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Research Article

Hydroelectric projects and wildlife hunting in Northeast India: A conservation perspective

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Abstract

Arunachal Pradesh is one of the most bio-diverse and forested states in India. The state is home to 26 tribal groups and 110 sub-tribes. Traditionally, hunting has been a major part of the tribal communities in Arunachal Pradesh. Hunting is conducted majorly for food, recreation, games, trophies collection and for religious beliefs in the area. In this study, we aimed to collect baseline data on hunting rates and the reasons for hunting through primary surveys conducted in 4 major villages of West Siang district in Arunachal Pradesh. The sampling sites also coincided with the proposed locations for the construction of five future hydroelectric power projects in Arunachal Pradesh. We found a total of 34 trophies/hides in the study area with average hunting rates of 0.68 animal/household/annum and 0.97 animal/active hunter/annum. *Sus scrofa cristatus* (Wild Boar) was the most hunted species, followed by *Naemorhedus* sp. (Goral) and *Ursus thibetanus* (Black Bear). Among the most hunted species, 5 belonged to the 'Vulnerable' category of IUCN. Our findings also revealed that if the proposed Environment Management Plans (EMPs) of the 5 hydroelectric power projects were properly implemented, a total of 2000 jobs could be provided to the 2243 families in this study area. This has the potential to alleviate hunting pressures in the area. Besides, the EMPs of all the major hydroelectric power projects have provisions for community awareness and community education programmes. We propose that together with the state governments and non-governmental organizations, the hydroelectric project developers can play a very constructive role in decreasing hunting pressures and mitigating biodiversity losses in Northeast India.

Keywords: Arunachal Pradesh, Community Awareness, Community Education, Environment Management Plans

Introduction

Arunachal Pradesh represents the earth's northernmost evergreen tropical rainforests in India (Proctor et. al., 1998). The region is part of the Himalaya biodiversity global hot spot (Myers et al., 2000), one of the 200 globally important ecoregions (Olson & Dinerstein, 1998) and is the state with the highest per capita forest area in India (Chaudhuri et al., 2003). As per India State of Forest Report (2013) about 83% of the total geographic area of Arunachal Pradesh (83,743 sq km) is under forest cover, of which about 62% area is endowed with dense and moderately dense forests. The enormous forest covers facilitate conducive refuges to a large number of animal species, viz. mammals (105 species), birds (473 species), reptiles (78 species), amphibians (39 species), fishes (143 species), etc. (Ramakrishna & Alfred, 2006). Notably, Arunachal Pradesh is one of the most unexplored areas in India due to its undulating rugged topography, dense forest cover, poor infrastructure and inaccessible terrains, therefore, many more faunal species are anticipated to inhabit these areas (Pandit, 2017).

Besides rich biodiversity, the state is home to roughly 26 tribal groups and 110 sub-tribes with distinct cultural identities (Datta et al., 2008). The Census of India (2011) indicates that Arunachal Pradesh has the lowest human population density (17 persons per sq. km) in India. The tribes traditionally subsisted on slash-and-burn cultivation (*jhum*) and animal hunting and have been closely associated with forest and forest produce since time immemorial.

In essence, legislation in Arunachal Pradesh grants rights and privileges to tribes. Arunachal Pradesh's tribes are partially ruled by their own set of rituals and customs. Animal hunting in the state is widespread with poor apprehension of laws. Food is the main driving factor of hunting in Arunachal Pradesh, albeit hunting is intimately associated with traditional marriages and religious ceremonies (Aiyadurai, 2007; Aiyadurai et al., 2010; Selvan et al., 2013). The enforcement of government laws in the remote areas of Arunachal Pradesh is not strict but traditional laws have a large impact on the lifestyle of tribes (Velho & Laurance, 2013). The vast majority of the tribal population is meat-eaters and relies on the 'Mithun' (*Bos frontalis*), a semi-domesticated bovid for a daily supply of domestic meat. However, bushmeat is considered to be highly delicious, thus, wild hunting is conducted by active hunters not only for subsistence but also for commercial trade, cultural and customary satisfaction, medicinal purposes and thrill (Selvan et al., 2013).

