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RESEARCH ARTICLE

PERCEPTION ON THE BENEFITS AND BURDENS OF COMMUNITY LIVING AROUND THE PROTECTED AREAS: A CASE STUDY OF SYAUBARI BUFFER ZONE COMMUNITY, LANGTANG NATIONAL PARK, RASUWA, NEPAL

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ABSTRACT

Buffer Zone communities living around the National Parks in Nepal have both benefits and burdens. Park office provisions the buffer zone communities, handovers the community forest and shares 30-50 % revenue for conservation, livelihoods and community development. But burdens do exist primarily as human wildlife conflict. 145 households were interviewed in Syaubari community, Langtang National Park, Rasuwa, Nepal to assess the benefits and local perception towards those benefits. Focus group discussion and participatory rapid assessment were applied to collect the data on burdens. Forest inventory was carried out to estimate growing stock. The buffer zone program contributes little as 4% to the household income. However the indirect benefit is substantial as it saved yearly 2,351 days or opportunity cost US$ 11,190 by reducing resources collection time. The growing stock of the forest was 1,065 cf/ha. The total number of stem per hectare is 210. Human wildlife conflict incidences have been increased. The crop damage is the most wide spread. The wild boar and black bear were found to be the most problem animals. Approximately 38-40 hectares of land were fallow. Water holes have been drying up. Artificial water holes should be created. Despite of increased human wildlife conflict, community people were largely unaware of the relief policy of government. Conservation education programs should be launched to create awareness.

INTRODUCTION

National Parks and Wildlife Conservation Act, 1973 is the first key legal instrument in protecting biodiversity of the country. The Nepal government issued Himalayan National Park Regulations (1979) in the same decade which has made special provisions for people living in mountain parks to collect natural resources such as firewood, leaf litter, fodder and timber. The Regulations allow people to graze their domestic animals on park rangeland (Sharma, 1999). Perhaps the most notable policy shift was witnessed when Buffer Zone Management Regulations came in to existence in 1996. The regulations make provision for buffer zone (BZ) and entrusts BZ institutions to collect royalty from natural resources and invests in conservation, livelihoods and community development. Three major criteria are considered for delineating buffer zone i) communities affected by the restriction on forest resources by national park office ii) communities affected by the restriction on grazing and iii) Communities affected by wild animals. The National Park Office considers these communities while selecting for buffer zone which are the impact zone accordingly to Buffer Zone Management Guideline (1999). Earlier concept was "shoot and protect" which failed because of absence of local stewardship and centralized structure. So, the buffer zone concept was evolved to provide additional layer of protection around protected area as well as to bridge the gap between the immediate needs of local people and the long-term objective of protected area system (Aryal, 2008). BZ program is designed on Integrated Conservation and Development Program (ICDP) model and therefore encourages the local participation in conservation and development activities (Bajracharya *et al.,* 2007). The term ICDP has been applied to a diverse range of initiatives with a common goal: linking biodiversity conservation in protected areas with local social and economic development (Wells *et al.,* 1999). In this spirit, regulations mandate park office to share tourism revenue and provide relief to buffer zone communities who are sharing the space with wild animals and therefore get affected (Poudel *et al.,* 2007). Budathoki (2004) examined the strengths and weaknesses of buffer zone policy and practices and found

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there were inconsistencies between the vision of the programs and its policies and practices. Majority of study were conducted in low land national parks aimed at species. There is a dearth of study to evaluate the contribution of buffer zone policy and program in the household income particularly in mountain national parks. In addition, Buffer Zone Management Guidelines (1999) provisions 30%, 30%, 20%, 10% and 10% budget should be allotted for conservation, community development, income generation & skill development, conservation education and administration respectively. In this context, the study attempts to assess benefits and burdens of Syaubari BZ community, Langtang National Park. The Langtang National Park (LNP) is the first mountain national park officially set up in 1971 with an area of 1,710 km^2. An additional 420 km^2 was added to the park as a buffer zone in 1998. (Karki and McVeigh, 2000). Located in north-central Nepal, the park's southern boundary extends to north of Kathmandu. It is bounded by the Nepal-Chinese border to the north. In Langtang National Park, one BZ Management Committee, 21 BZ User Committees and 332 BZ sub-committees are functional. BZ Management Committee is the apex body operating in park level. The representative of District Development Committee is member of BZ Management Committee. Community representative chairs management committee while warden is the member secretary. Similarly, BZ user committee operates at the sector level while BZ sub-committee is active in village level. Syaubari subcommittee is one among 29 subcommittees functional in Laharepauwa VDC and therefore very little revenue trickles down (Annex-1).

