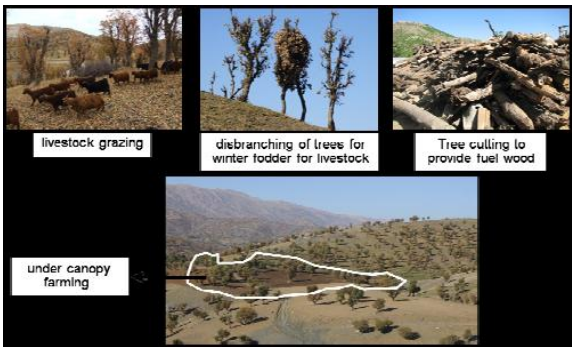

Fig. 2. Traditional forest management activities in northern Sari forest.

Forest management regimes of public forests are important in determining the outcome of forest use

(Kant 2000). The worldwide establishment and expansion of forest conservation has the unintended consequence of displacing people and isolating them from their principle source of social and economic livelihood. These people are often involuntarily displaced. They are referred to as "conservation refugees" (Geisler *et al.* 2011). In most cases, the consequences of the displacements and exclusion are not considered. The state control of and the total exclusion of local communities and indigenous people from forest areas lead to disruption in socio-economic systems that are age-old and time-tested practices known to be beneficial to forest management (Adams and McShane 2010). Therefore, it becomes necessary to understand the incentive structures that govern forest use by local communities to determine the optimal management regime that would address the people's need without jeopardizing conservation. The new approach of incentive-induced conservation has two distinct elements: (1) it allows people in the vicinity of the protected area or others with property rights to participate in the conservation process; and (2) to link the objectives of conservation with the local development needs of the people (Hutton and Leader-Williams 2003). Researchers pointed out the centrality of the local communities in the process of natural resource management (Guthiga and Mburu 2006). Local community hand has been shown to be effective managers of local resources (Ostrom 2010; Bromley 2007). Not only do they have greater knowledge of local resources, but are better able to monitor resource use and rule compliance (Ghazanfari *et al.* 2004).

Little research has been reported on local community perceptions and participation in forest management in Sari region (Fattahi 1995). Much of the existing literature on incentives for conservation focused on their application to farmland. The use of incentives has been examined in the case of private forest owners as well (Hardie and Parks 1996; Kluender *et al.* 1999). Some studies evaluated the impact of cost-sharing on non-industrial timber supply (Boyd 1984; Royer 1987). However, the propensity of owners to take up any incentive is not driven primarily by financial goals. Rather, ability to deploy access incentives to longer-term stewardship goals may be sufficient to bring them into the forest conservation scheme (Church and Ravenscroft 2007). Public acceptance is of utmost importance to every management decision that public agencies make concerning natural resources (Bruce *et al.* 2002). Forest conservation may negatively impact the livelihoods of the local communities and this may reduce the effectiveness of the intended policies.

We investigated a set of Forestry Incentives Programs (FIPs) based on important functions of forests. The FIPs are desirable and encourage local people to implement sustainable forest management. We consider that the strict management strategy adopted by government managers (FRWO) has not led to forest conservation after 40 years in the Sari forests that have a long history of utilization. We think FIPs could be replaced with restriction programs to synchronously preserve forest benefits to local people and improve forest conservation. We first developed incentive programs using interactive methods, then we evaluated incentive programs financially, to determine the financial value of incentives needed to discourage forest degradation and while providing benefits to local communities.

Materials and methods

Study area

We studied three forest villages (Kochar, Belaka and Kandasura) in Mazandaran Province in northern Iran (Fig. 1). Each case study includes a village and the land utilized by the village community of that village (Customary village unit). In general, livestock husbandry was the most important occupation (in terms of income and employment). There is customary ownership in custom units in these villages. The forest land of every village and family was fixed by custom. The vegetation types in the study area are mainly oak trees and shrubs-bushes at 1200–2300 m asl. and differentiated and mixed in different parts of the area on the basis of ecological

factors. From measurements over a 15-year period (1986–2001), average annual precipitation in Kiasar city is approximately 760 mm.

Sampling and data collection procedures

The study covered 276 families in three villages. Qualitative and quantitative methods were used to collect data, including review of documents, observations, interviews and questionnaires. Seventy-six questionnaires were completed by householders for quantitative analysis. Ten households were excluded during the process of data review. The sampled households were randomly located in the study area and sampling was performed using simple random sampling (SRS). The questionnaires elicited information on household socio-economics, farming, type of products and quantities extracted from the forest and costs incurred, and perceptions of approaches to forest management. Detailed information on traditional forest management and management challenges were complemented by interviews with local stakeholders and focus group discussions were held separately in each of the three study villages to explain the goal of the discussion and the analysis (forest management) as well as to compile opinions on different issues related to management challenges in the case study regions. Additional data such as prices of forest products were collected from local markets in the citie of Kiasar.

