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Anthropogenic Influences on the Tolipir Landscape, Lesser Himalayas, Pakistan

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Erratum

A co-author is removed from the manuscript upon request of the corresponding author.

ANTHROPOGENIC INFLUENCES ON THE TOLIPIR LANDSCAPE, LESSER HIMALAYAS, PAKISTAN

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ABSTRACT

The present study describes anthropogenic pressure in Tolipir landscape of lesser Himalayas. The GIS tools, questionnaire and field sampling surveys were used to estimate threats in landscape. The study was conducted from January 2013 to January 2014. The five model villages (Ali Sojal, Kanchi Kot, Khori Chana, Kahoo Kot and Noor Kot) of Tolipir landscape were selected to determine anthropogenic pressure. The study documents that Tolipir landscape has average number of house (350 ± 82.4), with number of individual per house (10.8 ± 1.1) and fuel consumption per day (43.72±3.30) kg. The preferred fuel wood plant species among inhabitants of landscape are; *Quercus incana* (41.2%), *Quercus* dilatata (41.2%), *Pinus wallichiana* (21.6%), *Rubus fruticosus* (14.3 %), *Aesculus indica* (13.3%), *Salix acmophylla* (12.3%), *Dicliptera bupleuroides* (10.2%), *Robinia pseudoaccacia* (7.8%), *Machillus odoratissima* (5.9%), *Olea cuspidata* (3.9%), *Ailanthus altissima* (2.0%,), *Berberis lyceum* (2.0%), *Abies pindrow* (2.0%), *Machillus odoratissima* (2.0%), *Dodonia viscose* (2.0%), *Punica granatum* (2.0%) and *Melia azaderach* (2.0%). The inhabitants of landscape has an average owned land area of 20.9 ± 4.1 kanal, with average livestock (6.1 ± 6.7) and resident feed livestock, by green fodder (61%), meadow (20.8%), forest (18.2%), cultivated fields (89.3%) and farm (8.3%). The results indicate Tolipir landscape has significant greater pressure in the form of fuel wood consumption, population, grazing when compared international standard of other hilly areas. The assessments of anthropogenic pressure provide baseline information in developing conservation strategies, for mountain ecosystems regionally and globally.

Keywords: landscape, anthropogenic pressure, GIS, Lesser Himalayas

INTRODUCTION

Mountains contain many different ecosystems and exhibit higher species richness and are biodiversity hotspots (Singh, 2010). Mountain ecosystems provide a vast array of goods and services to humanity (TEEB, 2010), usually presented as four broad categories, i.e., provisioning, regulating, supporting and cultural (Jordan et al., 2010). Provisioning services include food, grazing, fodder, fuel, timber, and medicinal products, which contribute to agricultural, socio-economic and industrial activities (Boyd and Banzhaf, 2007). In every ecosystem vegetation has a role in the regulation and maintenance of abiotic environment. Plant biodiversity provides sustainable foundation for environmental and ecosystem resources, including, agriculture, land, water, soil formation, fertility and nutrients, biogeochemical cycling, weather, climate and preventing soil erosion and floods (Rasul, 2010). About 10% of the world's population depends directly on mountain resources for their livelihoods and wellbeing, and an estimated 40% depends indirectly on mountain

resources for water, hydroelectricity, timber, biodiversity and niche products, mineral resources, flood control, and recreation (Schild, 2008).

Identifying the gradient of services and threats that occur along the Tolipir Mountain Landscape provide the first step towards developing long-term management and conservation strategies for ecosystems. Such strategies might, therefore, have optimistic outcomes for the maintenance and increase in mountain biodiversity and ecosystem services which will also have a positive impact on the lowland ecosystems which depend on the sustainability of these mountainous ecosystems.

This study was conducted with the objective to collect information about population size, landholding, fuel, livestock, grazing, and preference of fuel wood.

MATERIALS AND METHODS

The study area, Tolipir (Azad Jammu and Kashmir, Pakistan; 33°53'49.80"-33°53'43.43" NL and 73°51'52.54" --3°51'52.61" E; 2153-2238 m above mean sea level) lies in the western Himalayas, having subtropical to moist temperate veget ation (Anon, 2007). Tolipir hilltop falls in Tehsil Rawalakot (District Poonch). It is about 40 km, or a 45-minute drive from Rawalakot town (district headquarter). The weather is harsh cold from October to March and summer is pleasant. Major part of the area is a hill slope, which is thickly dotted with scattered human habitations, usually organized into 5 villages: Ali Sojal, Kanchi Kot, Khori Chana, Kahoo Kot, Noor Kot and top hill folds are popular tourist spot.