MATERIALS AND METHODS

In order to select a representative BZ sub-committee populated with Indigenous Tamang community, framework of parameters was applied consulting with national park warden. LNP covers part of Rasuwa, Sindupalchowk and Nuwakot districts. The framework has three categories respectively ecological, social and institutional (Table 1). The objective is to narrow down the potential study areas to capture the benefits and burdens. The key informant interview was also done on relevance of parameters (personal comm. with Gautam Poudel, Manager, Buffer Zone Support Program)

Study Area: Using framework of parameters, Syaubari buffer zone community of Laharepauwa village development committee was selected as study area (Fig. 1). The Syaubari community comprises of four hamlets respectively Kavre tole, Lama tole, Gumbudanda and Bastala totaling 225 households. It is located in ward number 8 of Lharepauwa village development committee.

The Syaubari is highly populated by Tamang community who was believed to come from Tibet. They were horse traders. "Ta" in Tibetan means horse; "Mang" means traders (Bista, 1967). They are traditionally agro-pastoralist and possess rich ethno-botanical knowledge. The Syaubari sub-committee has been managing community forest since 2007. The area of forest is approximately 136 hectares with dominant tree species like Oak (*Quercus semicarpifolia*), Pine (*Pinus roxburghii*), Alder (*Alnus nepalensis*) and Rhododendron (*Rhododendron arboreum)* (LNPBZSP, 2013).

Questionnaire Survey: The semi-structure questionnaire was designed for socio economic characteristics, income from various sources including forest resources and non-timber forest products, resources collection time, perception on forest condition change and benefits of buffer zone program. Systematic random selection was applied for selecting households. The first household was randomly selected and thereafter every 3rd household was approached for survey. Sampling frame was obtained from the Forest Operation Plan, 2008. 145 households were interviewed. The data was analyzed in STATA and graphs were produced in Excel spreadsheet. While calculating the opportunity cost, one day is assumed equal to NPR 500 (US$ 4.7) which is the prevailing wage for unskilled labor in a local market. US$ 1 equal to NPR 105 was used as an exchange rate.

Forest Inventory: 0.5 % sampling intensity was taken in accordance with Community Forestry Inventory Guideline, 2004. This is the government guidelines and is widely used by community forest user groups (CFUGs) across country. The guideline recommends 0.1% for barren, open grazing land or with sparse vegetation while 0.5 % for other types of forest. The total area of all forest sample plots constitutes 0.5% (7,090 m^2) of total area. The area of the forest was 136.2 hectare. 36 sample plots (7.97 m radius or 200m^2) were laid out in forest blocks with the aid of Arc view. Proportionately six, nine, nine and twelve plots were assigned in block A, B, C and D respectively. The location for the first plot is randomly selected and other plots thereafter placed in 200 meter interval–systematic sampling with the random start (Fig.2). The coordinates were recorded in GPS. The circular plot was used in order to minimize the edge effect of sloppy area. The diameter and height of the pole and tree were measured by d-tape, measuring tape and vertex. The data were recorded in the standard data sheet prescribed by guideline.

Transect walk: Transect is relatively efficient method to measure relative abundance of variety of mammals, birds and other animals (Tucker *et al.,* 2005).

Table 1. Frame work of parameters (Field survey, 2013)

S.N	Ecological Parameter	Social Parameter	Institutional Parameter
1	Community belongs to Middle mountain (1200-3000 m), characterized by mixed broadleaf and conifer forests, high productivity farming valleys	Pre-dominantly Indigenous community or mix community	Community implementing over 10 years of BZ program
2	Size of the forest > 100 ha.	Highly depended on forest resources for subsistence livelihoods	Implementing Forest Operational Plan, involved in Biodiversity Conservation activities
3	The forest ideally includes shrub land or grazing land	Community with over 150 HHs –variance on income level would be ideal	Institutions inclusive of gender, poor and disadvantaged groups
4	The community forest ideally at close proximity or adjoined with park forest	Community's reliance also on park areas	The institution has devised the regulations pertinent to forest conservation
5	Forest functions as wild habitats	Local livelihoods impacted by human wildlife conflict	local communities initiated preventive measures against human wildlife conflict incidence