Arunachal Pradesh appears to be an ideal ecoregion due to its abundant biodiversity and low human population. However, hunting poses a severe threat to the state's animals and biodiversity and necessitates urgent protection (Velho & Laurance, 2013; Mazumdar et al., 2014). In non-tribal areas of India, the enforcement of strict rules has played a significant role in conserving wildlife, however, it does not seem to hold true for tribal belts like Arunachal Pradesh. The effective conservation of wildlife can only be achieved through the active participation of tribes in this exercise Bhatt & Pandit, 2019). To develop effective mitigation strategies, it is essential to understand the traditions, cultures, and belief systems of the tribes that drive animal hunting. In addition, economic development and poverty alleviation need to be given a place in Arunachal Pradesh. Inadequate agricultural produce and cash income are generally attributed to the high dependence of tribes on forest produce (Sharma et al., 2015). The development of infrastructure has had a challenge in the state due to its rugged mountainous topography and inaccessible terrains. This may be one of the reasons tribes rely on forest resources for their livelihood. Owing to these geographical and environmental limitations, tribes had spent decades being socially, culturally, and economically cut off from modern-day India. We realize that developmental projects like hydroelectric projects can be exploited positively for the conservation of biodiversity in Arunachal Pradesh. In recent years, developmental activities like road construction, communication networks, development of hydroelectric projects, etc. have been paced in Arunachal Pradesh (Pandit, 2017). The developmental activities have eased human access to previously untouched areas. In this contribution, we suggest certain mitigation measures for wildlife protection, which evolved from our studies in different tribal parts of Arunachal Pradesh and interaction with tribal people in Arunachal Pradesh.

Material and methods

The study was carried out in the Tato, Pidi, Monigong and Mechuka administrative circles of West Siang district in Arunachal Pradesh (Fig. 1). To conduct the Environmental Impact Assessment of various hydroelectric projects, viz. Tato II, Tato I, Heo, Pauk and Hirong hydroelectric projects, comprehensive surveys of various villages/hamlets were conducted between 2007 and 2012. To assess the hunting intensity in this region, a total of 12 villages located in four circles were surveyed in 2011. To locate animal trophies and hides in households, we randomly selected 50 families for surveys in different villages/hamlets. Only the trophies

and hides of large animal species were taken into account as those of small animal species are not typically preserved by the people. We interacted with the heads of the families and/or active hunters concerning various information like types of hunting weapons used, how old was trophy/hide present, hunting season, hunting distance, causes of hunting, number of active hunters per family, availability of employment etc. We considered only one-year-old trophies and hides for this study.

Furthermore, we engaged with educated people who worked in government and business sectors in neighbouring towns and shared the objectives of the study. The objective of such interaction was to harness the traditional knowledge of people focused on alternate means of subsistence and biodiversity conservation. We assumed that all hydroelectric projects proposed in this area can provide high employment opportunities to local people if implemented, therefore, we used data from environmental management plans of Tato II, Tato I, Hirong, Heo and Pauk hydroelectric projects to know the scale of employment opportunities suggested in these reports. We used the Census of India Report (2011) to know the population status and total number of households in these circles.