Statistical methods

Local people in our study area had various relationships with forests and their products. Statistical analysis was carried out to identify current relationships between forest ecosystems and people. We evaluated the financial benefits received by communities from forests. We listed the needs of people whose livelihoods depended on the forest. The approach taken for developing a set of conservation incentives on the basis of cause-effect was systematic, including bottom-up, DPSIR and interaction analysis of forest-people relationships. DPSIR formed a framework in this study that enabled systematic assessment and classification of findings (Vacik 2006). DPSIR stands for Driving forces, Pressures, Status, Impact and Responses. To adjust human-forest relationships and clarify financial values of incentive programs, we evaluated the finances of incentive programs and the community benefits from forests.

Results

The main socio-economic variables of the sampled households and characteristics of the villages are summarized in Fig. 3 and Table 1. Following traditional ownership rules, each household owned a section of the forest to provide household needs. The area of a village was divided into ownership plots for each family. Harvesting fodder, poles and fuel wood were within the authority of the owners. Gathering forest fruit and dead wood as fuel was a public right. Each family managed its own forest plot as a "management unit" (Jamshidiyan 2003), each of which was small (Table 1). The main method of land acquisition was through inheritance (90%) and ownership was transferred trough generations (Fig. 3). Therefore, the management unit areas are bound to decline in future if populations continue to increase and there will be increasing pressure on land to meet villager food needs.

Table 1. Population structure of study villages.

Village	Family number	Family size		Customary forest unit size (ha)		Total years of Formal education of Household head (years)	
		Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Kochar	52	6.04	2.35	4.13	3.58	2.66	3.06
Belaka	143	5.62	2.15	4.98	3.39	3.17	2.33
Kandasura	81	5.34	2.07	6.07	4.31	3.19	3.42

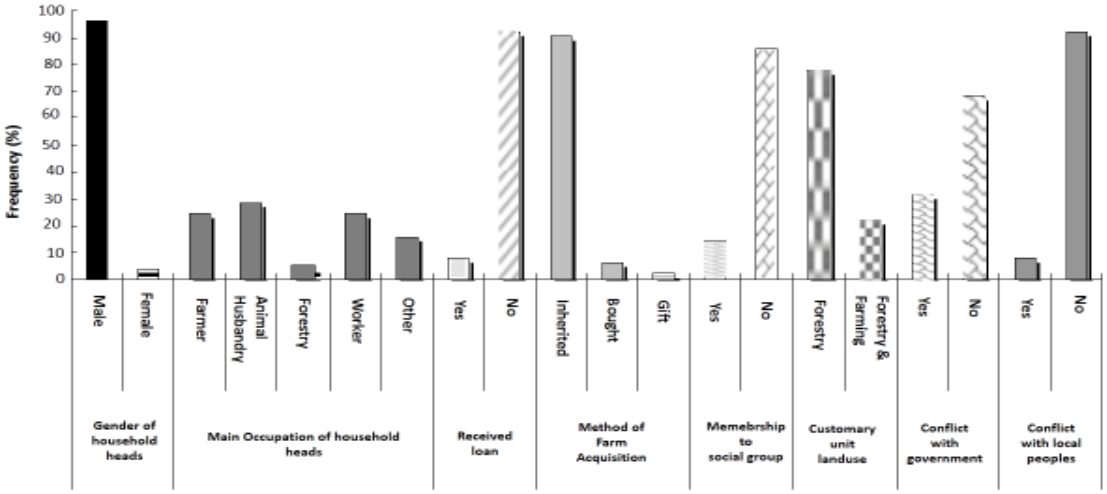

Fig. 3. Frequency of selected household socio-economic characteristics.