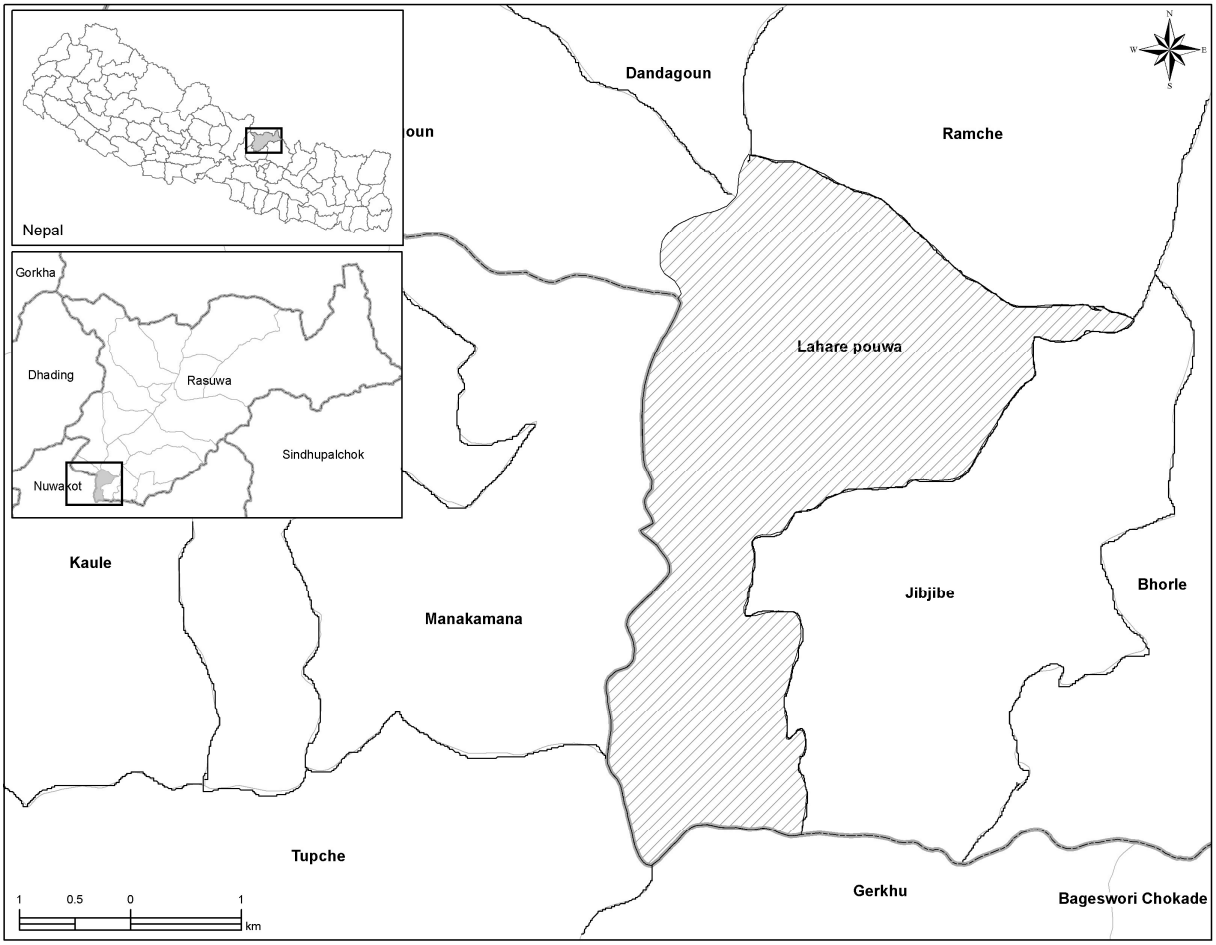

Figure 1. Location map of study area

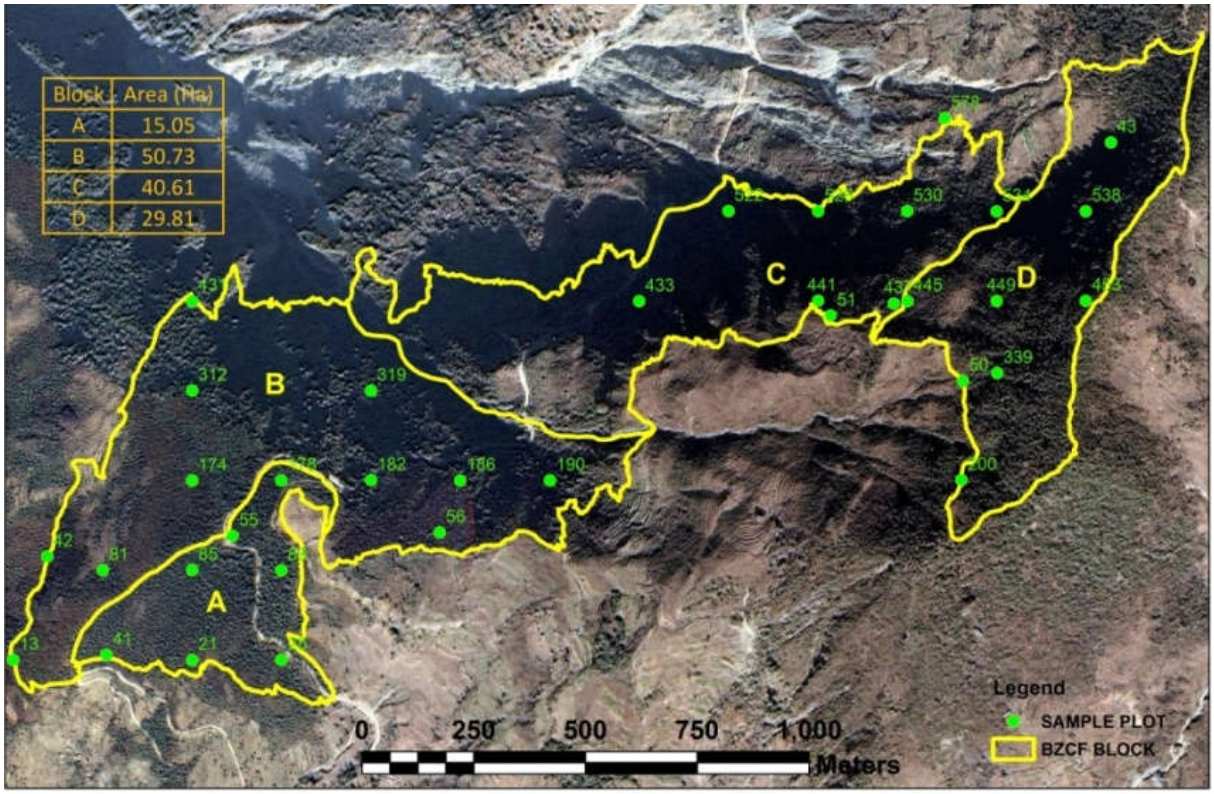

Figure 2. Distribution of sample plots (Field survey, 2013)

This method was used to collect signs of wild animals and to assess the habitat characteristics. The advantage of this method is that it is good for open habitats and simple method compared to point-counts but it is difficult in dense vegetation and steep terrain. Given the time/resource constraints and sparse forest, this technique was applied. Forest path with the higher chance of sighting of wild animals was followed with the help of forest guard and committee secretary. The signs were collected and identified using the local knowledge of forest guard. Locations of direct sighting and sign were recorded in GPS (Annex-2)

RESULTS AND DISCUSSION

Direct benefit to the household income

Local people in southern part of Langtang National Park are primarily agro-pastoralist, of which animal husbandry is an essential component and an integral part of the social, economic and religious life (Karki and McVeigh, 2000). This was well supported by the fact that 97.2% respondents were farmers. Maize, wheat and millets are the primary agricultural crops. In recent years, however farmers have been attracted to potatoes and vegetables as these cash crops are more profitable (personal comm. with Bikram Lopchan). The study reveals that 95.9 % rely on forest for fire wood, fodder, leaf litters and timber. Fire wood is major source of energy though villagers use liquefied petroleum gas. 87% households derive income from non timber forest product (NTFP), i.e. wintergreen (*Gaultheria fragrantissima*). Villagers collect leaves/twigs of wintergreen and sell to the oil processing plant. The current rate is NPR 3 (US$ 0.03) per kg. Earlier raw materials were used only in animal bedding. Wage labor supports to over 50% households while the percentage with business and job are respectively 35.9% and 5.5%. Wage labor is seasonal in nature. Business includes grocery shop, tea shop, poultry and brewing local wine. 26.2% households have income from remittance but it constitutes the largest share in household income with 46%. Only 1.4 % has income from pension. The share of BZ program (forest resources and non timber forest products) to household income is only 4%. The mean annual income from BZ program was respectively NPR 5,768 (US$ 55) and NPR 259.6 (US$2.5). The average and total income from all available sources were NPR 146,422 (US$ 1,394) and NPR 21.2 million (US$ 202,209) respectively.

Indirect benefits of buffer zone program

