

## Management Strategies for Sustainable Forest Biodiversity Conservation in Protected Areas of Bangladesh: A Study of Bhawal National Park, Gazipur

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### Abstract

Bhawal National Park (BNP) is one of the biologically historic and rich habitats in Bangladesh. Therefore, the study aimed to assess the current management strategies of BNP for sustainable biodiversity conservation along with investigations focusing underlying causes of deforestation and biodiversity losses. A structured questionnaire survey, interview, focused group discussions (FGDs), key informant interviews (KII), and literature survey were used as research tools. The results reveal some threats to the sustainable park management, such as its proximity to urban areas, encroachment, abundance of private land within its boundaries, and the pressure of rapid industrialization. It is found that extensive fuelwood collection, industrial setup, agricultural activities, forest fire, forest land encroachment, wood collection are significant causes for deforestation and biodiversity loss. Moreover, number of species of plants and wildlife has decreased roughly by one-third and one-half, respectively. The findings of this study are valuable for sustainable forest biodiversity conservation and management apart from formulating relevant strategies, planning, and policies for the protected areas of Bangladesh.

### Keywords

Biodiversity loss, Deforestation, Management strategies, Protected area, Bhawal National Park (BNP)

## Introduction

Protected areas (PAs) are one of the most promising and effective biodiversity conservation strategies and forest resources management sites (Masum *et al.*, 2015). Globally, there has been a significant increase of PAs over the last few decades in recognizing importance for the protection of biodiversity. Today, there are more than 100,000 PAs in the world, covering approximately 12% of the world's land surface (Ahsan, Aziz and Morshed, 2016). However, the effective management and enforcement of rules and regulations are not abided during the establishment of PAs (Rashid, Craig and Mukul, 2016). Thus, various drivers of global change, such as population pressure, climate change, and land-use change pattern have affected these high conservation value areas, and the global biodiversity situation is threatened more than ever in the history (FAO, 2006; Akber and Shrestha, 2013).

Bangladesh, the world's largest deltaic region, lies in the Northeastern part of South Asia, between 20°34' and 26°38' N latitude and 88°01' and 92°41' E longitude (Mukul, 2007; Hossain, Rahman and Islam, 2016; Salehin *et al.*, 2020). The majority of the country's land is formed by rivers alluvium adjoining the Ganges and Brahmaputra and their tributaries (Sohel *et al.*, 2015; Makul, Biswas and Rashid, 2018), which consists of some hilly areas (12%), flood plains (80%) having subtropical monsoon weather (Islam, 2003; Hossain *et al.*, 2019; Ghosh *et al.*, 2020). Moreover, Bangladesh is the part of the Indo-Burma biodiversity hotspot, which is one of the 10 globally significant areas with high species biodiversity (Nishat *et al.*, 2002; Islam and Ma, 2018). For its unique geophysical location, Bangladesh is exceptionally characterized by a rich biological diversity (Nishat *et al.*, 2002; Chowdhury and Koike, 2010). An estimated 5,700 species of angiosperms (Mukul, 2007; Rahman and Vacik, 2015), of which about 221 species of plants, have been recorded in BNP (Kabir and Ahmed, 2005). According to BFD, the country has 2.5 million ha of forestland (hill forest, Sal forest and tidal mangrove forest), equivalent to 17.4% of country's total area, out of which 1.6 million ha area is managed by the BFD (BFD, 2016; Islam, Jashimuddin and Hossain, 2017; Rahman and Miah, 2017). Although there are inconsistencies about the total area of forest land, but the National Forest Assessment 2007 reported about 1.44 million ha which is about 9.8% of the total land (MoEF and FAO, 2007). However, FAO's Global Forest Resources Assessment 2015 reported that total forest area of Bangladesh is 1.43 million ha i.e., 11.2% of the land. The per capita forest land in Bangladesh is less than 0.015 hectare and 19 million people are directly dependent on forest resources for their survival (FAO, 2015). The forestry sector contributes for about 3% of the country's GDP and 2% of the labour force (Rahman and Miah, 2017). Thus, Bangladesh has been facing a critical situation for the country's biodiversity conservation and ecosystem services for the last decades.