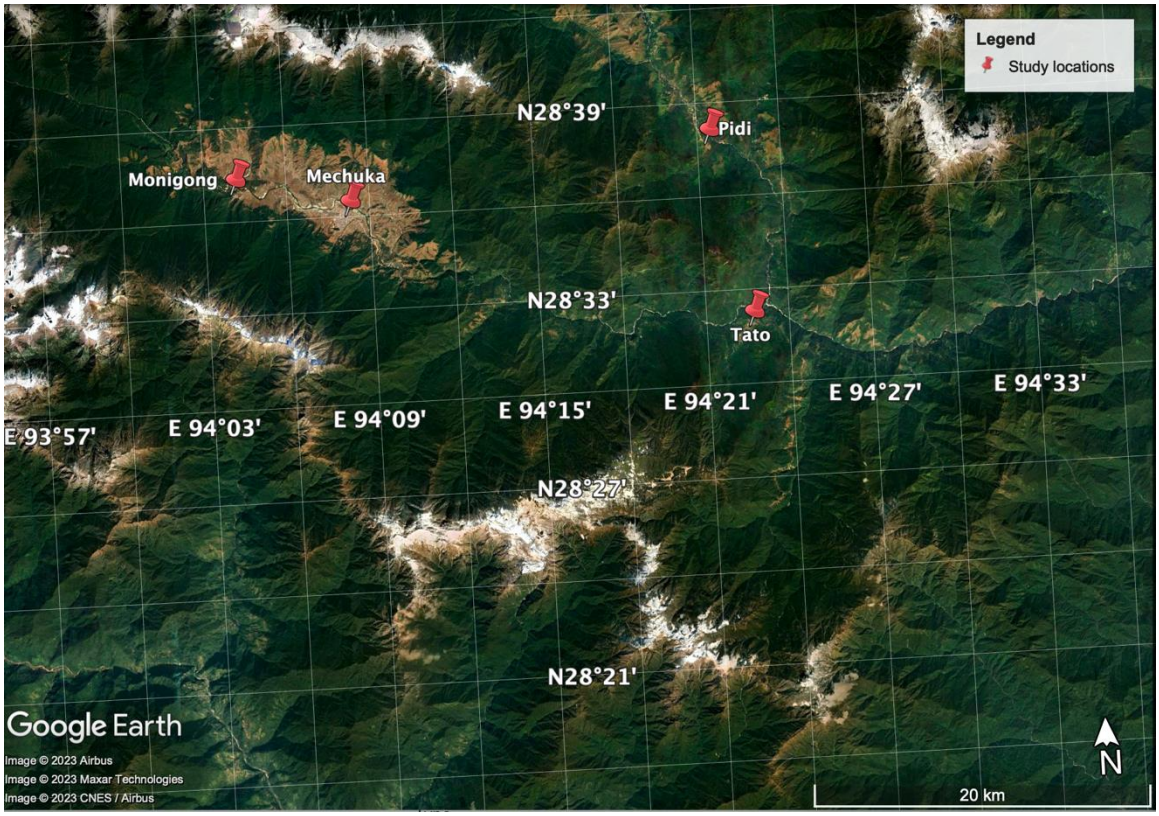

Figure 1. Map showing the study locations or survey sites in the current study.

Results

Hunting

Taking one-year-old trophies/hides into consideration, a total of 34 trophies/hides were observed from 29 households (out of 50) of Tato, Pidi, Monigong and Mechuka administrative circles. A total of 35 active hunters could be located in these surveyed households (Fig. 2). Thus, average hunting rates were computed to be 0.68 animal/ household/ annum and 0.97 animal/active hunter/annum. Trophies /hides of a total of 15 large mammals were observed from different households, of which 5 species have been categorized under the 'vulnerable' category of the IUCN red list (Table 1; Fig. 3). Our interactions with hunters and local people revealed that people were reluctant to preserve the trophies of small mammals like rats, mice, bats, squirrels, etc. *Sus scrofa cristatus* (Wild Boar) was the most hunted species, followed by *Naemorhedus* sp. (Goral) and *Ursus thibetanus* (Black Bear). Food, tradition, cultural beliefs and games were the main drivers of hunting among the tribes, however, want of bushmeat is preferred for the hunting. The hunting guns are used as the main hunting gear among the tribes.

Table 1. Estimation of the hunting rates based on the survey made in the different circles of West Siang district of Arunachal Pradesh

Sl. No.	Taxon	Number of trophies	Villages/Hamlets	Conservation status	Hunting rate
1	*Muntiacus muntjak*	3	Meying, Rigo	LC	0.085
2	*Naemorhedus* sp.	5	Meying, Gapu, Tato, Mechuka	-	0.142
3	*Budorcas taxicolor*	2	Puring, Meying	VU	0.057
4	*Ursus thibetanus*	4	Sogeng, Puring, Gapu	VU	0.114
5	*Sus scrofa cristatus*	7	Puring, Meying	LC	0.2
6	*Belomys pearsoni*	1	Puring	DD	0.028
7	*Herpestes edwardsii*	1	Meying	LC	0.028

8	*Martes flavigula*	1	Sogeng	LC	0.028
9	*Panthera pardus*	2	Gapu, Puring	VU	0.057
10	*Neofelis nebulosa*	1	Puring	VU	0.028
11	*Prionailurus bengalensis*	1	Lungte	LC	0.028
12	*Arctictis binturong*	1	Puring	VU	0.028
13	*Semnopithecus entellus*	1	Sogeng	LC	0.028
14	*Macaca mulatta*/*assamensis*	1	Lungte	LC/NT	0.028
15	Unidentified	3	Mechuka, Meying, Lungte	-	0.085
	Total	**34**			