The household survey reveals that indirect benefits of the buffer zone program by reducing the forest resources collection time is substantial. Previously, the mean collection time was 9.8, 9.6 and 9.6 hrs for fire wood, fodder and leaf litter respectively. This time includes both ways travelling, searching for the forest resources, cutting, bundling and returning to own house. Since forest was not managed by local institutions, over exploitation was common so users did not easily get the forest resources. Currently, the mean collection time has been reduced to 2.1, 1.9 and 2 hours. This was made possible by the regulation of forest blocks for allowing user to collect forest resources for specific period of time. The Syaubari subcommittee promoted private forestry program so villagers would have access on resources in homesteads. Increased access to liquefied petroleum gas also contributed tower the resource demand. It saved forest dependent household annually 51.9, 60.5 and 18.2 hours for fire wood, fodder and leaf litters respectively. In the community level, it saved 2,351 days or opportunity cost worth US$ 11,190 yearly. However, it is important to note that saved time has to be converted in to cash for economic benefits. Since Syaubari is one sub-committee among several under the Laharepauwa User Committee, the revenue sharing is little and primarily spent on community development programs (personal comm. with Bed Kumar Dhakal).

Non Timber Forest Product (NTFP) Management

Artemisia spp. (*titepati*), Zanthoxylum *spp*. (*timur*) and wintergreen (*Gaultheria fragrantissima*) are major NTFPs found in community forest. Wintergreen processing plant was set up as a livelihoods support program to benefit local community. Prior to that, due to the lack of financial resources and technical expertise, villagers were not able to extract the value of wintergreen. National park office took initiation for setting up plant. Buffer Zone Support Project outsourced NTFP expert for a resource inventory. Inventory estimated an annual stock of 157,500 kg leaves/twigs (Pyakurel, 2008). In 2009, the plant was set up by national park office, buffer zone support office, Syaubari community and private company with a total investment of NPR. 1,004,420 (US$ 9,565). The annual production capacity is 500 kg oil (Pyakurel, 2008). Private company invested part of installation cost and signed an agreement for buy-back of product. Community makes cash by supplying raw materials. Syaubari sub-committee opens forest in October-December and April-May. This is a seasonable wage opportunity. Children are also involved collecting raw material during holiday. No outsiders are allowed to collect a raw material. The price is NPR. 3 (US 0.02) per kg. The forest based enterprise benefited villagers and local institutions. The subcommittee plans to extract oil from (*titepati*) and Zanthoxylum (*timur)* in a near future.