The status of the biodiversity of Bangladesh has deteriorated day by day, mainly due to its high population pressure and extreme poverty (Mukul *et al.*, 2008; DoE, 2015). For the protection of the biodiversity and natural resources of all types of ecosystem, 34 protected areas covering 327,876 hectares have been established so far as per the provisions of the Bangladesh Wildlife Conservation Order 1973 (Chowdhury, 2014; Rahman and Vacik, 2015). The majority of the PAs of the country is being declared very recently (Mukul and Quazi, 2007). Bangladesh has four categories of PAs, including national parks (NPs), wildlife sanctuaries, eco-parks, and game reserves that have been defined under the Bangladesh Wildlife Preservation Act, 1974. Presently, there are 34 declared protected areas in Bangladesh surrounding all types of ecosystem (Chowdhury, 2014). Among those, 17 are national parks (NPs) in total 45,746 ha, 17 are wildlife

sanctuaries in total 270,479 ha and only 1 is a game reserve with a total area of 11, 651 ha (BFD 2013; Chowdhury, 2014; Rahman and Vacik, 2015). Covering almost 2% of the country's total area, the protected areas of Bangladesh cover 11% of the total forest area, an average of 5% of the hill forests, 11% of the Sal forests and 23% of the mangrove forests being protected (Mukul 2007; Chowdhury, Koike and Muhammed, 2009).

Bhawal National Park (BNP) is one of the historic and rich habitats in Bangladesh. It has a significant influence on environmental, social and economic balance, but the biodiversity of this forest is now under threat due to some underlying causes (Hasan and Khalid, 2014). The BNP has some unique characteristics compared to other PAs in terms of proximity to urban areas, the abundance of private lands and pressures of rapid economic development projects (Chowdhury, 2013; Hasan and Khalid, 2014). Besides, a diverse group of the local population is living in and around the park, who are migrated from the countryside and urban areas and have settled in the buffer zone (Chowdhury, 2013). In addition, there are various ethnic communities, such as the Kuch, who live within the boundaries of the park (Chowdhury, 2013). In BNP, the majority of agricultural land inside the park is owned by the Forest Department giving no right to people to manage private land (Hasan and Khalid, 2014; Macura, Secco and Pullin, 2015). Another pressure on the BNP is that there are over 150 industries in and around the buffer zone, with thousands of workers from these industries living around the park (NSP, 2006; Chowdhury, 2013; Masum *et al.*, 2015). Fuelwood collection, significant activity in BNP, is another practice that threatens forest biodiversity (Chowdhury, 2013; Hasan and Khalid, 2014). Ground fires are a common feature in BNP that destroy vegetation, medicinal herbs and shrubs. Thus, approximately 70% of forest habitats have been damaged as a result of these factors in the last 4-5 decades (Chowdhury, 2013).

The BNP is divided into two zones: a core area and buffer zone area. Activities like the establishment of industries, extraction of forest resources, and the planting of exotic species are prohibited at the core zone (GOB, 2006; Mohd *et al.*, 2008). However, all of the activities are allowed in the buffer zone where only the park beat is nominated as the core zone, and the rest of the beat is located in the buffer zone (Mohd *et al.*, 2008; Chowdhury, 2013). There are two categories of forest ranges in BNP: National Park Range and Bhawal Range. The National Park Range consists of three beats, such as Park, Bankharia and Baupara, while the Bhawal range consists of four beats namely Bhabanipur, Rajendrapur West, Baroipara, and Bishawakuribari (Masum *et al.*, 2015). As a result, conflicts arise between officials and the local population on land use, particularly for the ownership of disputed land (Sharma *et al.*, 2006; Chowdhury, 2013). Further, the Forest Department is planting the fast-growing timber species of short rotation to increase forest biomass, which is called exotic monocultures (Sharma *et al.*, 2006; Hasan and Khalid, 2014). This reforestation activity has threatened the biodiversity of the park immensely. In addition, the residents and ethnic people of the BNP harvest plants and fruits for their consumption from the park. Sometimes, they also hunt jungle fowl and wild boar for household consumption, which is a significant threat to forest biodiversity loss (Sharma *et al.*, 2006; Jahan *et al.*, 2017). Therefore, this study is aimed to investigate the existing park management techniques of Bhawal National Park (BNP), identify the underlying causes of deforestation and degradation of forest biodiversity.

