



People and protected areas: livelihood and ecological impact in Barnadi wildlife sanctuary, India.

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Abstract

The Barnadi Wildlife Sanctuary in Assam is a protected forest area and a lot of such human interactions with the wildlife sanctuary have been observed from which the locals have been benefited greatly. This, in turn, has led to a strong emotional bond among them and the wildlife sanctuary as a whole. Apart from this, concern regarding the human-animal conflicts particularly in case of elephants, which due to its high population in the area sometimes cause huge loss to life and property of the local people. In this chapter, the interactions, the effect on the overall economic aspect of the local areas near the sanctuary, the growth of eco-tourism sector, the role of government and the forest department in maintaining a harmonious interaction between the locals and the sanctuary has been discussed.

Keywords: Human interference, protected forest, wildlife sanctuary, eco-tourism

1. Introduction

Humans have evolved and reached this modern age as a result of their relation and interaction with nature. Approximately 12% of the world's surface is currently covered by more than 100,000 protected areas (Chape, Harrison, Spalding, & Lysenko, 2005). From the beginning, human civilization has been dependent on the natural resources for survival as well as various other needs. This direct interaction can be observed aptly by studying the involvement of local people residing near protected forest areas. The interactions are primarily for livelihood, forest resources, etc by the humans and on the other hand, wild animals from the protected areas also visit the nearby human settlements in search of food and water. The demand for provisioning services provided by ecosystems like food, water and timber is ever-increasing at a rate faster than the population growth (Overpeck et al., 2005).

The forests, particularly the parks with different status of protection are centre for public attention and they are an integral part of a region's culture. In many cases, the entire area is known due to the existence of a protected area. The local people living around the

peripheral areas of these protected areas are therefore very much involved with the forests in almost every aspect. Human interference in these areas is known to be harmful to the forest in terms of destruction of its resources, disturbances to the fauna and flora and degradation of the balanced forest ecosystem. The various activities carried out due to ever-increasing human settlements in the nearby areas have led to frequent human-animal conflicts.

On the other hand, due to the establishment of nature-based tourism facilities in and around the protected areas has helped the local people a lot in terms of generating season income in particular. The traditional skills and art gets recognition due to the inflow of tourist and thus traditional markets get developed in the process (Mamahooana, Malabeja, & Cheyo, 2013). This also results in the overall development of the area in terms of better connectivity and more recognition. But the downside of nature-based tourism concept is that it adds to pollution in the naturally rich areas in terms of increasing the rate of waste generation and disturbance of natural setup in general. In contrary to the benefits for the human population, the forest ecosystems along with the wildlife

present in the protected areas are harmed due to the increasing anthropogenic activities. Deforestation, fragmentation, exploitation are a general phenomenon which is normally taking place in and around the protected areas. These are detrimental to a balanced forest ecosystem in any instance.

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Apart from this, concern regarding the human-animal conflicts particularly in case of elephants, which due to its high population in the area sometimes cause huge loss to life and property of the local people. In this chapter, the interactions, the effect on the overall economic aspect of the local areas near the sanctuary, the growth of eco-tourism sector, the role of government and the forest department in maintaining a harmonious interaction between the locals and the sanctuary has been discussed.