Local perception on forest condition and current access on forest resources

User's perception on the forest condition was collected. The Likert scale captures the responses in five options i) highly improved ii) improved iii) do not know iv) not changed and v) degraded. The study reveals that 70.3% perceived that forest condition is highly improved. Nearly 28.3 % said it is "improved". 1.4% said "Do not know". No negative response was reported. The forest condition generally applies a volume, density of stock, crown coverage and numbers of seedling and saplings. Similarly, 60.7% highly agreed that access on firewood is much improved under the community management. 38.6% respondents agreed while 0.7% had no idea. No percent disagreed and strongly disagreed**.** Regarding fodder, 38% strongly agreed that current access is improved where as 45.5% were just agreed. 4.1% had no idea while nearly 12.4% disagreed.

The disagreement is largely due to regulation of forest blocks depending on resources availability. 47% strongly agreed while 42% just agreed that current access to leaf litter is improved. 7.6% did not know while 3.4% disagreed. Did not know response might be due to no collection. It is important to note that 8 % households did not go to forest. Higher percentage of strongly agree and agree was attributed by effective forest management and reduced demand due to the private forestry.

Forest Inventory

The Syaubari subcommittee has been managing community forest since 2007 according to Forest Operational Plan. Forest operational plan is the five year plan document that outlines the growing stock, harvesting schedule, tariff per cubic feet of forest resources and planned conservation and development activities. Among all, regular forest patrolling is the focus action. The total area of the forest is about 136.2 hectares and entire forest is divided in to four blocks (A, B, C and D) for management purpose (Fig.2). The forest inventory calculates a growing stock of 1,065 Cft/ha however it greatly varies across blocks. The total growing stock is the sum of volume of tree and pole which are two different categories of life form. Tree is a category having above 30 cm diameter breast height (dbh) over bark while pole is the category having dbh between 10 and 29.9 cm (CFIG, 2004). The block A has the highest mean stem volume of 1691.6 Cft followed by B (1,315.5 cft), D (911.8 cft) and C (341 cft) (Fig. 3a, 3b, 3c, 3d). Block C is the second largest block (40.61 ha). The reason for least mean steam volume is that Block C has large area consists of grazing land, bare rock/cliffs and abandoned crop field. Open grazing land, shrub land are found in block C and D in limited extent. The largest numbers of pole per hectare (300) was found in D (Annex-3). Pole species mainly comprises of pine (*Pinus roxburghii*), oak (*Quercus spp.)*, alder (*Alnus nepalensis*), rhododendron (*Rhododendron arboreum*), chilaune (*Schima wallichii*), jhingane (*Eurya acuminate*) and ficus (*dudhilo*). Nepal Government's Forest Resource Project, 1999 has estimated total number of stems per hectare for mid hilly area of Central Development Region is 448 (dhb over 10 cm). The total number of stem in Syaubari is 210, less than half of regional average. The ratio of number of pole to tree was 15:1. Pole number far exceeds tree which indicates that the forest is young. Good regeneration of alder, castanopsis, oak, and rhododendron were observed. The villagers were mobilized for fighting fire few times in the pine forest (with personal comm. with forest guard). The buffer zone support program supported an artificial tank for community based fire fighting strategy and irrigating multipurpose nursery.

Human Wildlife Conflict (HWC)

The forest harbors wild boar (*Sus scrofa)*, barking deer (*Muntiacus muntjak)*, Himalayan black bear (*Ursus thibetanus)*, ghoral (*Naemorhedus goral*) (suspected), common leopard (*Panthera pardus*), monkey (*Macaca mulata*), porcupines (*Hystrix indica*), yellow throated marten (*Martes flavigula*), Jackal (*Canis aureus*) and number of avian species (LNPMP, 2013). The community forest connects with park area in north part from Syaubari essential oil plant and makes community vulnerable from human wildlife conflict. Human Wildlife Conflict (HWC) is a phenomenon where wildlife negatively impacts on human wellbeing or when the actions of people are detrimental to the survival of wildlife (Madden, 2004). HWC is attributed to loss and fragmentation of habitats through human activities such as logging, animal husbandry, agricultural expansion and developmental projects (Fernando *et al.,* 2005). The participatory rural appraisal revealed that crop damage is the most wide spread. The most concentrated crop damage has been reported in at Syaubari, Amfe, Kamargadi and Chauki Bhanjyang. Wild boar and himalayan black bear were perceived the most problem animals (Table 2). Other animals that damage crops are barking deer, porcupine, rodent and monkey. The HWC incidence affects 80% households. The July-August and March-August were found to be the high risk months.

