

Working Paper 518

**Biodiversity and Ecosystem
Governance in Indian
Protected Areas: A Case
Study from Manas in Assam**

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BIODIVERSITY AND ECOSYSTEM GOVERNANCE IN INDIAN PROTECTED AREAS: A CASE STUDY FROM MANAS IN ASSAM

Michael Islary¹ and Sunil Nautiyal²

Abstract

Biodiversity provides multiple services for the benefit of human welfare. However, conservation of biodiversity in a landscape characterised by human dominance has always been challenging, particularly in developing countries where poverty, high population density and urban expansionism is ubiquitous. In this context, this paper makes an attempt to understand the biodiversity and ecosystem governance of an Indian Protected Area in Manas landscape in Assam. Manas landscape, a part of Eastern Himalayan range, is an important conservation area which is also inhabited by deprived tribal as well as non-tribal communities. Empirical fieldwork was carried out wherein a well-defined questionnaire survey was administered to understand forest resource users, patterns of resource use and forest management systems. Besides that, in-depth interviews were also conducted with forest and NGO officials to corroborate the household data and secondary sources of information were also referred to. The demand for food and other needs have added pressure to the existing forest habitats which is only exacerbated by the changing climate. Meanwhile, strict conservation measures implemented in the protected area have temporarily halted species loss and habitat degradation, but have alienated marginal people from their sources of livelihood. On the other hand, failure to implement forest rules by weak institutions in a non-protected area have deteriorated the forest habitat. This has posed difficulties for forest users, especially for the women as they have to go farther deep in the forest, risking their lives. Tourism offers an alternative livelihood opportunity to the locals to come out of poverty. However, it needs to be extended to other forest areas within the landscape and the revenue collected should be shared for the development of local communities. To successfully conserve this bio-rich landscape dominated by humans, there should be a fine balance between conservation and resource for the sustainability of socio-ecological systems.

Keywords: Biodiversity conservation, ecosystem governance, protected area, development.

Introduction

Biodiversity conservation aims to protect and manage biodiversity for maintaining threshold level which could support its benefit for sustainable use for generations (Nautiyal *et al*, 2020). Traditional societies across the globe conserved forests or natural sites in their localities based on years of knowledge accumulated through a complex interplay of ecological, social and cultural factors (Gadgil, 1993). For instance, in India, 'sacred groves' are forest patches which are dedicated to ancestral spirits or deities (Bhagwat and Rutte, 2006). Such forests possess a wealth of biological diversity and a treasure trove of endangered plant species including scarce herbs and medicinal plants (Tiwari *et al*, 1998). The sacredness, religious beliefs and taboos play a significant role in promoting sustainable utilisation and

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conservation of flora and fauna (Khan *et al*, 2008). In India, sacred groves are found in Garhwal Himalayas, Western Ghats, Central India and Northeast India, among others.

A growing population and increasing per capita consumption have led to the exploitation of the earth's biological diversity which is only intensified by the change in climate, acidification of oceans and other anthropogenic pressures, remark Rands *et al* (2010). The changes in the ecosystem have changed the benefits humans have derived from the ecosystem (MEA, 2005). To minimise the biodiversity loss due to human impacts, several conventions have been held at a global level to discuss and adopt measures against this loss. One such convention that defined the importance of biological diversity has been the United Nations Convention on Biological Diversity (CBD) held at Rio de Janeiro in 1992. This convention was a watershed moment because later it was incorporated into the UN Millennium Development Goals (MDG) in 2005 (Rands *et al*, 2010). Governments at national and regional levels have adopted this mechanism to control biodiversity loss. For instance, in India, the Biodiversity Act based on this convention was enacted in 2002.

Globally, biodiversity conservation has been carried out by establishing national parks under strict supervision and prohibition of human use of resources. Ever since the first national park was set up at Yellowstone in USA in 1872, the world followed suit. Until 2016, according to International Union for Conservation of Nature (IUCN) 14.7% of the Earth's land (excluding Antarctica) and 10% of its territorial waters were under protection. According to the National Wildlife Database maintained by the Wildlife Institute of India, there are 870 protected areas in India, covering 5.02 per cent of total geographical area of the country. The protected areas have been recognised as a blueprint both by CBD and Agenda for Sustainable Development to meet target the targets like Aichi Biodiversity Target 11, SDG goals 14 and 15 (Protected Planet Report, 2016).

However, the protected area (PA) approach of biodiversity conservation is not free from criticism, because of its exclusivity and top-down approach. Particularly, it ran into problems in developing countries, where a large number of people depend upon forest resources for their livelihoods and other cultural services. There's a bulk of literature that points out the negative impact of a protected area (Pimbert & Pretty, 1997; Maikhuri *et al*, 2001; West *et al*, 2006; Lasgorceix & Kothari, 2009; Nautiyal & Nindamanuri, 2012;). In the light of these criticisms, different approaches to conservation have evolved over the years to incorporate the interests of various stakeholders. For instance, ecological restoration within and outside PA, landscape-scale approach, trans-boundary conservation, payment for an ecosystem services approach and eco-tourism among others. IUCN itself has categorised the PA into six categories³ based on conservation priorities and to allow the use of resources with varied management regimes from very strict to open access.