* LC – Least Concern, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient

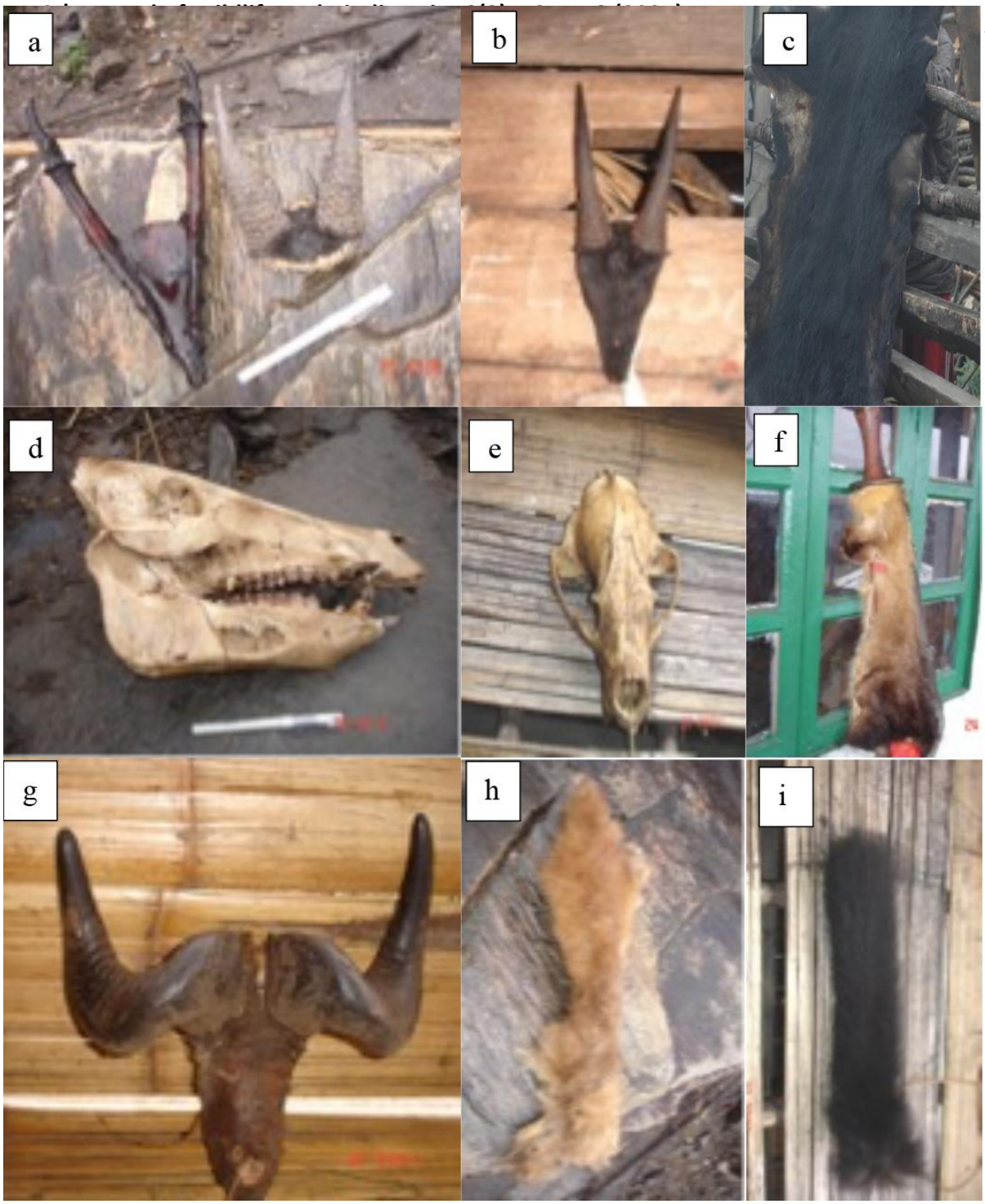

Figure 2. Photographs of various trophies observed during the field visits: (a) Horns of Barking deer (*Muntiacus muntjak*), (b) Horns of Chinese goral (*Naemorhedus caudatus*), (c) Skin of Black bear (*Ursus thibetanus*), (d) Jaws of Wild boar (*Sus scrofa cristatus*), (e) Skull of Black bear (*Ursus thibetanus*), (f) Skin of Himalayan martin (*Martes flavigula*) used as a case of a large knife, (g) Horns of Mishmi Takin (*Budorcas taxicolor*), (h) Skin of Common Mongoose (*Herpestes edwardsii*), (i) Tail of Binturong (*Arctictis binturong*). Photo credits: Jay Prakash Bhatt.