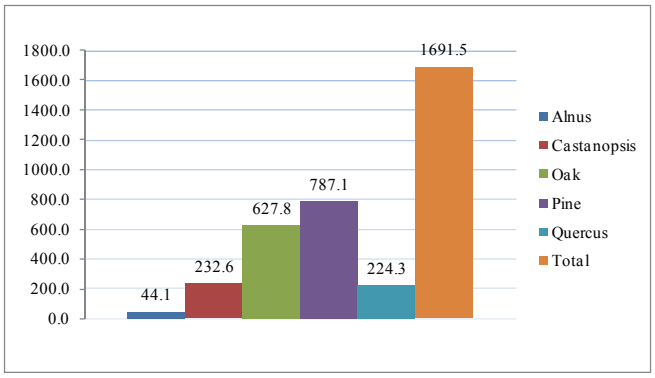

Figure 3a. Growing stock (cft/ha) in block A;

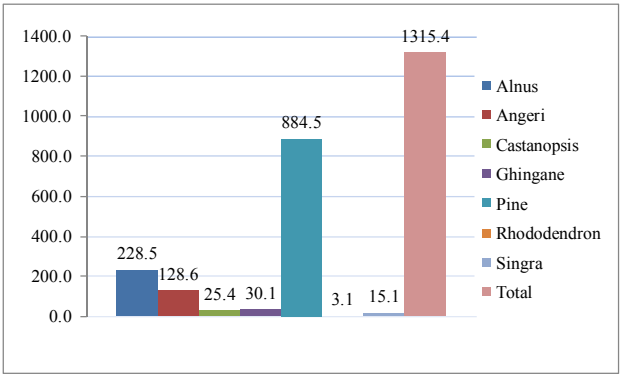

Figure 3b. in block B (Forest Inventory, 2013)

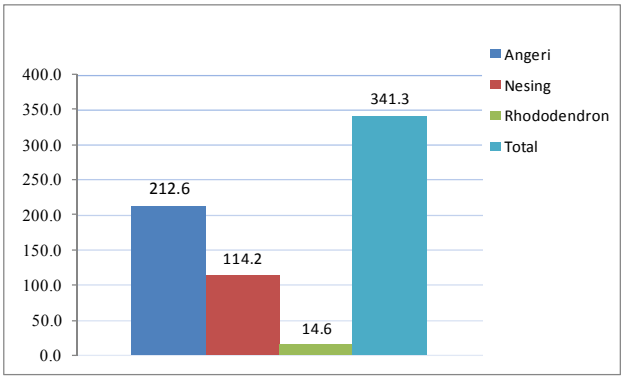

Figure 3c: Growing stock (Cft/ha) in forest block C;

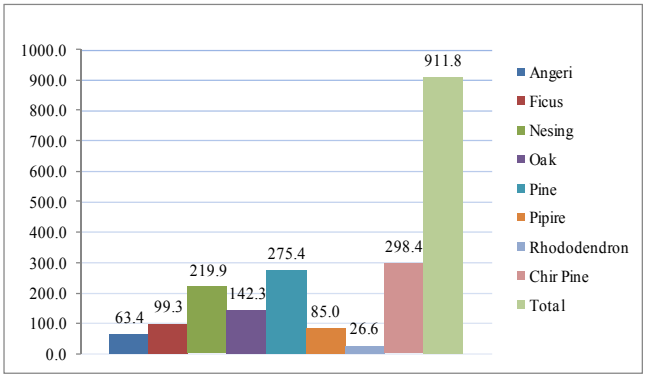

Figure 3d. in block D (Forest inventory, 2013)

Table 2. Status of crop damage, Syaubari community, Rasuwa (Field Survey, 2013)

Wild animals	overall ranking	wheat	maize	millet	potato	paddy	mustard	oil seed
Black bear	2	2	1	1	3	2	NA	NA
Barking deer	3	3	NA	1	NA	NA	2	4
Monkey	6	4	1	3	2	4	NA	4
Porcupine	4	NA	1	NA	1	NA	NA	NA
Wild boar	1	3	1	2	1	2	NA	NA
Rodents	5	3	2	1	3	1	NA	NA

Wild boars was a common sight in a group of nine to 11- often come close to houses and damages millets, potatoes and cabbage. Barking deer damages mostly millet, mustard. Farmers guard crop 3-4 months yearly. It is found that farmers abandoned crop field due to frequent crop raid. Minjur Tamang was one such farmer who left approximately 24.5 *ropani (*one ropani=508 m^2) land fallow for 11 years. It was estimated that approximately 750-800 *ropani* (38-40 ha) land are fallow mostly in Amfe and Kamargadi.