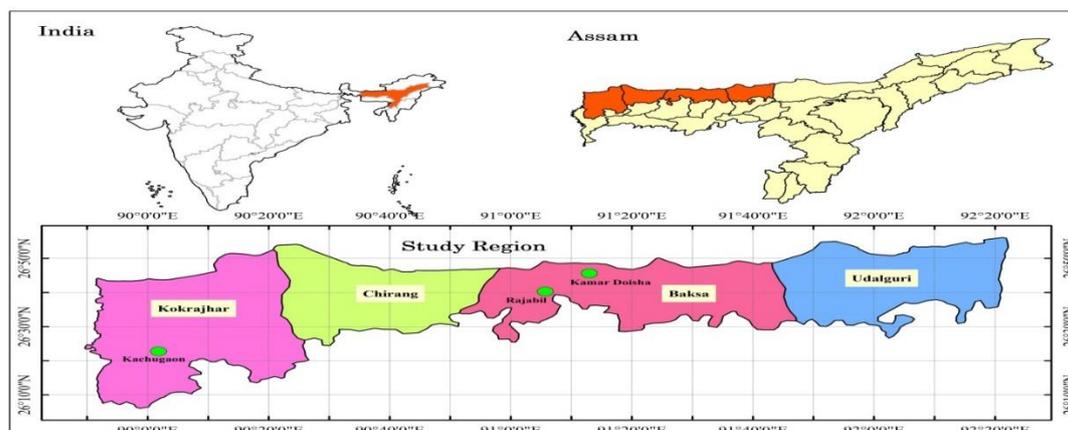
The present study is an attempt to understand biodiversity conservation and its challenges in a 'human dominated' landscape. A human dominated landscape can be defined as "areas that face immense challenges posed by poverty, high densities of people, rapidly changing landscapes, complicated political and institutional regimes, and recent economic growth and urbanisation. These

³ PA Categories – Category Ia: Strict Nature Reserve; Category Ib: Wilderness area; Category II: National Park; Category III: Natural Monument or Feature; Category IV: Habitat Species Management Area; Category V: Protected Landscape/Seascape; Category VI: Protected area with sustainable use of natural resources.

regions have historically supported and continue to support high biodiversity, with significant conservation value” (Karanth & DeFries, 2010). Manas landscape situated in the state of Assam and a part of Eastern Himalayas, an important area for biodiversity conservation is considered for the study. It is also an area, inhabited by tribal as well as non-tribal communities with varied land use patterns. The landscape which comprises different forest areas is conserved with varying regimes of management as per IUCN classification of PAs. In this particular study, Manas National Park (MNP), a protected area (PA) is a strict conservation area and Kachugaon Reserve Forest (KRF), a non-protected area, where use of resources is allowed, are being selected to understand the biodiversity conservation in the landscape. MNP forms a core area of the Manas Tiger Reserve (MTR) as well as that of Manas Biosphere Reserve (MBR). On the other hand, KRF acts as a buffer zone to both MTR as well as MBR on the west. The researcher used empirical field data as well as census data to provide demographic characteristics and governance regimes of the landscape. Besides that, to understand the ecological changes, the researcher also used remote sensing (RS) integrated with Geographic Information System (GIS) to analyse land-use and land-cover change in Manas National Park. At the end, this paper suggests that biodiversity conservation in a human dominated landscape like Manas is to maintain a fine balance between resource conservation and use for the sustainability of the landscape.

Study Area

Figure 1: Map of Manas Landscape



Source: CEENR, ISEC

The Manas Landscape in the state of Assam has been selected for detailed study. It comprises an area of 2,840 sq. km. and is situated in between 89°51'45"E to 92°07'00"E longitude and 26°56'43"N to 26°56'43"N latitude. The landscape situated in the northern bank of the river Brahmaputra shares a contiguous border with the Royal Manas National Park, Bhutan in the north. The Manas landscape is spread across four districts of Kokrajhar, Chirang, Baksa and Udalguri in the state of Assam. These four districts are collectively known as Bodoland Territorial Area District (BTAD) and the council that administers it is called the Bodoland Territorial Council (BTC), which was established under the sixth schedule of the Indian Constitution. The landscape can be divided into six forest divisions

namely Kachugaon Forest Division, Haltugaon Forest Division, Manas National Park, Orang Wildlife Division, Chirang Forest Division and Dhansiri Forest Division.