The average number of education years for heads of households was relatively low (Table 1). There was limited conflict at forest management unit boundaries between local peoples: villager ownership of forests has been formally recognized. There were, however, many conflicts (70% of the respondents) between local peoples and government because of illegal conversion of pasture and forest to farmland, lopping of oak trees and illegal timber felling and other wood product harvesting, and some incidents led to serious penalties at court. Goat husbandry was the most important activity. Dry farming was more common than irrigated farming because of insufficient aqueduct networks and sloping lands. Wheat and barley were the main crop species for dry farming and both were used to feed livestock during winter and to earn subsistence income for families. Membership in social groups such as village councils and forestry cooperatives was low. All households used firewood for cooking bread and 36% of households used firewood for cooking and heating. About 1.43 tonnes fuel wood were consumed per family per year. The main source of wood fuel was homestead forests (85%). As a substitute for wood, it is possible to develop kerosene and gas consumption provided by governmental subsidies. Other forest products were either consumed directly or marketed locally. Utilization of forest products by three sample villages is summarized in Table 2. As shown in Fig. 3, householder age and frequency of livestock husbandry as the main occupation were significantly and positively correlated (p <0.05, Pearson's correlation coefficient). There was a positive and significant correlation between the age of household head and size of customary forest unit (p <0.01) (Table 3). Also, there was a significant positive correlation between livestock husbandry and lopping (p <0.01), indicating the dependence of livestock husbandry on forest resources.

Table 2. Average quantity of NTFP utilization in year.

villages	Oak leaf fodder (Local unit of 'Luye Gala')			Fuel wood (Kg)			Gazou (Kg)			Mazuj (Kg)			Acorn (kg)		
	TOT	AVG	STDV	TOT	AVG	STDV	TOT	AVG	STDV	TOT	AVG	STDV	TOT	AVG	STDV
Kochar	30	2	4.55	18500	1233	982.46	500	33	45.46	200	13	22.94	220	15	51.63
Belake	342	10	11.60	50100	1431	639.74	1400	40	47.34	0	0	0	1320	38	41.09
Kandasura	115	4.5	7.49	36200	1392	756.26	970	37	42.10	400	15.4	61.26	850	32	34.96

Table 3. ANOVA test for subsistence variables in three villages.

	Household head's age	Livestock husbandry	Disbranching	Size of customary forest	Proletarian (Occupation)	Other (Occupation)
Household head's age	1	*0/236	0/221	**0/490	**-0/407	*-0/257
Livestock husbandry	*0/236	1	**0/729	**0/366	*-0/253	*-0/009
disbranching	0/221	**0/729	1	*0/429	*-0/287	0/194
Size of customary forest	**0/490	**0/366	*0/429	1	**-0/415	-0/143
Proletarian (Occupation)	**-0/407	*-0/253	*-0/287	**-0/415	1	-0/241
Other (Occupation)	*-0/257	*-0/009	0/194	-0/143	-0/241	1

* Significant at 5%, ** significant at 1%

Income from livestock husbandry and income from other occupation (any activity, except farming, NTFPs and livestock husbandry) were significantly different at 1% level (Table 4), livestock husbandry (goats account as main livestock in study area) is a main income source for villagers which depicts dependency of livelihoods on the woodland resources. The forest-based incomes were obtained through livestock husbandry (grazing and oak tree fodder), dry farming of forest lands, collection of NTFPs and also there are non forest based income such as income from proletarian work (day-labor) and other sources of income. People declaring livestock husbandry as their main job had most conflict with government (Kruskal-Wallis nonparametric analysis (Table 5), followed by respondents who declared NTFPs as their main livelihood resource, other income, farmer and proletarian income.

Table 4. ANOVA test for subsistence variables that studied in the three villages.

		Mean Square				
Change source	d.f.	Income from livestock husbandry	Income from dry farming in forest lands	Income from NTFPs	Income from proletarian works	Income from other sources
village	2	**108× 6527	108×2608	108×7805	107×7458	**108×8140
error	73	108×1184	108×1438	108×7807	107×3149	108×8091

* Significant at 5%, ** significant at 1%

Table 5. Kruskal-Wallis nonparametric test for the variables of main occupation and conflict with government.

Main Occupation of household heads	Conflict with government
Livestock husbandry	12.5
NTFPsfrom	25.17
Other	39.94
Farmer	40.5
Proletarian	45.54
Significant level	0.006

A framework was required to illustrate the main factors which are acting in the study area as well as their interactions. The DPSIR approach was chosen to provide this framework. The result of this analysis shows as follows in the case study villages.

Driving force: (1) Poverty, (2) Insufficient employment opportunities, (3) Undeveloped villages.

Pressure: (1) Over grazing and forest regeneration grazing by livestock, (2) Over wood harvesting (fuel wood and timber), (3) Under canopy farming and conversion of forests to farms particularly dry farms.

State: (1) Disorder in forest regeneration and low number of seed origin trees, (2) Decrease in forest canopy cover, (3) Decrease of biodiversity in forest, (4) Erosion types and quantity of erosion due to over grazing, (5) Contribution of forests to income and

energy of resident, (6) Adaptability of indigenous knowledge of forestry and animal husbandry.