## Materials and Methods

### *Location and description of the study area*

Geographically, Bhawal National Park (BNP) lies between the latitudes 24°02' to 24°11' N and longitude 90°21' to 90°28' E (Figure 1) in Gazipur district under the Forest Division of Dhaka, about 40 km north of the capital city Dhaka, from where it is easily accessible throughout the year by road (Kabir and Ahmed, 2005). It has been marked under IUCN Management Category IV as a protected landscape. The protected area was established and maintained as a national park since 1974, while it was declared officially in 1982 under Bangladesh Wildlife Act, 1974. This NP covers 5,022 hectares area including 950 ha core area, which is managed by the Bangladesh Forest Department (Jahan *et al.*, 2017). The current feature of the forest area is honeycombed with habitations and rice fields. The topography is characterized by low hills, which rise from 3.0 to 4.5 meters above the surrounding rice fields, known locally as "Chalas", which are crossed by several depressions or baidis (Kabir and Ahmed, 2005; Masum *et al.*, 2015). The dominant Sal trees (*Shorea robusta*) have been removed almost. In contrast, a large number of exotic trees species have been planted as part of the conservation program, covering 90% of the area (Sarker and Fazlul Huq, 1985). Recently, 221 species of plants (24 species of climbers, 27 species of grasses, 3 species of palms, 105 species of herbs, 19 species of shrubs, and 43 species of trees) have been recorded (Kabir and Ahmed, 2005). The NP is a safe habitat for many mammals such as Bengal fox (*Vulpes bengalensis*), jackal (*Canis aureus*), small Indian civet (*Viverricula indica*), wild boar (*Sus scrofa*), etc. The avifauna is similar to that found in Madhupur National Park (Kabir and Ahmed, 2005; Hossain *et al.*, 2015).

### *Sampling design*

Administratively, BNP comprises two forest ranges namely Bhawal Forest Range and National Park Range. The present study was carried out in two villages namely Bhabanipur and Baroipara, situated in Bhawal Forest Range of BNP Sal forest. These two villages were selected purposively because of abundance of industrial setup, land encroachment, new settlements, densely populated areas, and over-extraction of forest resources, which ultimately cause degradation and depletion of forest biodiversity. Total 90 survey questionnaires were completed in the study area. The respondents were selected randomly from various forest stakeholders for the questionnaire survey and interviews. In order to fulfill the study objectives, the different forest stakeholder groups (workers, day labourers, farmers, ethnic people, and businessmen) were selected purposively. The demographic characteristic of the respondents was 67% male and 33% female. Most of the respondents (54%) were in the age group of 30–40 years. 47% of the respondents came from non-residential areas, 37% from streets and migrated area. A relatively higher percentage (50%) of the respondents was illiterate. It was identified that among the respondents, 40% were day labourers, 34% were farmers, and 17% were service persons. 44% of the respondents' monthly income was 3000-5000 BDT, whereas the income of 34% was 5000-8000 BDT.

### *Data Collection methods and analysis*

Both primary and secondary data were used for this study. The primary data were gathered from various forest stakeholders through observations, questionnaire surveys, key informant interviews (KII), and focus group discussion (FGD). The structured questionnaire survey was conducted in this study, which is considered as a useful tool that can provide in-depth and detailed information

regarding the objective of the study. The questionnaire used both open and closed-ended questions. However, it was more common to use open-ended questions to obtain in-depth information about the causes of deforestation and biodiversity loss.

Interviews were conducted with multiple classes of respondents, including day labourers, visitors, local farmers, workers, local ethnic community, and forest resource collectors for understanding the exact causes of deforestation and biodiversity loss in BNP. However, three KIIs were conducted with the personnel of the Forest Department (FD) (i.e., Beat Office, Range Office, Divisional Forest Office) and local community leaders. Furthermore, two FGD sessions were carried out with local farmers, workers, resource collectors, and people in business, where a total of 18 respondents actively participated. In the FGD sessions some key questions were asked based on the study objectives such as forest dependency, causes of biodiversity loss and deforestation, existing management systems exercised by the FD. Apart from primary data, the collection of secondary data was based on existing literature, books and reports. Moreover, the existing park management facilities, the status of biodiversity, and constrains of park management data were collected from Forest Range Office and Divisional Forest Office of the BNP and the Ministry of Environment, Forest, and Climate Change. The collected data was edited and coded in a database for further analysis. The data analysis was carried out by Statistical Package for the Social Sciences (SPSS) version 22, and MS Excel-2007.