Data and Methods

In order, to understand biodiversity conservation, socio-ecology and governance structure in Manas Landscape, a pilot study was conducted at MNP as well as KRF. Based on the pilot study, a well-defined questionnaire schedule was prepared for household survey. The household questionnaire survey was carried out to understand the characteristics of forest resource users, pattern of resource use, condition of forest and type of forest conservation. To corroborate the household data, in-depth interviews were taken with officials from the Forest department as well as NGO officials. Focus was laid to various benefits as well as costs derived from the forest, organisations or institutions involved in monitoring, rule enforcement and management of forest, forest products harvested and used at household levels. The data was collected from two different forest management systems within the landscape. Household data of 2 villages in Kachugaon Forest Reserve (N=100) and 2 villages located in Manas National Park (N=100) were collected. From villages located within a close radius of 0.5 km to 1 km from the forest in consultation with forest officials and conservation, volunteers were selected.

Besides primary sources of data, various secondary data sources like Census India reports, journals and local newspapers were studied to obtain background information. To know the ecological changes in Manas National Park, the authors used Sarma *et al's* analysis on land-use and land-cover change (LULCC) in Manas National Park, using the following satellite data images.

Table 1: Satellite data used in present study

Data type	Path/row	Date of acquisition
Landsat TM	147/42	8 February 1977
IRS IB LISS III	110/53	16 February 1998
IRS ID LISS III	110/53	12 February 2006

Source: Sarma *et al*, 2008

Results

Socio-Economic Profile and Resource Use

A significant segment of the population of the area belongs to the Scheduled Tribes (ST) category. The ST proportion increases from Kokrajhar (31.41 per cent) to Udalguri (32.15 per cent) to Baksa (34.84 per cent) to Chirang (37.06 per cent). The landscape is predominantly rural based: Chirang (92.67 per cent), Kokrajhar (93.8 per cent), Udalguri (95.47 per cent) and Baksa (98.71). Population densities in Kokrajhar (269 people/sq. km) and Chirang (251 people/sq. km) are lower than in the rest of India (382 people/sq. km). However, population densities in Baksa (387 people/sq. km) and Udalguri (413 people/sq. km) are higher than in the rest of India (382 people/sq. km) (Census of India, 2011b).

Table 2: Socio-economic Profile of the Landscape

Districts	Total Population	Rural Population (%)	Density of population (per sq km.)	Literacy Rate (%)	SC (%)	ST (%)	Working Population (%)	Non-Working Population (%)	Total Villages
Kokrajhar	8, 87, 142	93.8	269	65.22	3.33	31.41	38.45%	61.55%	1,068
Chirang	4, 82, 162	92.67	251	63.55	7.29	37.06	40.21	59.79	508
Baksa	9, 50, 075	98.71	387	69.25	7.69	34.84	42.81	57.19	690
Udalguri	8, 31, 688	95.47	413	65.14	4.55	32.15	41.49	58.51	800

Source: Census of India, 2011

The literacy rate of the area is lower than that of the literacy rate of India (74.0 per cent): Kokrajhar (65.22 per cent), Chirang (63.55 per cent), Baksa (69.25 per cent) and Udalguri (65.14 per cent). In each of these districts, the recorded working population is less than 50 per cent (Kokrajhar 38.45 per cent, Chirang 40.21 per cent, Baksa 42.81 per cent and Udalguri 41.49 per cent). These workers are categorised as cultivators, agricultural labourers, workers in household industry and service holders and businessmen/businesswomen, who are termed as other workers.

The census data also reveals a large section of the population in these districts is non-working (61.55 per cent in Kokrajhar, 59.79 per cent in Chirang, 57.19 per cent in Baksa and 58.51 per cent in Udalguri). It is this section of society that is more dependent upon forest resources for their livelihoods and sustenance. There is seasonal migration to other cities and towns from this strata of society for gainful employment, though there is no concrete data to support about their movement and nature of employment. The people living in Manas landscape use forests for various needs like fuelwood, house construction, water for agriculture and production of local implements among others. In addition, they also use the forest for grazing their livestock.

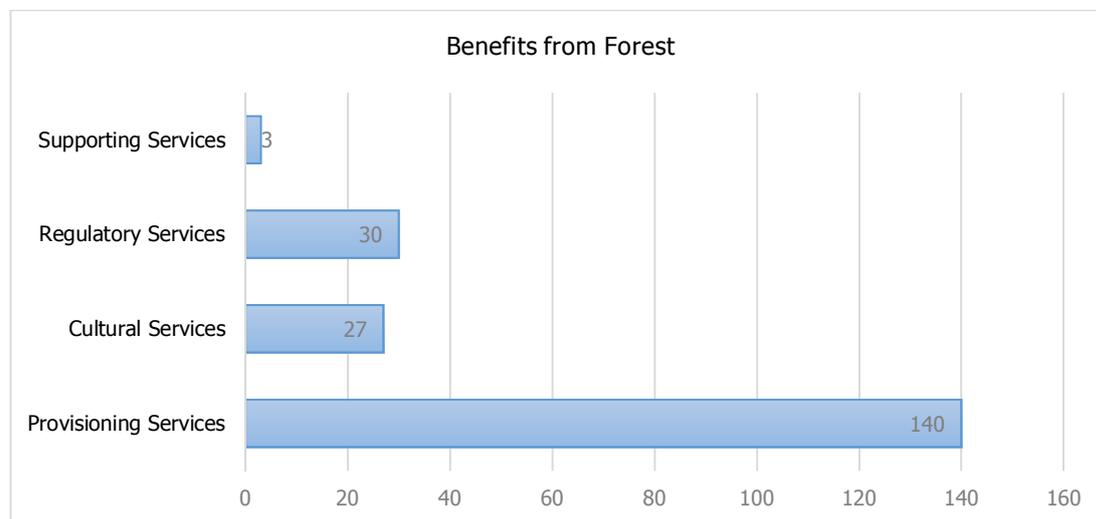
To understand the benefits derived from the forest, we carried out a questionnaire survey with 200 people across the landscape. The questionnaire survey was carried out in 4 villages (50 HHs each from 2 villages in protected area and 50 HHs each from 2 villages in non-protected area) to know the benefits of the forest. The benefits derived from the forest are classified into four categories in accordance with millennium ecosystem assessment (MEA, 2005) report on ecosystem services. The MEA groups ecosystem services into four – a. Provisioning (food, fresh water, wood and fiber, fuel etc.), b. Supporting (nutrient cycling, soil formation, primary production etc.), c. Regulating (climate regulation, flood regulation, disease regulation, water purification etc.), and d. Cultural (aesthetic, spiritual, educational, recreational etc.).