Impact: (1) Insufficient fuel wood and timber for subsistence use, (2) Changes in forest pattern and structure, (3) Low productivity of livestock husbandry and insufficient income. (4) Soil erosion, (5) Aging of forests without regeneration.

Response: (1) Providing of fodder for villagers and husbandry related facilities, (2) Classifying ownership situation regarding customary rights, (3) Providing of kerosene and gas for villagers and its related facilities as cooker, heater, etc., (4) Changing pattern of husbandry, (5) Development of NTFPs and medical plants, (6) Developing the irrigation farming, (7) Offering some seedlings as Walnut, (8) Constructing schools and health centers in villages, (9) Development of local industry for production of NTFPs, (10) Increase in income of resident, out of forest and decrease in dependency to forest. Based on the information collected and the issues mapped into the DPSIR framework, local community incentive programs developed as a response.

The hedonic pricing method was used to estimate economic values of fodder collected from forests and rangeland (Kim *et al.* 2009). Based on Total Digestible Nutrient content (TDN) and using hedonic pricing method, the average value of oak leaf fodder for each household was about US$ 287 per year. Also, the average value of firewood harvested was US$ 32 per household per year. Fuel wood had a direct market in the study area. We estimate that an incentive of US$ 319 per year would be needed for each household to prevent lopping and firewood collecting as agents of forest degradation.

Discussion

The needs of rural communities resulted from the characteristics and environmental features of villages, and local communities enjoyed substantial economic benefit from northern Sari forests. Therefore, for continued realization of these benefits, there is a need to balance levels of extraction with conservation. There is a big challenge for the management regimes to ensure that extraction does not lead to overexploitation. Ebrahimi (2000) declared that the main reason for mismanagement of Sari forests is weak social acceptance of management plans. For conservation of forests, and for programs to be socially accepted and cost effective for government and local communities, the heterogeneity in communities' preferences and goals should be taken into account. The uptake of incentives has proven difficult to predict and there are numerous example of farmers not responding to the incentives on offer so financial evaluation of incentive programs should be done in this case. Without evaluation it is difficult to judge how the program could be modified to improve forest management (Arun and Ostrom 2001; Guthiga and Mburu 2006).

Most farmers did not have any education beyond the elementary level. Therefore, they had limited employment opportunities in the non-farm sector or to operate commercial enterprises. This is supported by the observation that most of the respondents were involved in farming and livestock husbandry as their main occupation. Livelihood dependency on forests can be reduced by income diversification. Projects exploring options such as incentive programs would be useful. Engaging people in such programs could also add to the diversification of the sources of income (Salehi 2009). Many programs have encouraged owner participation by offering direct incentives. For example, energy sources in the study area comprise fuel wood, kerosene and gas. Kerosene is offered to villagers free of transport cost by the forestry administration service. However, kerosene supply did not cover all of the villager energy demand. Thus, villagers were dependent on fuel wood for cooking, heating and bathing (personal communication with villagers). In many areas of the Sari region, non-timber forest products (NTFPs) had higher value than timber (Sagheb-Talebi *et al.* 2004). The main benefits of harvesting NTFPs is that they provide a source of income without notable costs

(only labour costs) and cause limited damage to natural resources. Promotion of sustainable use of NTFPs can be recommended to alleviate poverty and conserve forests.

The size of forest management units was small and bound to continue declining because of inheritance through generations.

This affects landowner willingness to participate in incentive programs (Sun *et al.* 2008).As land ownership increases through comprehensive management, the probability increases of local peoples participating in a program. Awareness of other incentive and assistance programs is also a determinant factor for landowner participation. In forested areas of Sari, communities were dependent on the forest for a range of goods and services. The needs of peoplewhose livelihoods depend on the forest must be incorporated into sustainable forest management (Colfer *et al.* 1999). Incentive programs also affect structures and bureaucrats in forestry organizations are seeking to maximize budget and trying to shape policy (Wintrobe 1997). So because land degradation and forest decline is a multi factor problem, needs multi and interdisciplinary solutions. Effective management of natural resources needs a clear, well-structured, workable and transparent framework of goals, objectives and indicators. As a recommendation for future research on land use policy, how do we evaluate the effect of policies when the impacts assessment are difficult to measure, and how do customary landowners express their demand to program officers, need to be investigated in Sari mountain forest. A clear, well-structured, workable and transparent framework of goals, objectives and indicators. As a recommendation for future research on land use policy, how do we evaluate the effect of policies when the impacts assessment are difficult to measure, and how do customary landowners express their demand to program officers, need to be investigated in Sari mountain forest.

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