The data was collected from 5 main localities of Tolipir including Ali Sojal, Kanchi Kot, Khori Chana, Kahoo Kot and Noor Kot (Figure 1). A questionnaire was developed to extract information about socioeconomic set up and services harvested from wild bioresources by inhabitants (population, fuel, landholding, livestock, grazing, ornamental plants, preference of fuel wood). The area was also surveyed and anthropogenic influences on habitat assessed and photographed following Khan et al. (2011).

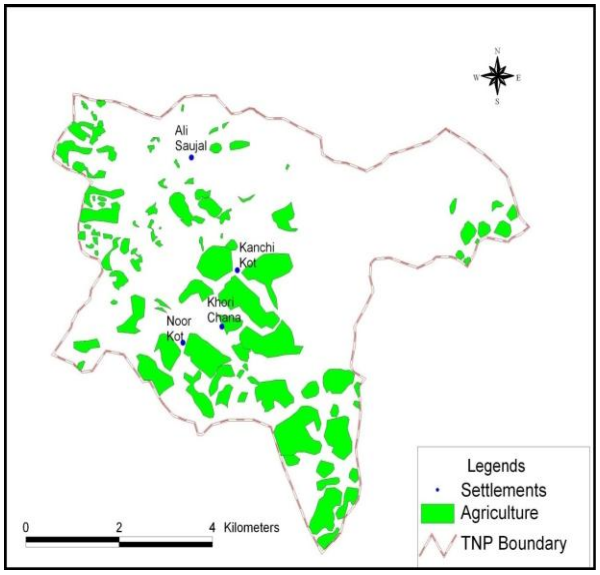

Figure 1: A simplified satellite imaginary showing the general distribution of agriculture and forested plantation in Tolipir (source: Arc View 3.3 and Google Earth pro 4.2).

RESULTS AND DISCUSSION

The villages in the area represent scattered houses and the perception/ limit of a village varies with different persons. However four main villages have been generally accepted and appear on revenue record, which are located on different mountain spurs, i.e., western north-south oriented hills (Ali Sojal), middle east-west oriented central hill (Kanchi Kot), the southern east-west oriented hill (Khori Channa), and extreme southern ridges (Noor Kot). The respondents of the questionnaire suggest that Ali Sojal and Kahoo Kot are two comparatively larger village having 450±107.4 (SEM) and 550±166.3 (SEM) household units. Kanchi Kot comprises of 350±51.8, Khori Channa has 200±27.5 and Noor Kot comprise of 100±40.7 households.

Household Size

The sample of responses suggested that the average size of the household in the five villages, of Tolipir area is 10.8±1.1 (SEM) persons/ household. The calculation of 95% confidence limits suggests that the household size largely remains within 8.62 and 12.98. There is some variation in the size of the household between the villages. The household size was the largest in Ali Sojal (12.9±1.0/ household), followed by Kahoo Kot (11.3±0.6/ household), and Noor Kot (9.5±2.2). The household size was relatively small in Khori Channa (9.2±1.0) and Kanchi Kot (8.7±0.6) (Table 1).

Population Size

Based upon the information collected on the number of the households and the average size of the household in the villages a population of some 18,000 (17,855) directly or indirectly influences the bio resources of Tolipir area. Ali Sojal is the largest village (population around 6,000). Kanchi Kot is the second largest village (3,000 heads). Khori Channa (2,000) and Noor Kot (1,000) are two relatively smaller villages falling within the Tolipir area (Table 1). The density of human population residing within Tolipir area comes to 2.31 individuals/ha (230.7 persons/km^2). This is a relatively large population, disturbing the general wilderness of the Tolipir area and is probably over harvesting the natural biotic resources.