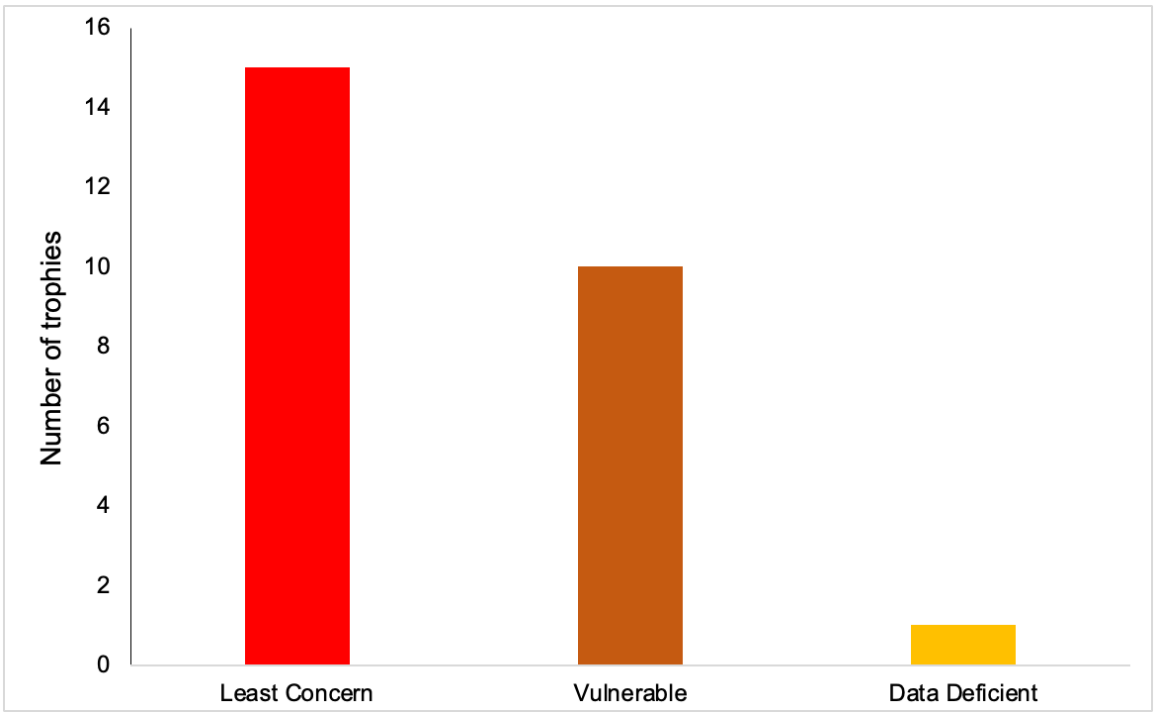

Figure 3. Bar graph depicting the number of trophies of species belonging to the different IUCN Red List categories.

Demography and socio-economic profile

The area is sparsely populated. The total population of four administrative circles accounts for 13,310 persons belonging to 2,243 families (Census of India, 2011). Nearly 95% of the total population is Scheduled Tribe. Slash-and-burn (*jhum*) agriculture employs most of the area's primary labour force. The locals' preferred kind of employment, salary-based work, is extremely underdeveloped in this area. From 2009 to 2012, we conducted door-to-door surveys with 337 families impacted by the Tato I, Heo, Pauk, and Hirong Hydroelectric projects. The results showed that only 59 out of 1045 respondents (5.6%) worked for the government.

Employment opportunities and hydroelectric projects

Environment Management Plan of Tato II, Hirong, Tato I, Heo, and Pauk hydroelectric projects have provision of a total of 3860 workers to be employed in these projects. According to Arunachal Pradesh's Rehabilitation and Resettlement Policy (2008), native tribes will receive 25% of skilled jobs and 75% of unskilled jobs. Thus, roughly more than 2000 jobs shall be provided to 2,243 families in this area. Notably, many other projects like Kangtakshiri, Pemashelpu, Rapum, Rego etc. are proposed in these administrative circles. All these projects are anticipated to fill the huge gap in unemployment in the local population.