The following chart (Figure 2) reveals the benefits derived⁴ from the forests by the people in Manas landscape. A majority of respondents (70 per cent or 140) claimed that the benefits derived are in the form of provisioning services (such as firewood, reeds, fish, grazing, vegetable, wild fruits, medicinal herbs, timber etc.). Most of the respondents claimed that benefits derived from the forest are used domestically and are not monetary in nature. Almost similar proportions of people have responded that forests perform important regulatory services (clean air, rainfall etc.) (15 per cent or 30) and that

⁴ Response on benefits derived from the forest is grouped by the researcher into four Services or Benefits derived from the Ecosystem as per MEA classification.

forest provide important cultural services (aesthetic beauty, recreation, spiritual and tourism) (13.5 per cent or 27). While, 1.5 per cent (3) of the respondents said the forests also produce supporting services such as soil nutrients which are important for agricultural activities.

Figure 2: People’s Response to Questions on the Benefits derived from the Forest



Source: Field Survey

A similar study on resource extraction and utilisation (Sarkar *et al*, 2008) in Manas landscape also informs that dependence upon forest for firewood (98.84 per cent) was the highest by the people of the area, followed by timber (85.36 per cent), bamboo (63.78 per cent), grasses (52.22 per cent), cane (1.93 per cent) and medicinal plants (0.77%).

Biodiversity Conservation Status of Manas Landscape at a Glance

Prior to being declared as a wildlife sanctuary in 1928, Manas used to be a reserved forest. Even to this day, the locals, particularly the older generation, call it by that name. Manas was declared as one of the 9 tiger reserves under the Project Tiger by the government of India in 1973 with an approximate total boundary of 2837 sq km. In 1985, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) declared Manas as a world heritage site. Manas has been declared as a world heritage site for fulfilling three criteria under the natural criteria sub-section. The three criteria are – Criterion VII: to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; Criterion IX: to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; Criterion X: to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

A Biosphere Reserve was created here in 1989. The area of the biosphere reserve is the same as that of the tiger reserve. The ultimate coronation of Manas as an important site of biodiversity conservation came about in 1990, when it was declared as a national park. However, the euphoria was

short-lived as the UNESCO declared Manas as a world heritage site in danger in 1992. The UNESCO (1996) cited a number of reasons like civil unrest, illegal activities like poaching and felling of trees, land conversion and destruction of park infrastructure, among others for pinning on Manas such a tag. Putting Manas the 'endangered' tag has had serious implications over biodiversity conservation in the form of stoppage of fund flow, which is crucial for the management of the park. It also questioned the authorities on their lack of efficiency and capability to manage the park. In 2011, long after the cessation of civil unrest, the undying efforts of the local administration along with various stakeholders to revive Manas resulted in the removal of the world heritage site in danger tag by UNESCO. To strengthen conservation measures, 350 sq km of the eastern side of Manas reserve forest was added to the existing 500 sq km of Manas National Park in 2016. The area is now called as the first addition to the Manas National Park.

Management Approaches

An overview of how biodiversity and ecosystem governance has been carried out in a protected and non-protected forest is given in this paper. Different stakeholders or institutions are involved in biodiversity and ecosystem governance in the landscape which can be largely categorised into four: namely the Bodoland Territorial Council⁵ (BTC), State Initiated Institutions, Community Institutions and the Non-Governmental Organisations (NGOs).