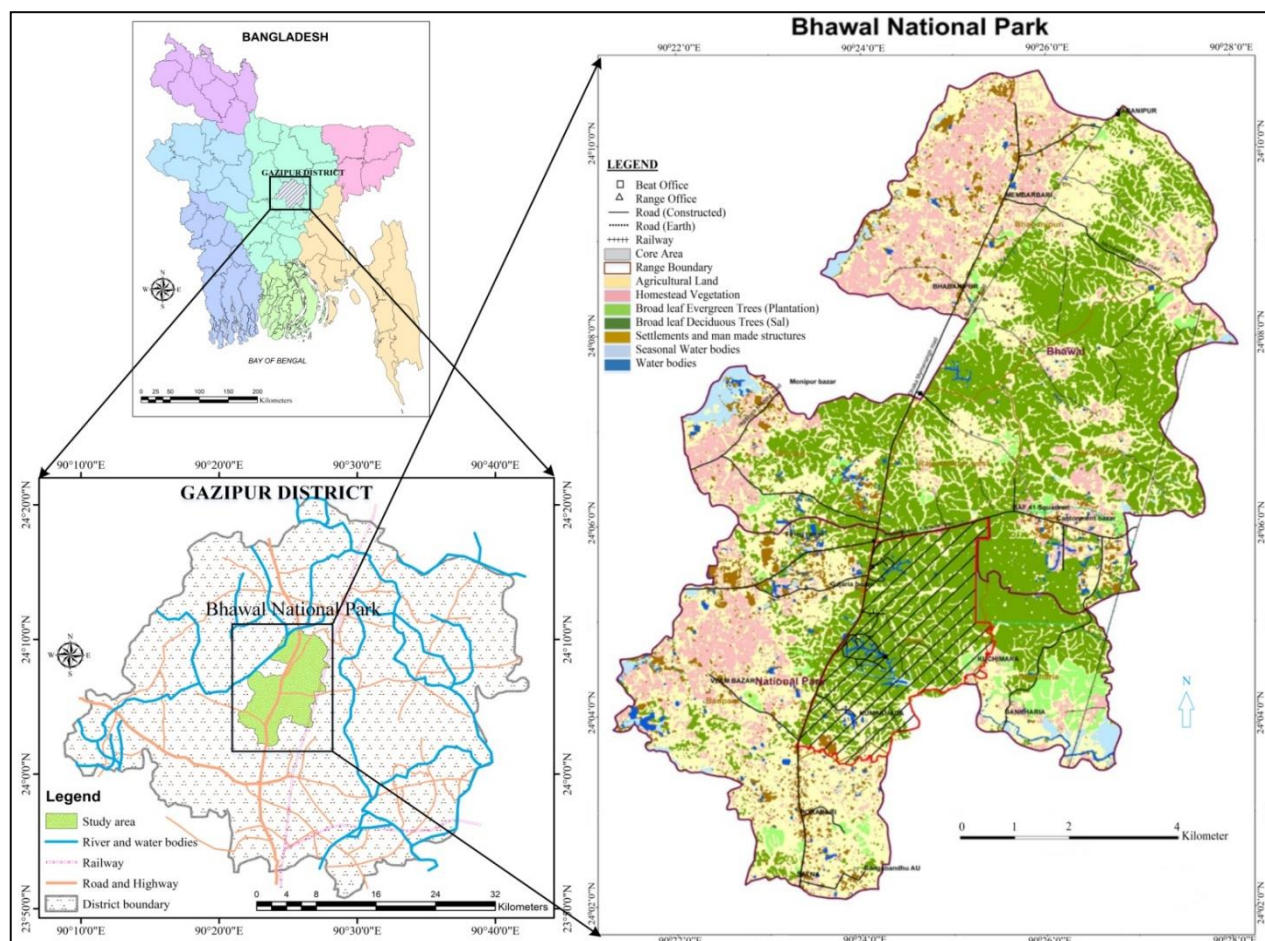


Figure 1: Location of the study area Bhawal National Park in Bangladesh

## Results and Discussion

### *Structural management and major hindrances to park development in Bhawal National Park*

The vicinity to town areas, forest land encroached, the abundance of private lands within its boundaries, and pressures of rapid industrialization are certain features of BNP that make it a unique PA. Most of the national parks in Bangladesh are situated away from the urban areas, while BNP is the only park that is close to the capital city of Bangladesh. BNP has a limited number of facilities for park management, such as mini zoo, a wildlife breeding centre, and a child park, which are not sufficient for better park management. Other facilities, such as the number of picnic spots, cottages and watchtower are not also enough to support existing number of visitors (Table 1).