2. Study area

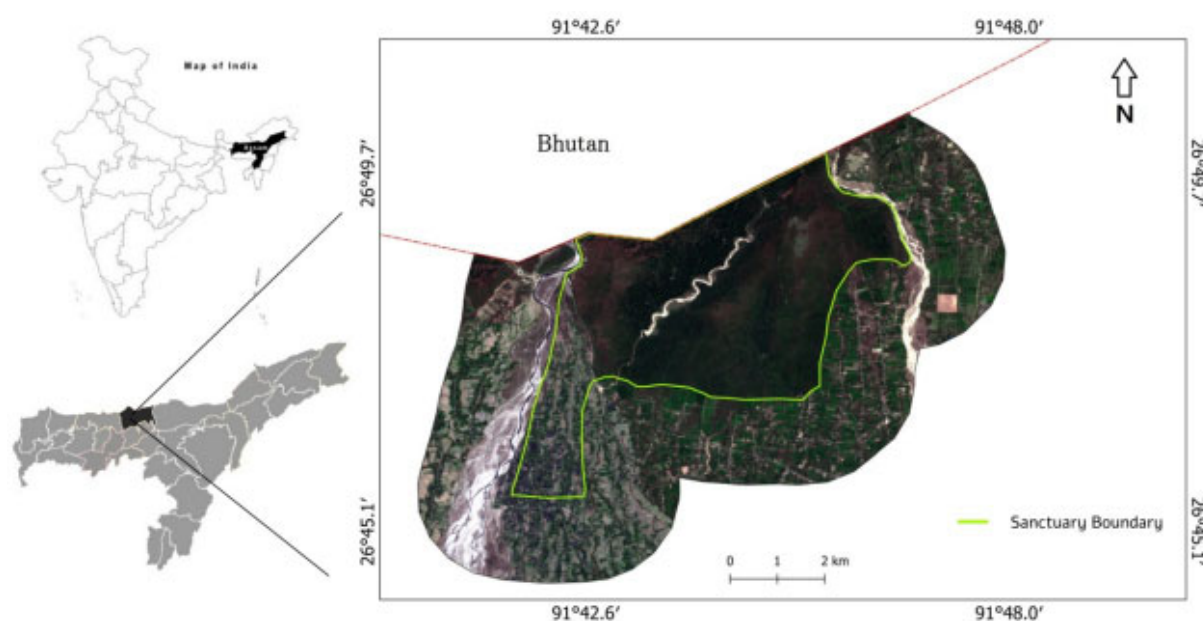


Fig. 1 Map of the study area

The Barnadi Wildlife Sanctuary, which has an area of 26.22 sq. km., is situated in the northwestern part of the Udalguri District under BTAD in the foothills of Eastern Himalaya. The sanctuary falls under Manas Tiger Reserve and Manas Biosphere Reserve. The sanctuary shares its northern border with Jomotshangkha Wildlife Sanctuary of Bhutan. It is also designated as an Important Bird Area (IBA) by Birdlife international. It derives its name from the Barnadi River which enters from Bhutan and flows along the western boundary of the sanctuary. The sanctuary is an important habitat to some of the very critical species like Pygmy Hog (*Porcula salvania*), Hispid Hare (*Caprolagus*

hispidus) as well as other prominent animals like Asiatic elephant (*Elephas maximus*), Gaur (*Bos gaurus*), common leopard (*Panthera pardus fusca*) etc. Most of the human settlement and agricultural land is found in the southern boundary. Tea plantations share a significant part of the forest edge in the southern boundary. The eastern boundary is the Nalanadi River which remains dry most of the year except for few months in the monsoon. The vegetation features dry and moist deciduous forests on the inner parts. The buffer area outside the sanctuary features mostly scrubland.

3. Method of study

Primary data was collected by interview method

and by questionnaire survey (Turner, Cardinal, & Burton, 2015). Household survey and interview was conducted during several visits between 2018 and 2019. The questionnaire was filled up by the interviewer after

explaining the questions. The household survey was used to obtain data regarding the use of forest resources from the fringes of the sanctuary and whether any economic benefits are obtained from it