Fuel

Under the present trends, the fuel wood is preferred by different proportions by residents of Noor Kot (50%), Kahoo Kot (50%), Khori Chana (45.2%), Ali Sojal (41.0%) and Kanchi Kot (32.3%). The preference for LPG in different villages varies between 67.7% (Kanchi Kot) and 54.8% (Khori Channa) while mineral coal is used only in Ali Sojal 5.4%. The fuel wood combustions (kg/household/month) varies in different villages; Ali Sojal (488±76 SEM), Kanchi Kot (450±66), Khori Chana (400±56), Kahoo Kot (350±46) and Noor Kot (300±40) (Table 1).

Landholding

The average landholding of the family is relatively large in Ali Sojhal (25.8±5.1 kanal), as compared with Kanchi Kot (20.4±4.3 kanal) and Khori Channa (15.4 ± 3.2 kanal). The landholding is relatively small in Noor Kot (12.0±3.1 kanal) and Kahoo Kot (11.0±3.0 kanal). Cultivated land per household is the highest in Ali Sojhal (12.4 ± 2.1 kanal), followed by Kahoo Kot (4.3.0± 0.9), Noor Kot (7.0 ± 1.0), Kanchi Kot (15.5±3.0) and Khori Chana (5.8 ± 0.8). Uncultivated land claimed by the residents as their ownership is also correspondingly large Ali Sojhal (16.1±4.9), followed by Kahoo Kot (6.8±2.7), Noor Kot (7.3±2.7), Kanchi Kot (10.6±2.9) and Khori Chana (10.6 ± 2.9) (Table 2).

About half of the land (11.1±2.1 kanal) available with a family is cultivated (mostly rain-fed), while an equal proportion of the family land (12.7±3.9 kanal) remain uncultivated, having natural wild vegetation. The family has the full rights over the uncultivated land, said to be owned by the family and at many places the families claimed that the forests appearing on such their land were planted through private afforestation efforts. The families claim their right over the trees and fodder appearing in such tracts. The cultivated and uncultivated land is present in patches along with the unclaimed land, believed to be owned by the Forest Department.

Livestock

Seven types of livestock, i.e., cows, buffaloes, sheep, goat, donkey, horse and poultry are maintained in the villages. One or more than one type of the livestock is maintained in almost every housing unit. The general estimates for the area suggest that on the average 0.3 ± 0.1 cows, 1.4 ± 0.2 buffalo, 2.7 ± 1.3 sheep, 3.3 ± 1.6 goat and 6.8 ± 1.1 scavenging poultry is maintained in each household. A small number of donkeys/ horses are also present in the area, especially in Ali Sojal (Table 2).

Grazing

The effect of grazing pressure is difficult to be judged in the absence of long term studies on the randomly marked fixed quadrats. However the present sampling of the area suggests that the mammalian livestock (61%) is mainly maintained on stall feeding, while some 21% is maintained through direct grazing in pastures and the other 18% exploit the forest resources (Table 3). This trend is followed in all the villages with slight variation, pasture grazing limited in Khori Channa and Kahoo Kot, while grazing in forests is limited around Kahoo Kot and Noor Kot. The food in such cases mainly come from the agricultural fields, mainly coming from the dried stumps of wheat and maize, though fodder is specially cultivated in selected fields and grass is harvested from forest, wastelands and associated areas. For stall feeding the green fodder is collected from the uncultivated privately owned tracts (89%), while this fodder is also collected from the forests (11%), though farm cultivated fodder is available in 8% of the livestock maintained on stall feeding. The fodder is collected from the wild forests or privately owned lands from an average distance of some 2.8 ± 1.1 km.

Table 1: Distribution of human population and fuel wood consumption in villages of Tolipir area.

Villages	House (#)	Individuals/ Household	Estimated Population	Fuel Wood (kg/m)	LPG (kg/m)	Average Fuel Consumption (kg/m)
Ali Sojal	450 ± 107.4	12.9 ± 1.0	5805	41.1	50	488±76
Kanchi Kot	350 ± 51.8	8.7 ± 0.6	3045	32.3	67.7	450 ± 66
Khori Chana	200 ± 27.5	9.2 ± 1.0	1840	45.2	54.8	400 ± 56
Kahoo Kot	550 ± 166.3	11.3 ± 2.2	6215	50	50	350 ± 46
Noor Kot	100 ± 40.7	9.5 ± 2.2	950	50	50	300 ± 40

Table 2: Exploitation of natural resources and livestock maintained per household in different villages of Tolipir area.