Table 3A: A Glimpse of Biodiversity Conservation in Manas Landscape

Particulars	Manas National Park (MNP)	Kachugaon Reserve Forest (KRF)
Genesis of Conservation	Until the first two decades of 20th century, the park was known as Manas reserve forest under the North Kamrup Forest Division. Gradually, given, its ecological and biological significance, upgraded to Wildlife Sanctuary, Tiger Reserve, World Heritage Site, Biosphere Reserve and National Park.	Kachugaon reserve forest was under Goalpara Forest Division from 1857 to 1968. When Kachugaon, itself, was made a forest division with the headquarter at Kokrajhar and subsequently changed to Gossaigaon. Kachugaon reserve forest acts as a buffer area to both Manas Tiger Reserve and Manas Biosphere Reserve. Furthermore, it is a part of the elephant reserve and an important bird area.
Public participation in conservation	Strictly managed by the state forest department as mandated by the Wildlife Protection Act of 1972. However, there are many community based institutions that participate in managing the park.	Public participation in forest management was encouraged through various programmes like Joint Forest Management (JFM) and Golden Langur (<i>Trachypithecus ghee</i>) conservation programme but eventually died out with the end of the aforementioned conservation programmes.
Socio-cultural relations with the forest	Older generations used to perform spiritual rites prior to the forest being converted to a park. People close to the park used to depend upon the forest for food, grazing and resources for building houses.	Besides being renowned for its biological wealth, Kachugaon reserve forest is also known for rich Bodo tribal folktales. Also, it's a home to the endangered golden langur (<i>Trachypithecus ghee</i>), which is considered as a deity by the tribals.
Law and administrative setup	It is governed by the principles of Wildlife Act -1972 under Manas National Park Wildlife Division.	Monitored and managed by the Forest Department under Kachugaon Forest Division.
Economic benefit	Significant economic benefits are derived from tourist activities like park entry, recreation, boat riding, elephant safari, parking and accommodation among others.	The forest department receives revenue by selling timber varieties like Sal (<i>Shorea Robusta</i>), Sissoo (<i>Dalbergia sissoo</i>) etc. The villagers depend upon the forest for firewood, fish, vegetables, medicinal plants and grazing among others.

⁵ The administrative body of the area.

It is clear from the table that both areas of biodiversity conservation were forest reserves at the beginning. However, the uses of both were different. Before being declared as a wildlife sanctuary, Manas reserve was used as a hunting ground both by the colonial rulers as well as the royal family of the Cooch Behar and King of Gauripur. Saikia (2011) narrates that a British forester named A.J. Milroy had employed a large force of Assam Rifles to prevent poaching in the newly established Manas Game Sanctuary. On the other hand, Kachugaon reserve forest under Goalpara Forest Division was kept primarily as a future forest village to continue the labour supply to the forest department (Saikia, 2011).

MNP is governed by the IUCN guidelines for protected areas, which states that "A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values." Therefore, the management of MNP is heavily top-down in approach with limited public participation for management and use of resources. Although, Kachugaon reserve forest is under the legal ownership of the state government, the law allows people to participate in forest management and use of forest resources. According to IUCN categorisation of protected area, Kachugaon forest comes under Category-V which aims "to protect and sustain important landscapes/seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices".

Several studies (Allendorf *et al*, 2013; Horwich *et al*, 2013; Horwich *et al*, 2010) have described the successful conservation of the golden langur by engaging local communities in Kachugaon reserve forest and other reserve forests within the Manas biosphere reserve. Allendorf *et al* (2013) emphasises the motivations that pulled the community members towards the langur conservation programme. The study shows that while social and economic benefits are important, it is conservation in itself that drew them closer to the langur conservation programme. The tribals inhabiting in the vicinity of MNP as well as KRF have a close socio-cultural affinity with their forests. The people of MNP have to forgo their socio-cultural rites as the strict enforcement of park rules came along. However, there are still economically marginalised sections of the society, who depend on the park for their basic necessities. On the other hand, at KRF, people still continue to practice their age old traditions by performing spiritual rites in the forest.

The Assam forest department holds the responsibility of administrating the MNP under the Wildlife Protection Act of 1972. Since the park lies within the administrative area of the BTC, MNP is also jointly managed by the council. On the other hand, KRF is managed by the forest department of BTC. Ever since tourism was restarted in the early 2000s (UNESCO, 2006), it remained the backbone of revenue generation of MNP. To harness the economic potential of tourism, the local administration developed tourism infrastructure like roads, facilities for accommodation, parking lots, and public toilets among others. On the other hand, with the lack of tourism at KRF, revenue comes from the sale of timbers like Sal (*Shorea robusta*), Sissoo (*Dalbergia sissoo*) etc.

MNP being a PA, has functioned as a strict area for biodiversity conservation without any or little scope for resource use and people's participation in conservation. This has left the poor people close to the park deprived of the use of resources for their subsistence. They are being forced to change their livelihood patterns from resource gatherer to working as casual labourers. Therefore, there

is an uneasy relationship between the forest department and the local people. On the other hand, as resource use rights are bestowed upon the people of KRF, people are deriving various benefits from the forest. However, as there is a limited protection of forest, unsustainable resource use practices of the people are putting pressure on the forest.