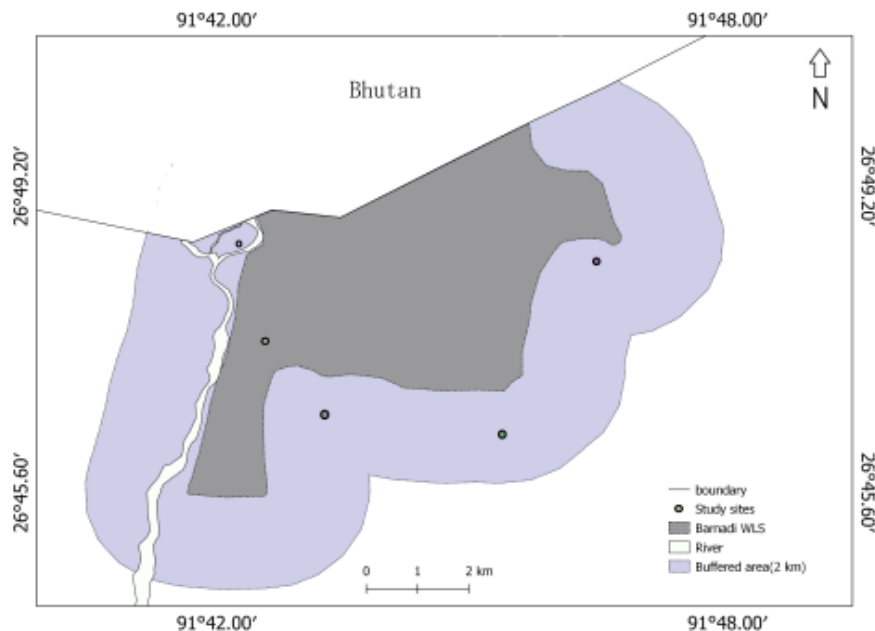


Fig. 2 Location of study sites within a 2 km buffer area from the sanctuary

other than for household use. Direct observation and interview of the people involved in seasonal income generation arising from nature-based tourism were also carried out.

4. Study sites selection

A buffer zone was created that delineates the area around the sanctuary where the maximum interaction between people and the forest takes place. This interaction zone is obtained by considering criteria such as continuous forest, migration corridor of certain species, watershed area and most importantly the interaction between human and environment (DeFries, Karanth, & Pareeth, 2010). A 2 km buffer was created around the sanctuary and the study sites were selected from villages and settlements falling within the buffer area.

We selected five study sites which were widely distributed along the edge of the sanctuary. Each site consists of settlements comprising of around 12 to 35 households (except the Bogamati picnic spot) in the villages namely Deosunga, Khairajar, Rajagarh and Tenkibasti. The sites feature different micro-

landscapes ranging from tea plantation area to sparse settlements around scrublands. We selected the site's location based on some pre-determined settlements and villages by random selection.

The Bogamati picnic spot was visited for obtaining data regarding Nature-based tourism. The spot is on the western boundary of the sanctuary where the Barnadi River enters from Bhutan side. It attracts a large number of visitors especially in the winter season and creates an opportunity for seasonal income among the locals. Secondary data was collected to obtain the demographic profile as well as the economic importance of the resources utilized by the people.

5. Livelihood generation from forest

The local communities have a very strong connection with a protected area as the forest has been an integral part of their culture since many generations, along with this, the relation of a forest with its original local inhabitants exists since time immemorial. These people have been dependent on the forest for a very long period for many generations for forest products like firewood, fruits etc. We interviewed 40 households

among the four survey sites in the area. Each household comprises of 4-8 family members and those belonging to below poverty line (BPL) were mostly involved in collection of non-timber forest products (NTFPs). Firewood contributed the most collected of the NTFPs at 31%. Fruit (26%) is the second most collected item and Indian plum commonly known as 'Bogori' were mostly collected from the western part of the sanctuary. The collection of fruit is a seasonal affair and only a few reported to sell it in the nearby marketplace. Fishing is quite common on the Barnadi River and Deosunga watershed area along the western and southeastern part of the sanctuary and fish (17%) makes a significant part of collected NTFPs. It is a source of side income and is sold in evening market places of the region. People also collect edible plants such as leafy herbs for consumption; its collection is mostly confined to forest edges. Only a few of the respondents told about the honey collection and it makes up the least collected NTFPs. Honey collection is mostly an opportunistic event and they seldom enter the forest with the main motive of collecting.

6. The ecological impact of human-forest interactions

The human-forest interactions can be taken into account in the classic examples of people living in the peripheral areas of the protected areas. Human societies have displaced and exploited forests for millennia (Ledig, 1992). In the human-forest interactions, the people from the nearby areas of protected areas get limited access to forest products in the form of firewood, grazing land for animals in the edges, etc., depending upon the status of protection of the area and the range of human activities allowed according to the forest laws of the country. But human settlements near the protected areas face a detrimental effect when it comes to conflict with the wild animals which visit the edge areas along with the nearby human habitations for various reasons.