Villages	Own Land Area	Cultivated Land Area (Kanal)	Un-cultivated Land Area (Kanal)	Livestock					
				Cows	Buffalos	Sheep	Goats	Poultry	Average Livestock
Ali Sojal	25.8 ± 5.1	12.4 ± 2.1	16.1 ± 4.9	-	1.7 ± 0.1	63.3±37	5.6 ± 2.3	10.2 ± 1.5	20.2±14.4
Kanchi Kot	20.4 ± 4.3	15.5 ± 3.0	10.6 ± 2.9	0.4 ± 0.1	1.4 ± 0.2	8.5 ± 7.7	1.6 ± 0.8	5.6 ± 0.8	3.5 ± 1.5
Khori Chana	15.4 ± 3.2	5.8 ± 0.8	10.6 ± 3.2	0.3 ± 0.2	1.2 ± 0.2	0.2 ± 0.2	0.2 ± 0.1	3.4 ± 0.4	1.1 ± 0.6
Kahoo Kot	11.0 ± 3.0	4.3.0 ± 0.9	6.8 ± 2.7	-	0.8 ± 0.3	-	1.0 ± 1.0	3.3 ± 0.7	1.7 ± 0.8
Noor Kot	12.0 ± 3.1	7.0 ± 1.0	7.3 ± 2.7	-	1.3±0.3	-	1	2.8±0.5	2.1±0.8
Overall	20.9 ± 4.1	11.1 ± 2.1	12.7 ± 3.9	0.3 ± 0.1	1.4 ± 0.2	2.7 ± 5.3	3.3 ± 1.6	6.8 ± 1.1	6.1 ± 6.7

Preference of Fuel Wood

The preference of fuel wood plants, according to respondent are; *Q. incana*, *Q. dilatata* (41.2%), *P. wallichiana* (21.6%), *R. fruticosus* (14.3%), *A. indica* (13.3%), *S. acmophylla* (12.3%), *D. bupleuroides* (10.2%), *R. pseudoaccacia* (7.8%), *M. odoratissima* (5.9%), *O. cuspidata* (3.9%), *A. altissima* (2.0%), *B. lyceum* (2.0%), *A. pindrow* (2.0%), *M. odoratissima* (2.0%), *D. viscose* (2.0%), *P. granatum* (2.0%), and *M. azaderach* (2.0%) (Table 4).

Table 3: Average distance (Km) and source of cattle feed in different villages of Tolipir area.

Villages	Green Fodder		Meadow		Forest		Field		Forest		Farm		Forest Grazing Distance	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Ali Sojal	22	55	11	27.5	7	17.5	34	82.9	3	7.3	4	9.6	17	2.6 ± 0.8
Kanchi Kot	10	52.6	4	21.1	5	26.3	19	79.2	3	8.3	2	8.3	4	4.1 ± 1.8
Khori Chana	10	83.3	0	0	2	16.7	17	89.5	2	10.5	0	0	2	0.5 ± 0
Kahoo Kot	3	100	0	0	0	0	3	100	0	0	0	0	0	0
Noor Kot	2	66.7	1	33.3	0	0	2	50	1	25	1	25	2	1.8 ± 0.3

Table 4: Preference for wood fuel by the residents of different villages of Tolipir area.

Preferable Wood For Fuel	Villages											
	Ali Sojal		Kanchi Kot		Khori Chana		Kahoo Kot		Noor Kot		Overall	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Quercus incana, Quercus dilatata	9	40.9	5	55.6	7	41.2	0	0	0	0	21	41.2
Pinus wallichiana	3	13.6	4	44.4	2	11.8	0	0	2	66.7	11	21.6
Robinia pseudoaccacia	3	13.6	0	0	0	0	0	0	1	33.3	4	7.8
Machillus odoratissima	0	0	0	0	3	17.6	0	0	0	0	3	5.9
Olea cuspidate	0	0	0	0	2	11.8	0	0	0	0	2	3.9
Ailanthus altissima	1	4.6	0	0	0	0	0	0	0	0	1	2.0
Berberis lyceum	0	0	0	0	1	5.9	0	0	0	0	1	2.0
Abies pindrow	0	0	0	0	1	5.9	0	0	0	0	1	2.0
Machillus odoratissima	1	4.6	0	0	0	0	0	0	0	0	1	2.0
Dodonia viscose	1	4.6	0	0	0	0	0	0	0	0	1	2.0
Punica granatum	1	4.6	0	0	0	0	0	0	0	0	1	2.0
Melia azaderach	1	4.6	0	0	0	0	0	0	0	0	1	2.0
Rubus fruticosus	4	11.8	1	10	3	42.9	0	0	0	0	8	14.3
Aesculus indica	3	10.5	2	9	3	32	0	0	0	0	8	13.3
Salix acmophylla	2	5.6	1	8	2	25	0	0	0	0	5	12.3
Dicliptera bupleuroides	1	4.5	1	8	3	22	0	0	0	0	5	10.2