Ecological Changes

To understand the ecological changes of the MNP, land-use and land-cover change analysis done by Sarma *et al* (2008) was referred. As MNP was established in 1990, the researcher wanted to compare the status of land-use and land-cover change prior to its establishment until 2006. A lot has changed socio-politically as well in the landscape in recent years. Sarma *et al* (2008) classifies MNP into following land-use and land-cover typologies.

Table 4: Land-use and Land-cover change in MNP (km²)

Land-use class	Area (km ²)			Net change (Km ²)	
	1977	1998	2006	1977-1998	1998-2006
Woodland	253.1	242.18	233.21	-10.92	-8.97
Savannah grasslands	120.86	132.84	161.97	11.98	29.13
Alluvial grasslands	94.38	83.21	44.37	-11.17	-38.84
Waterbody	8.88	6.67	4.99	-2.21	-1.68
River sand	23.74	20.52	35.97	-3.22	15.45
Encroached area	0	15.54	20.47	15.54	4.93

Woodland: It comprises tree species that are mostly semi-evergreen forest and moist mixed deciduous forests. Some semi-evergreen forest found in MNP are *Pterospermum acerifolium*, *Dysoxylum binectariferum* etc. While moist mixed deciduous forest are *Bombax ceiba*, *Terminalia bellerica* etc. The area under this category is 233.21 km², a net change of -8.97 km² from 1998.

Savannah Grassland: Savannah grasslands are tall in nature such as *Narenga porphyrocoma*, *Imperata cylindrica* etc. At present, the total area of the park under this land category is 29.13 km².

Alluvial grassland: This land-cover type is spread across the park. Alluvial grasslands can be distinguished for pure patches of grasslands and the presence of water during the rainy season. These grasslands have been critical for the survival of rhinoceros and swamp deer (Sarma, *et al*, 2008). Total land-cover under alluvial grassland is 44.37 km², a net change of -38.84 km² from 1998.

Water bodies: There are several water bodies (wetlands and rivers) present inside MNP. Total area under water bodies is -1.68 km². Most of the water bodies are situated towards the southern boundary of the park, in close proximity to the Bansbari range.

River sand: River sand banks have increased from 20.52 km² in 1998 to 35.976 km² in 2006. As a result of recurring floods in the rainy season, it has led to siltation of river banks.

It is evident from table 2 above that there has definitely been a change in land-use and land-cover in MNP. Due to deforestation and illegal logging, the size of the woodland has shrunk throughout these years. Alluvial grasslands, which forms a major habitat for endangered pigmy hog, Bengal florican, swamp deer, rhinoceros and elephants have undergone a drastic change in close to three decades. The chief reasons for the decrease is siltation of water bodies, invasion of exotic weeds like

Eupatorium sp., Melastoma sp., etc. (Sarma *et al*, 2008). Besides, the above factors, these grasslands also face additional pressure from local communities who collect the grasses to use as building materials, grazing, fire etc. Due to massive floods in 2004, there has been a drastic change in the direction of the course of river Beki towards eastward.

On the other hand, people living in the forest fringes are also experiencing human – wildlife conflicts (HWC). This is because with the absence of poaching and other disturbances in recent years inside the park, the elephant population has increased. During the time of fieldwork (2018-19), there were approximately 1376 elephants in MNP. As a consequence, incidents such as crop depredation, house destruction and injury to the humans as well as wild animals increased (see Appendix I). Moreover, the compensation paid to the victims of HWC are inadequate and time consuming.

From the above analysis, we can conclude that despite strict protection in place, ecological degradation is still taking place in MNP. Further, it can also be argued that 'humans' are not the only factor behind this ecological change but due to the interplay of climate and growth of invasive species within the park premises.

Biodiversity Conservation and Poverty Reduction

There has been a long standing debate as to whether a link between biodiversity conservation and poverty reduction exists or not. For Roe *et al* (2011) "Biodiversity can provide a route out of poverty for some people. More commonly, it plays a vital role as a social safety net (providing food, medicines, clean water and so on) preventing people falling into – or further into – poverty". Barrett *et al* (2011) maintain that there is a geographical coincidence between extreme poverty and biodiversity hotspots, where livelihoods are heavily dependent on natural capital like forests, rangelands, soils, water and wildlife. It is pertinent to ask if biodiversity conservation benefits the poor. Roe *et al* (2011) answer that it can, if designed in a way that poor people are a part of it. They argue that there is a confusion between whether or not biodiversity benefits the poor and whether biodiversity conservation benefits the poor. They clear the confusion that the two are not the same. As rural poor depend upon biodiversity for their everyday needs and hence, it makes sense that protecting biodiversity will strengthen their livelihoods. However, conservation intervention may make poor people worse off, if not designed carefully. For instance, Ferraro *et al* (2011) claim that the establishment of a protected area in developing countries might conflict with poverty alleviation goals by reducing income. As access to natural resources are restricted, this might create new poverty traps or reinforce old ones. To overcome this challenge, the IUCN has modified the categories of protected areas to allow people living close to the forest to engage in sustainable means of livelihood.