In the case study of the ecological impact in the Barnadi Wildlife Sanctuary, it has been found that because of the human activities in the edges of the Wildlife Sanctuary, deforestation is occurring in an increased rate in some part. This is a general yet serious concern because in recent times human settlement has increased drastically in the periphery of the protected area and it has disturbed the ecological balance to a great extent. It is also reported that in certain rare cases the forest area suffered exploitation due to cutting of timber wood of high value illegally, although

this has now been brought under control by the constant efforts and strict actions taken by the officials of the forest department. Forest fragmentation is another phenomenon which occurs due to human-forest interactions. This has also been observed in the Barnadi Wildlife Sanctuary as the increased human settlements in the nearby areas of the protected area has led to disruption in the continuity of the forest patches even some areas which directly do not come under the protected areas do contribute towards the continuity of the forest area. The destruction of these outside yet important areas with a good number of trees cause the effects of fragmentation to be experienced and this is very much harmful to the overall healthy ecosystem of the forest as a whole. The demographic alteration has also resulted in the loss of older forest systems particularly in the edge areas and this has a deep effect on the overall health of the forest.

From the study, it can be concluded that human interaction with forests comes at a cost. The excess utilization often leads to exploitation of resources. Most interactions taking place in Barnadi have some negative impact on the environment to an extent. The problem of illegal logging is quite prevalent in the area although the extent of this activity is confined to certain parts where the patrolling duty by forest guards is not conducted regularly. Though hunting of mammalian species is extremely rare, hunting of birds along the edges of the forest occasionally takes place. The south-western part of the park has quite a large area of encroached human settlements and agricultural land. Its nearby region features scrubland habitat as most of the actual habitat was changed due to anthropogenic activity.

A major problem faced by the locals in the area is the human-elephant conflict. The conflict has a large impact on the people as it has resulted in the loss of human lives, property and crops. Crop-raiding by elephants during the harvesting season cause huge economic loss. The loss of continuous forest cover which provides corridor among the nearby forest reserves often led the elephants to move into once forest but converted agricultural lands. Among other animals, Gaur and wild pig often stray out of the sanctuary into nearby places but mostly to agricultural lands. These two animals have not been engaged in any serious conflicts with the nearby villagers as compared to elephants.

Grazing inside the forest is also a common issue and herds of cattle often enter deep inside the sanctuary from the southern boundary. Grazing harms

the composition and growth of forest floor vegetation (Ratovonamana, Rajeriarison, Roger, Kiefer, & Ganzhorn, 2013). Alteration of plant species in the forest floor can change the interaction and habitat of many species. Trampling and reduction of forest undergrowth due to cattle grazing cause decline in

certain bird species (Piana & Marsden, 2014).

7. Seasonal income from nature-based tourism

Nature-based tourism is a growing sector of the economy and in the state of Assam; it offers a lot of opportunities. The Barnadi Wildlife Sanctuary, along with its peripheral areas is blessed with lush green

Income source	Description	Benefits
Temporary Stalls	-Present during high- tourist season i.e. from December to March-Stalls deal with Fast Food, beverages/ packaged water, firewood, handicrafts, fruits, meat, pan and tobacco-based products	- Seasonal source of income- Entrepreneurship skill development
Recreation activity	- Includes zip-lining, river rafting- Requires skilled person	- Attracts tourist seeking adventure as these activities are limited to few places
Eco-tourism society	- Created by local youths for the maintenance and development of the picnic spot	- Cleaning of the spot, construction and maintenance of public facilities.

Table.1 various means of income generation activities, services and its benefit

sceneries all around. Among the centres' of attraction for tourists, the most popular one is the Bogamati picnic spot situated on the banks of the Barnadi River which has been able to achieve recognition as one of the emerging and popular picnic spots in the entire state of Assam. Nature-based tourism is one of the fastest-growing sectors of the economy (Fredman & Tyrväinen, 2010). The livelihood and socio-economic factor of local people nearby natural landscapes are largely affected by nature-based tourism. On this regard, the local inhabitants of the peripheral areas of the Barnadi Wildlife Sanctuary have rightly been benefitted by the growth of the Bogamati picnic spot. As the place is getting more and more attention and recognition, the increasing number of inflow of tourists from in and out of the state has made way for a seasonal income of the local people.