Similarly, common leopards and yellow throated marten were found to have killed livestock (Annex-4). Three goats were snatched by common leopard in *Bastala tole*. In one incident in *Gumbu Danda,* goat was snatched by leopard. Majority of cattle shed are of open type, some were weakly built by thin bamboo mats. Local community perceived that the number of black bear might have been increasing. In 2010, six bears (3 adults and 3 babies) were seen in *Guranse ban* which is located 1.5 hours distance. Bear not only damages crops but also come to settlement to eat wild berries and tender shoot during spring. One woman was killed by black bear while collecting firewood inside forest in 2009. In 2012, two common leopards were found dead at *Dhaibungkot,* neighboring village. These animals were suspected to be poisoned by famers. In summary, the human wildlife conflict was found to be on rise. Crop guarding was the widely used preventive strategy during high risk seasons (July-August and March-August). Scare crows, bamboo/wooden fence, stone wall were also used to protect crops and livestock. Scare crow was not effective for mammals but worked well for birds. Stone wall if constructed properly was proved to be effective against wild boar, black bear and deer. Similarly, mess wire was effective for wild boars. Porcupine digs hole and slips into to crop field even through fencing. It was reported that there were cases of poaching of deer, wild boars and pheasants from adjoining VDCs. Sub-committee members recovered traps and snares during patrolling. Despite increased crop damage, local people were largely unaware of government's relief policy.

Transect Survey

Opportunistic transect survey was applied. There was a direct sighting of two wild boars near essential oil processing plant. Coordinates of sign (rub signs, rooting signs) and pellets were recorded (Annex-2). Pellets were identified using the local knowledge of forest guard. It is reported that direct sighting or signs (indirect) of wild animals such as wild boar, black bear, common leopard were increased (Fig 4a; 4b). There was a suspected presence of *Ghoral* (*nemorhaedus goral)*. It is plausible that increased sighting of signs suggest the increased wildlife number. This might have been caused by regular forest patrolling, restriction of grazing inside forest and regulation for forest resources harvesting.

Syaubari subcommittee deploys a forest guard for forest patrolling on regular basis. Three perennial water holes were observed during transect survey. Water holes were reportedly shrunk due to the reduced recharge capacity of forest. This was presumably caused by changing climate which creates intense precipitation and higher run off. Though there were no baseline data on water holes, it may be well concluded that attributes of quality of habitat has been improved except water holes.

Conclusions

The study reveals that share of buffer zone program in household income is 4%.Though direct benefits of BZ program is small, indirect benefit by reducing the resource collection time is substantial. In the community level, it saved 2,351 days. The forest is young with the average growing stock of 1,065 per hectare. The Syaubari sub-committee was effective in regulating forest for resource use for users. Users largely perceive that current access to fire wood, fodder and leaf litters were improved under the community based management. However, it is concluded that human wildlife conflict has been on rise. Wild boar, himalayan black bear, barking deer and common leopards were the most problem animals. Maize and millets are damaged most. In addition, approximately 28-40 hectare land left fallow. The transect survey confirms the presence of these animals which were reportedly increased. Water holes were found to be shrinking. The national park office should educate villages on the government relief policy in addition to invest in additional preventive measures. Similarly, water holes should be created to support increased number of wild animals.

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ANNEXES

Annex 1. Name list of Buffer Zone Community Forest User's Group, Laharepauwa VDC

S.N	BZ Community Forest User Group	Address	HH
1	Betra Ganga Buffer zone User Group	Laharepauwa VDC – 1	40
2	Lahare Sibalaya Buffer zone User Group	Laharepauwa VDC – 2	28
3	Kalika Buffer zone User Group	Laharepauwa VDC – 3	25
4	Suryamukhi Buffer zone User Group	Laharepauwa VDC – 9	22
5	Sundaradevi Buffer zone User Group	Laharepauwa VDC – 7	45
6	Pairebesi Buffer zone User Group	Laharepauwa VDC – 5	20
7	Kaidaletar Buffer zone User Group	Laharepauwa VDC – 1	41
8	Barahi Buffer zone User Group	Laharepauwa VDC – 3	35
9	Banaba Danda Buffer zone User Group	Laharepauwa VDC – 3	32
10	Sita Pangkhi Buffer zone User Group	Laharepauwa VDC – 4	31
11	Kuwa Pani Buffer zone User Group	Laharepauwa VDC – 5	49
12	Karmi Danda Buffer zone User Group	Laharepauwa VDC – 6	22
13	Naba Bijayi Buffer zone User Group	Laharepauwa VDC – 6	36
14	Nilkantha Buffer zone User Group	Laharepauwa VDC – 1	30
15	Chaurkharka Buffer zone User Group	Laharepauwa VDC – 4	51
16	Manegau Bhimethan Buffer zone User Group	Laharepauwa VDC – 4	52
17	Amar Jyoti Buffer zone User Group	Laharepauwa VDC – 9	23
18	Pancha Kanya Buffer zone User Group	Laharepauwa VDC – 2	16
19	Sita Devi Buffer zone User Group	Laharepauwa VDC – 1	33
20	Chauki Tar Buffer zone User Group	Laharepauwa VDC – 3	15
21	Bimire Buffer zone User Group	Laharepauwa VDC – 6	27
22	Laharepauwa Buffer zone User Group	Laharepauwa VDC – 2	24
23	Bhimsensthan Buffer zone User Group	Laharepauwa VDC – 9	20
24	Shibsakti Buffer zone User Group	Laharepauwa VDC – 2	34
25	Bhalaya Danda Buffer zone User Group	Laharepauwa VDC – 5	36
26	Kapre Buffer zone User Group	Laharepauwa VDC – 8	40
27	Syaubari Buffer zone User Group	Laharepauwa VDC – 8	225
28	Lama Tol Buffer zone User Group	Laharepauwa VDC – 7	27
29	Tallo Dhunge Buffer zone User Group	Laharepauwa VDC – 7	35