Conservation measures

During our interaction with the local people, who were well aware of biodiversity conservation, we put various suggestive conservation measures for their perusal. They agreed to implement these measures. Such measures were also suggested in the Environmental Management Plan (EMP) of Tato I, Heo, Pauk, and Hirong hydroelectric projects. The conservation measures that government agencies and project developers can implement include:

(i) The State Forest Department may conduct an extensive education campaign about the value of biodiversity as one of the conservation measures to be carried out by government agencies and project developers. The chiefs of the villages (*Gramme Budhas*) and religious figures can be involved in this campaign.

(ii) Developers can readily find unskilled work for the active hunters in their projects. Active hunters' attitudes can shift when they take on full-time work.

(iii) With the right incentives, hunters who are actively hunting can be persuaded to give up their firearms. Under certain restrictions, project developers and district administration may implement this approach. Project developers can use fundraising to pay for this measure's implementation.

(iv) We noticed that the locals had a penchant for prizes. They made hats, decorations, coats, knife cages, and other items out of various body parts, such as hornbill beaks, large cat jaws and skulls, cat hides, bears, deer, and monkeys, among others (Fig. 2). Their affection can be sated by providing them with complimentary trophy reproductions. Project managers and non-governmental organisations can carry out this action.

Discussion

Notably, this survey excluded small mammals like Chiroptera, rodents, and bird species because their body parts were not preserved in the surveyed households. The hunting tradition in Arunachal Pradesh finds its roots in various facets such as sustenance, cultural heritage, and spiritual significance, alongside its role in commerce. (Velho & Laurance, 2013; Bhatt & Pandit, 2019). Different body parts of animals are used as trophies, which they perform in different socio-cultural and religious performances. The hunting rate (0.97 individual/active hunter/annum) calculated for the present study was based on the information provided by the respondents. In contrast, high hunting rates have been reported among the Nyishi and Apatani

(2.5 animals/hunter/annum), Monpa (1.9 animals/hunter/annum), Nyishi, Mishmi, Meyor (2.0 animals/hunter/season) tribes of Arunachal Pradesh by Chutia (2010) and Aiyadurai et al. (2010). If these values of hunting rates are extrapolated for the active hunters of nearly 1,95,000 rural households of Arunachal Pradesh (assuming that mainly people of rural areas are involved in hunting), the results would be anxious for conservationists and ecologists. Here, our purpose is not to predict hunting intensity and magnitude in Arunachal Pradesh but to take hunting as a matter of great concern and major threat to biodiversity into account and suggest a few sound conservation measures.

The situation is very similar to other parts of Arunachal Pradesh, even though our study only covered a small area in the West Siang district that was dominated by the Adi, Ramo, and Memba tribes/sub-tribes (see Chutia, 2010; Aiyadurai et al., 2010; Aiyadurai, 2012; Chutia & Solanki, 2013; Selvan et al., 2013, Mazumdar et al., 2014). Different drivers of hunting were earlier reported by different authors mentioned above; we believe that socio-economic factors and poor infrastructure facilities in Arunachal Pradesh are also directly linked to bushmeat hunting and environmental degradation (Pandit, 2017; Akinsorotan et al., 2020). We concur with the perspectives of Robinson & Bennett (2000) as well as Milner-Gulland and Bennett (2003) regarding the importance of aligning efforts for poverty alleviation and biodiversity conservation. We seek developmental projects especially hydroelectric projects as a main factor, which can provide huge employment opportunities to locals of this sparsely populated area. It would be worth mentioning that cascade developments in all major rivers of Arunachal Pradesh itself are under debate and controversies (Pandit et al., 2023). Also, developmental projects are generally regarded as one of the drivers, leading to the destruction of biodiversity (Kideghesho et al., 2006; Pandit & Grumbine, 2012; Grumbine & Pandit, 2013; Bhatt et al., 2017). Certainly, the adverse impacts of hydroelectric projects with mitigation measures have been outlined in EIA reports of Tato I, Tato II, Heo, Pauk, Hirong and other projects in Arunachal Pradesh, but these impact statements do not anticipate intentional hunting due to project workers. Pandit and Grumbine (2012) estimated a total forest loss of 30,568 hectares due to all 80 hydroelectric projects in Arunachal Pradesh if commissioned. Here, we do not support the construction of hydroelectric projects to conserve wildlife but suggest exploiting the projects positively, if unavoidable.