The spot is usually visited by a lot of tourists in the whole of the winter season. During this time, several stalls sell various items ranging from traditional delicacies to handloom and textile items. It was observed that 67% of the sellers were from the nearby villages within road distance of 10 km. Those from far places (>10km) were mainly involved in providing services that require a bit of higher investment as well as skill such as recreational

activities (zip-lining and rafting).

According to the locals, around seventy to eighty families have now engaged themselves all around the year for the preparation of food items, handicrafts which they sell on the tourism season. Apart from this, around thirty to forty families are dependent seasonally on the nature-based tourism for their income. Youths below the age of 30 run one-third of the total business establishments in the picnic spot and many of them have started small shops in their village due to their experiences. It shows that a new source of employment has been created for the local people of the area. Nature-based tourism has also resulted in the construction of concrete roads leading to the picnic spot. A section of the unemployed local youth has now found a very good way for their livelihood due to the constant development and promotion of tourism by the government and local administration. An Eco-tourism society was also formed to develop the region into a tourism hotspot. Eco-tourism concept is being considered by the local societies as it contributes to sustainable development and has very less impact on the local ecosystem. In addition to this, nature-based tourism will get a boost in the area as a huge lodging

facility in the form of a forest department guest house is scheduled to be constructed very soon.

8. Ecological impact of nature-based tourism

Human activities always leave a footprint on the environment which in some cases may be detrimental in the long term. Nature-based tourism can have

Activities affecting vegetation and faunal species
Destruction or alteration of vegetation and certain animal species habitat
Forest clearing for providing tourism-related facilities and infrastructure
Pollution
Soil pollution due to non-biodegradable waste left by tourist
Water pollution resulting from various activities such as dumping waste
Sound pollution as a result of vehicular and tourist activities
Visual impact
Construction of Tourist facilities in a natural landscape
Plastic wastes littered all over the place from tourist activities

Table.2 Nature-based tourism impact on environmental elements

some adverse effects on wildlife including flora and fauna in mainly two ways – by damaging the habitat and by causing changes to the behaviour of the animals. Wildlife species that utilize the edge habitats of forests are most vulnerable to human activities. The vegetation cover nearby picnic spots are often cleared and transformed to open spaces for accommodating a large influx of tourist during the peak season. Garbage disposal by picnickers pollutes the water bodies thereby affecting its quality for household uses. Another problem that is seen in the area is plastic waste, as the dedicated spot for waste disposal becomes insufficient due to the excessive influx of tourist. Garbage attracts feral dogs and a certain bird species like house crow and common myna. Feral dogs pose a threat to local wildlife, they are known to prey small mammals and destroy bird nests. Presence of dog influences the habitat and home range of small mammals (Lenth, Knight, & Brennan, 2008). Leftover food in plastic bags is often eaten by domestic cattle and even by wild animals like elephants. The remnants of plastic bits in the dung can be observed frequently. Plastic ingestion is known to harm the digestive system which may result in death due to starvation, stomach blockage, perforation and also cause hormonal imbalances (Katlam, Prasad,

Aggarwal, & Kumar, 2018).

The rise in tourism has also led to the development of infrastructure facilities such as restrooms, sheds parking space. Such developmental activity often modifies the local hydrographic network, soil composition, biodiversity and microclimate (Cianga, 2017). Buildings and man-made structures often alter the aesthetic beauty and sometimes make the natural landscape less visually appealing. Increased tourism in the region during the winter season has also affected the local watershed channels. The region being at higher elevation has a scarcity of groundwater and a lot of households are dependent directly on the river for daily use.