In the case of MNP, eco-tourism (if practiced right) offers a viable option to reduce poverty in the areas in the vicinity of the park. The local administration has put in efforts to bring tourists to the park by building tourist guest houses and holding cultural fairs. There are several tourist lodges and cottages owned by rich businessmen as well as local communities ranging from the easternmost range of the park i.e. Bhuyanpara, to the central range and the main entrance of park, the Bansbari range. The following table highlights the amount of revenue generated with the inflow of tourists to MNP.

Table 5: Revenue Collection on Arrival of Tourists in Manas National Park, Assam

Sl. No.	Years	No. of Visitors		Revenue Collected (Rs. in lakh)
		Indian	Foreign	
1.	2012-13	15, 890	218	25. 48
2.	2013-14	20, 527	211	30. 93
3.	2014-15	9, 786	475	33.48
4.	2015-16	40, 559	614	73. 69
5.	2016-17	36, 201	351	76. 24

Source: Economic Survey Assam 2017-18

From 2012-13 to 2016-17, there has been a fluctuation in the number of tourists visiting MNP as shown in the table. However, the total amount of revenue collected from the tourists continued to increase from 25.48 lakh in 2012-13 to 76.24 lakh in 2016-17. A rise of 199.2 % of total revenue was collected in 5 years. The revenue was collected in the form of gate receipts that include entry fees of tourists as well as vehicles and also a government-run tourist bungalow inside the park located at Mathanguri.

The locals are employed in tourism in Manas in various roles such as by being tourist escorts, tourist vehicle drivers, nature guides, members of cultural dance groups, service providers at tourist lodges and as tourist lodge owners.

Table 6: Household income from tourism activities in the study villages

Village	Number of Houses Surveyed	Houses Involved	Mean Monthly Income (in Rs.)
Daoharu	50	0	0
Barengabari	50	15 (30)	11, 500
Raimona	50	0	0
Rupnathpur	50	0	0

Note: Figures in parenthesis represent percentage Source: Field Survey

Field survey was carried out in four villages in Manas Landscape, namely Daoharu, Barengabari, Raimona and Rupnathpur. Daoharu and Barengabari are villages located near MNP. On the other hand, Raimona and Rupnathpur come under a non-protected forest reserve known as KRF. As is evident from the table, except for 30 per cent of households surveyed at Barengabari, none of the other respondents from the study villages received any income from tourism activities. Barengabari is located under the central range (Bansbari) of MNP where most of the tourism lodges and cottages are located.

KRF, under which villages like Raimona and Rupnathpur lie, has the potential to become a tourism destination for wildlife lovers as it boasts of rare and endemic flora and fauna like sal trees (*Shorea robusta*), golden langur (*Trachypithecus ghee*), white bellied heron (*Ardea insignis*), diverse butterflies and spotted deer among others. However, there are poor tourism infrastructural facilities like roads, hotels and cottages. A top official of the tourism department of the BTC blamed it on the law and order situation of the region.

The people of Manas would stand to benefit more from tourism revenue if a mechanism was put in place to share the income earned with the people. The mechanism here is that the income received is shared with local people as mandated by the Indian National Wildlife Action Plan (Tiger Task Force report, 2005). That way, people's dependency on the forest resources would reduce and uplift them from deprivation and hardship. For instance, Sinha *et al* (2012) provide an interesting account of how tourism profits are being shared with eco-development committees around Kanha tiger reserve in India. The amount received by the eco-development committees are further used for developmental activities in the village as per the decisions taken by the villagers. However, there are also cases similar to Manas where the income is not shared with local communities. A study on livelihood linkages of tourism in Assam's Kaziranga national park by Hussain *et al* (2012) and in Kanha Tiger Reserve by Sinha *et al* (2012) reveals that revenue generated through tourism is not equitably distributed among the service providers.

Conclusion

Manas landscape is very significant for biodiversity conservation as it is home to the some of the most threatened bird and animal species. The landscape also acts as a transboundary for the wildlife to migrate from one region to another. Further, it is also inhabited by many deprived tribal as well as non-tribal communities who depend on the forest resources for their sustenance. The demand for food and other social needs by communities puts added pressure on the forest resources already affected by the changing climate as shown in the case of MNP. On the other hand, adopting stringent conservation measures also puts undue burden to the local communities, who have already borne the costs after the establishment of protected area. Tourism offers an alternative livelihood opportunity to the locals to come out of poverty. At present, only a handful of people are getting the benefit from tourism activities in Manas. However, it needs to be extended to other forest areas within the landscape and the revenue collected should be shared for the development of local communities. The protected area approach adopted to conserve has not solved the problems of Manas in its entirety but has created new problems to the locals in the form of human-wildlife conflicts. The locals are increasingly experiencing crop depredation, damage to properties and attack on livestock among others by the wild animals. Moreover, compensation is either paid inadequately or very late. As is evident from ecological changes happening inside the park, strict conservation measures could not stop ecological deterioration. Therefore, to successfully conserve this bio-rich landscape dominated by humans, there should be a fine balance between conservation and resource use for the sustainability of socio-ecological systems. In other words, conservation programmes should be able to incorporate the livelihood needs of the local people; only then would the conservation programmes be successful.