Forests are important natural resource of fuel wood for rural livelihood and causing sever threats to forest especially in Himalayas (Ahmed et al., 2006; Akash et al., 2013). The present study suggests that in the absence of supply of the piped natural gas the inhabitants of the area mainly depend upon fuel wood and LPG for cooking and heating purposes. The average demand per month of a housing unit is 488±76 kg (95% CL 339–637 kg), with a higher demand in villages located at higher altitudes. This is understandable as the areas at higher altitude face harsher winter temperatures. Assuming the presence of some 1,100 housing units within Tolipir area limits suggests an annual requirement of some 6,442 metric tons of the fuel wood, which is being met through the general forested vegetation maintained over the wild or semi-wild area. The consumable fuel is too much greater than the figures reported from various studies of the western Himalayas (1.49 kg/capita/day) by Bhatt et al. (1994) and 2.97kg/capita/day by Hamayun et al. (2011). The prominent fuel wood species, like, *Aesculus indica, Clematis grata, Salix acmophylla, Dicliptera bupleuroides* and *Cedrela serrata* are widely used in cooking and warming the houses. The wood of *Quercus incana* is used as firewood and for making charcoal.

The livestock is a part of rural society of the area. However, large scale livestock farming for direct economic benefits is not practiced in the area, and hence smaller units of livestock are maintained in most households, usually housed in a part of the household or in some attached barn. These units have a limited dependence on the general wild resources; mostly stall fed on by products of agriculture. The productivity of this livestock farm is also low and little attention is paid to maintain more productive breeds as also on the veterinary health. Better management of this stock and development/ distribution of high yielding breeds can substantially increase the family economic support, coming through subsistence livestock farming. Keeping to the fact that the Tolipir area holds some 1100 households within its limits, lead us to suggest that Tolipir area has a flock of about 330 cows, 1540 buffalos, 2,970 sheep, 3,630 goats, and 7,480 scavenging domestic poultry birds. There is no practice of maintaining large livestock farms or large grazing units, and hence these are maintained as small family herds/ flocks to provide additional family income using the free unexploited labor. A huge anthropogenic pressure on Himalayan forest is due to overgrazing and forest wood fuel consumption (Ahmed et al., 1990, 1991, 2006).

CONCLUSION

The fuel wood consumption and extensive grazing patterns results in deforestation in the area. Higher fuel wood consumption is mainly due to lack of unconventional energy sources. There is no tradition of development of biogas units, using the animal dung, which can be used in partially meeting the energy requirements as fuel for cooking. This can also provide organic fertilizer compost to be used in the fields or sold out for direct economic benefits. The demand for the organic crops and vegetables are increasing with the passage of time. This compost, if properly handled and cured, can be a cost effective alternation to the chemical fertilizers required for a more organized farming and can better maintain the soil fertility. No model biogas plant is available in/ around Tolipir tract, and hence the possible success of such a plant cannot be visualized. The lower temperature, especially at higher altitudes, especially during winter, can be a possible problem for the effectiveness of such a plant and research on inoculation

with decomposers working at lower temperature and mechanical alternatives may be required for development of specially designed biogas plants. Bacterial cultures potential of continuing the fermentation at lower temperatures may also be required. However, successful introduction of effective biogas plants can substantially reduce the stress on the natural forest vegetation and the requirement of fuel wood. Searching other alternate energy resources, like cheaper hydro-electricity, can also meet the energy requirements of local populace and thence lowering stress on forest vegetation.

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