9. Conclusion

The human-forest interactions, in general, can be simply accounted as a result of human activities and an increasing number of settlements near the forest areas which are primarily causing a lot of negative effects on the forest ecosystem. Deforestation, fragmentation, translocation of many species of plants and animals due to human interference, habitat destruction, demographic alteration, etc have only resulted in environmental deterioration. The prime ecosystem services that the

people from nearby areas of the Sanctuary are receiving can be summarized as NTFP like the firewood, fruits, occasional honey extraction etc. But on the contrary, human activities have reduced the forest covers significantly which were just outside the protected area over time. This has adversely affected the overall ecology of the edge species of wildlife to a great extent.

The emergence of nature-based tourism in and around the Bogamati picnic spot has led to the overall development of the area in the form of better connectivity through concrete roads, generation of tourism-based seasonal employment. Exposure of

indigenous hand-made items has given the traditional skills of the area a new identity. The nature-based tourism has helped the overall economy of the locality, but it also needs to be controlled by adequate planning and implementation within strict limits so that its adverse effects like pollution of the picnic spot can be kept under control.

The contribution of forests in terms of ecosystem services and livelihood is immense and the delicate balance between nature and human beings is very much essential to maintain. For sustainable use of resources soon the local community needs to learn, adapt and transform the livelihood methods by a holistic approach.

References

- Chape, S., Harrison, J., Spalding, M., & Lysenko, I. 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1454), 443–455. <https://doi.org/10.1098/rstb.2004.1592>
- Cianga, N. 2017. the Impact of Tourism Activities. a Point of View. *Risks and Catastrophes Journal*, 20(1/2017), 25–40. https://doi.org/10.24193/rcj2017_02
- DeFries, R., Karanth, K. K., & Pareeth, S. 2010. Interactions between protected areas and their surroundings in human-dominated tropical landscapes. *Biological Conservation*, 143(12), 2870–2880. <https://doi.org/10.1016/j.biocon.2010.02.010>
- Fredman, P., & Tyrväinen, L. 2010. Frontiers in nature-based tourism. *Scandinavian Journal of Hospitality and Tourism*, 10(3), 177–189. <https://doi.org/10.1080/15022250.2010.502365>
- Katlam, G., Prasad, S., Aggarwal, M., & Kumar, R. 2018. Trash on the menu: Patterns of animal visitation and foraging behaviour at garbage dumps. *Current Science*, 115(12), 2322–2326. <https://doi.org/10.18520/cs/v115/i12/2322-2326>
- Ledig, F. T. 1992. Human Impacts on Genetic Diversity in Forest Ecosystems. *Oikos*, 63(1), 87. <https://doi.org/10.2307/3545518>
- Lenth, B., Knight, R., & Brennan, M. 2008. The Effects of Dogs on Wildlife Communities. *Natural Areas Journal*, 28, 218–227. [https://doi.org/10.3375/0885-8608\(2008\)28\[218:TEODOW\]2.0.CO;2](https://doi.org/10.3375/0885-8608(2008)28[218:TEODOW]2.0.CO;2)
- Mamahooana, L., Malabeja, M., & Cheyo, R. 2013. *Impact of Tourism on Wildlife Conservation*. <https://doi.org/10.1016/j.foreco.2009.11.007>
- Overpeck, J., Garfin, G., Jardine, A., Busch, D. E., Cayan, D., Dettinger, M., ... Udall, B. 2005. Ecosystems and Human Well-Being. In *Millennium Ecosystem Assessment (Program)*. https://doi.org/10.5822/978-1-61091-484-0_1
- Piana, R. P., & Marsden, S. J. (2014). Impacts of cattle grazing on forest structure and raptor distribution within a neotropical protected area. *Biodiversity and Conservation*, 23(3), 559–572. <https://doi.org/10.1007/s10531-013-0616-z>
- Ratovonamana, R. Y., Rajeriarison, C., Roger, E., Kiefer, I., & Ganzhorn, J. U. (2013). Impact of livestock grazing on forest structure, plant species composition and biomass in Southwestern Madagascar. *Scripta Botanica Belgica*, 50(January), 82–92.
- Turner, S., Cardinal, L., & Burton, R. 2015. Research Design for Mixed Methods: A Triangulation-based Framework and Roadmap. *Organizational Research Methods*, 20. <https://doi.org/10.1177/1094428115610808>