Annex 2. Coordinates of signs (Field Survey, 2013)

S.N	Description of signs	Coordinates	Wild animals	Remarks
1	Direct sighting	N28^{0}00'56.7" E85^{0}12'54.4" Elevation:2,093 m	2 Wild boars	
2	Rub signs against tree trunk	N28^{0}00'56.7" E85^{0}12'54.4" Elevation:2,093 m	Wild boars	Near dried water hole
3	Pellet	N 28.01852^0 E 85.21069^0 Elevation: 1,877 m	Ghoral (*Naemorhedus goral*) -suspected	Bigger pellets than barking deer
4	Pellet	N 28.01868^0 E 85.21055^0 Elevation: 1,873	Barking deer	
5	Pellet	N 28.01663^0 E 85.21149^0 Elevation: 1,930 m	Barking deer	
6	Pellet	N 28.01^0 E 85.21^0 Elevation: 2080	Barking deer	
7	Pellet	N 28.01711^0 E 85.21830^0 Elevation: 2106	Barking deer	
8	Rooting signs	N 28.01678^0 E 85.21931^0 Elevation: 2169	Wild boars	
9	Pellet	N 28.01310^0 E 85.21199^0 Elevation: 1863 m	Barking deer	
10	Pellet	N 28.02019^0 E 85.22851^0 Elevation: 2488 m	Barking deer	
11	Rooting sign	N 28.02265^0 E 85.22663^0 Elevation: 2295 m	Wild boars	
12	Scats	N 28.01883^0 E 85.21729^0 Elevation: 2000 m	Common leopard	

Annex 3. Stem count and volume (cft) by species

Block	Area (ha)	Species	Per hectare		Total		Total volume (cubic feet)		
			Pole	Tree	Pole	Tree	Pole	Tree	Total
A	15.05	Alnus	14	0	215	0	44.1	0	44.1
		Castanopsis	43	0	645	0	232.6	0	232.6
		Oak	79	14	1183	215	371.5	256.2	627.8
		Pine	64	21	968	323	194.1	593.0	787.1
		Quercus	43	0	645	0	224.3	0	224.3
		Total	200	36	3010	538	842.3	849.2	1691.5
B	50.73	Alnus	36	0	1845	0	228.5	0	228.5
		Angeri	14	0	692	0	128.6	0	128.6
		Castanopsis	18	0	922	0	25.4	0	25.4
		Ghingane	23	0	1153	0	30.1	0	30.1
		Pine	95	5	4842	231	784.0	100.6	884.5
		Rhododendron	5	0	231	0	3.1	0	3.1
		Singra	14	0	692	0	15.1	0	15.1
		Total	205	5	10377	231	1214.9	100.6	1315.4
C	40.61	Angeri	28	6	1128	226	70.0	142.5	212.6
		Nesing	50	0	2031	0	114.2	0	114.2
		Rhododendron	6	0	226	0	14.6	0	14.6
		Total	83	6	3384	226	198.8	142.5	341.3
D	29.81	Angeri	50	0	1491	0	63.4	0	63.4
		Ficus	19	0	559	0	99.3	0	99.3
		Nesing	69	0	2049	0	219.9	0	219.9
		Oak	81	0	2422	0	142.3	0	142.3
		Pine	44	6	1304	186	168.9	106.5	275.4
		Pipire	13	0	373	0	85.0	0	85.0
		Rhododendron	25	0	745	0	26.6	0	26.6
		Chir Pine	0	6	0	186	0.0	298.4	298.4
		Total	300	6	8943	186	805.3	106.5	911.8
Total	136.2		788	52	25714	1180	3061.3	1198.8	4260.1

Annex 4. Participatory ranking of livestock depredation

Wild animals	Overall ranking	buffalo	cow/ox	goat	poultry
Common leopard	1	2	2	1	3
Black bear	3	NA	NA	1	NA
Yellow throated marten	2	NA	NA	NA	1
fox/jackal	4	NA	NA	NA	1

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