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Appendix - 1

Compensation Paid due to Crop Damages Under Bansbari Range, MNP

Sl. No.	Name of Range	Name of Victim	Nature of Damage				Year of Depredation	Animal Involved	Amount Received (in Rs.)
			Death	Injury	House Damage	Crop Damage			
1	Bansbari	Laksheshwari Das, Katajhar, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
2	Bansbari	Goyari, S/O. Lt. Thaneswari Goyari, Kahibari, Baksa	*	*	Kitchen House	*	2017	Elephant	5000/-
3	Bansbari	Maheswar Ramchiary, Kathalguri, Baksa	*	*	*	Vegetable garden	2017	Elephant	3000/-
4	Bansbari	Minachari Ramchiary, Kamalabari, Baksa	*	*	*	Vegetable garden	2017	Elephant	3000/-
5	Bansbari	Kheng Swargiary, Kathalguri, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
6	Bansbari	Binoda Bala Das, Katajhar, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
7	Bansbari	Phulen Boro, Katajhar, Baksa	*	*	Dwelling house	Ate rice being stored	2016	Elephant	5000/-
8	Bansbari	Alaisri Boro, Katajhar, Baksa	*	*	Dwelling house	Ate paddy grains	2017	Elephant	5000/-
9	Bansbari	Mebro Daimary, Gosaibita, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
10	Bansbari	Nibari Basumatary, Mayangpara, Baksa	*	*	*	Ate paddy grains	2017	Elephant	5000/-
11	Bansbari	Sonima Boro, Mayangpara, Baksa	*	*	Dwelling house	*	2017	Elephant	4000/-
12	Bansbari	Rahim Badsha, Raghabil, Baksa	*	*	*	Vegetable garden	2017	Wild boar	5000/-
13	Bansbari	Pankaj Das, Ujanbahbari, Baksa	*	*	*	Vegetable garden	2017	Elephant	3000/-
14	Bansbari	Phanindra Basumatary, Mayangpara, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
15	Bansbari	Md. Danesh Ali, Raghabil, Baksa	*	*	*	Vegetable garden	2017	Wild boar	3500/-
16	Bansbari	Bhupen Das, Barengabari, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
17	Bansbari	Akash Goyari, Kahibari, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
18	Bansbari	Gendra Goyari, Kahibari, Baksa	*	*	*	Paddy crops	2017	Elephant	5000/-

19	Bansbari	Lakhi Bala Nath, Kahitama Pather, Baksa	*	*	Dwelling House	*	2017	Elephant	5000/-
20	Bansbari	Tili Basumatary, Palsiguri, Baksa	*	*	Cottage	*	2017	Elephant	5000/-
21	Bansbari	Lauthai Basumatary, Daoraibari, Baksa	*	*	Kitchen house	*	2017	Elephant	5000/-
22	Bansbari	Narayan Das, Barengabari, Baksa	*	*	*	Bamboo plantation	2017	Elephant	3000/-
23	Bansbari	Jyothi Rekha Das, Kahitama Pather, Baksa	*	*	Dwelling house	Coconut trees	2017	Elephant	5000/-
24	Bansbari	Bilasi Bala Barman, Odalguri, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
25	Bansbari	Prem Bahadur Newar, Odalguri, Baksa	*	*	*	One bigha of Jute field	2017	Elephant	3000/-
26	Bansbari	Lab Barman, Odalguri, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
27	Bansbari	Khagen Machahary, Langdangpara, Baksa	*	*	*	Three bighas of paddy crop	2017	Elephant	5000/-
28	Bansbari	Berga Basumatary, Palsiguri, Baksa	*	*	Properties	*	2017	Elephant	5000/-
29	Bansbari	Berga Basumatary, Palsiguri, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
30	Bansbari	Dalimi Sutradhar, Gyatigaon, Baksa	*	*	Cottage and place of worship	*	2017	Elephant	3000/-
31	Bansbari	Khagen Basumatary, Kahibari, Baksa	*	*	*	Paddy crops	2017	Elephant	5000/-
32	Bansbari	Swmkhwr Machahary, Palsiguri, Baksa	*	*	*	Paddy crops	2017	Elephant	3000/-
33	Bansbari	Merga Mochahary, Palsiguri, Baksa	*	*	*	Four bighas of paddy crop	2017	Elephant	3000/-
34	Bansbari	Mrs Phuleswari Boro, Gosaibitha, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
35	Bansbari	Sunil Khariya, Gyatigaon, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
36	Bansbari	Lalita Gour, Fatemabad Tea Estate, Baksa	*	*	Dwelling house	*	2017	Elephant	5000/-
37	Bansbari	Shanti Gour, Fatemabad Tea Estate, Baksa	*	*	Whole house	*	2017	elephant	7000/-

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