The main purpose of hydroelectric projects is to harness the power potential of Arunachal Pradesh and is part of the policy of the Government of India. We understand that the probability of implementation of all 80 projects in Arunachal Pradesh is low because many carrying capacity and cumulative impact assessment studies are under progress in Arunachal Pradesh; their recommendations may scrap out many projects. If an approach of sustainable development is followed, a few projects even can fill the gap in unemployment in Arunachal Pradesh. Such employment opportunities would play a vital role not only in alleviating poverty but also in diverting the focus of active hunters.

A comprehensive awareness programme may be a useful tool to conserve wildlife in Arunachal Pradesh (Kouassi et al., 2019). Our surveys in many tribal areas like Tawang, Kameng, Siang, Lohit valleys etc. in Arunachal Pradesh reveal that active hunters and rural population are not well aware of the consequences of hunting, enforcement of laws like Wildlife (Protection) Act (1972), Forest Conservation Act (1980), Environment Protection Act (1986) and significance of biodiversity. Compared to other Indian states, Arunachal Pradesh has lax rule enforcement because the state's infrastructure, including roads, communication systems, and access to dense forests, is lacking and government agencies are obligated to safeguard the rights and privileges of indigenous tribes. Moreover, numerous superstitions have an impact on tribes. Among tribes, owning a gun is a sign of bravery, and having trophies, particularly skulls, on display in homes is a way to both fend off evil spirits and honour hunting customs. People think that the ghosts guard them against illness and other natural disasters (Chowdhury, 1996). Coordination between governmental organizations, project developers, civil society organizations, and leaders of religion and culture is necessary to crush such myths. Hunters' views can be influenced by the teachings of religious and cultural authorities (Velho & Laurance, 2013).

A few other measures are required to check the hunting; these measures include the surrender of hunting guns and the distribution of artificial trophies among the tribes. The usage of guns has indeed replaced more conventional weapons like bows, spears, traps, and nets (Milner-Gulland & Bennett, 2003). Hunters utilize hunting weapons a lot, especially when they attempt to kill land mammals. Encouragement of active hunters to give up their hunting weapons is one of the strategies listed in the Tato I Hydroelectric project's Environment Management Plan. This plan can be implemented by proposing an attractive one-time incentive to each active hunter. Proper coordination between state administration and project developers is needed to implement

this plan. Also, there should be some definite terms and conditions for this process. For example, once a hunting gun is surrendered by a hunter, the gun and license will not be issued by the administration in future.

The distribution of replicas of trophies and hides among the tribes has also been suggested in the Environmental Management Plans of Tato I and Tato II Hydroelectric projects located in the study areas. It was observed that tribes are very much attracted to the articles (headgear, coat, garland, case of knife etc.) made up of animal remains. If replicas are prepared and made available in the markets, people might turn to them and these replicas can fulfill the desire of people. The Nyishi tribal area of Arunachal Pradesh has effectively implemented similar procedures with the assistance of the Wildlife Trust of India. The Nyishi tribes received the manufactured artificial hornbill beaks and were urged to use them instead of the real beaks, which the tribes use as headgear. The conservation of the hornbill population in this area has benefited greatly from this exercise (see Kumar & Riba, 2015).

Conclusions

We conclude that animal hunting in Arunachal Pradesh is directly related to the socio-political privileges, easy access to wildlife, weak enforcement of laws, game, custom and tradition and poverty (e.g. Bennett et al., 2007; Brashares et al., 2011). We strongly believe that contrary to slash and burn practices, wildlife hunting in Arunachal Pradesh cannot be linked to people's livelihood. Most of the rural population rears *Bos frontalis* (a semi-domesticated bovid), these animals are slaughtered in the villages and towns for food during ceremonial occasions. These animals suffice the protein supplements of local people. We understand that strict enforcement of rules cannot be conservatory measures in Arunachal Pradesh. However, any policy that supports the sustainable harvesting of wildlife in Arunachal Pradesh is strongly denied (see Bennett et al., 2007). Strengthening community participation in resource management, poverty alleviation programmes, infrastructure development and involvement of NGOs and private sectors (developers) can play an effective role in wildlife conservation in Arunachal Pradesh.

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