Table 1: Existing park management facilities of BNP

<i>Facilities Provided by FD</i>	<i>Number</i>
Rest house	6
VIP rest house	4
Non-VIP rest house	2
Cottage	13
Picnic spot	5
Ponds	50
Watchtower	2
Child park	1
Mini zoo	1
Wildlife breeding centre	1

*Source:* BFD (2016)

In winter, a large number of visitors come to BNP mainly for picnics and nature observation. The Bangladesh government earns significant revenue from the park. For example, in 2011, the park earned BDT 15,150,000 (equivalent to USD 214,000) from about 10,000,000 visitors. Visitors walking in the park often disturb wildlife as they are not restricted to footpaths and designated areas (Rahman and Vacik, 2009). The human resources who are responsible for management (Table 2) are not sufficient and are not well trained to contribute to better park management. Therefore, the existing Sal forest management practices are inadequate and inefficient to sustainable management of the forest.

### *Drawbacks with present management strategies*

The trees that are planted by the Bhawal National Park are grown and nurtured in Rajendrapur range. It means that the Assistant Conservator of Forest (ACF) has dual responsibility that could lead to conflicts in future regarding administration of the trees (Kabir and Ahmed, 2005). BNP is not a 100% reserve forest (RF) because there are still 52 families residing in 400 acres of the forest land that have yet to give their land to the Forest Department. The Sal forest has been managed under two working ranges: (a) National Park Range, and (b) Bhawal Range. The National Park Range consists of three beats, such as Park, Bankharia, and Baupara, while the Bhawal Range consists of four beats, namely Bhabanipur, Rajendrapur West, Baroipara, and Bishawakuribari (Rahman and Vacik, 2009). For management purposes, BNP is divided into two zones: a core zone

and a buffer zone. However, all kinds of economic activities are prohibited, such as establishing a business, harvesting all types of forest products, and planting exotic species. Besides, only park beat is designated as the core zone, and the rest of the beats are in the buffer zone. In contrast, neither a survey nor any census was carried out to count mammals and reptiles. As previous studies also reported, the Sal forest management policies cannot be successfully implemented due to the following main causes: densely populated areas, livelihoods dependency on forests, firewood collection for wage earning, conflicts between local and political elites, and encroachment of forest land by locals (Rahman *et al.*, 2010). Corruption at various tiers of management systems, illicit removal of forest timber and poaching of wildlife are some of the major constraints in successful implementation of development projects (Alam *et al.*, 2008; Rahman *et al.*, 2010). The antagonistic relationship between the Forest Department and locals is an obstacle for effective Sal forest management (Alam *et al.*, 2008).

Table 2: Existing human resources and order of BNP for park management

<i>Person responsible park management</i>	<i>Numbers</i>
Chief Conservator of Forest	1
Deputy Chief Conservator of Forest	4
Conservator of Forest	8
Divisional Forest Officer	1
Assistant Conservator of Forest	1
Range Officer	2
Forester	5
Deputy Ranger	2
Forest Guard	14
Total	38

Source: BFD (2016)

### *The factor responsible for deforestation and degradation of forest biodiversity*

#### Daily Fuelwood Collection

Comprehensive fuelwood collection, a significant activity in BNP, is a threat to forest biodiversity. This activity continues throughout the years, while the collection is more intense during the dry season. Fuelwood is usually collected for both domestic consumption and commercial sale. It is observed that majority of the collectors are adults, both male and female, and adolescent boys. The fuelwood collectors are mostly poor, and they supplement their income by selling fuelwood. As displayed in Figure 2, 46% of the respondents opined that 35-40kg fuelwood is collected daily for household cooking purposes. Further, 29% of people opined that 30-35kg firewood is collected daily to earn income, followed by 17% responding that 40-45kg fuelwood for commercial sale and 8% of them saying that 15-20kg is being collected for Forest Department staff. Similar research findings revealed that an average 11-15kg of fuelwood is collected daily for household consumption in Modhupur National Park (MNP) (Hossain *et al.*, 2015; Hasan *et al.*, 2020).

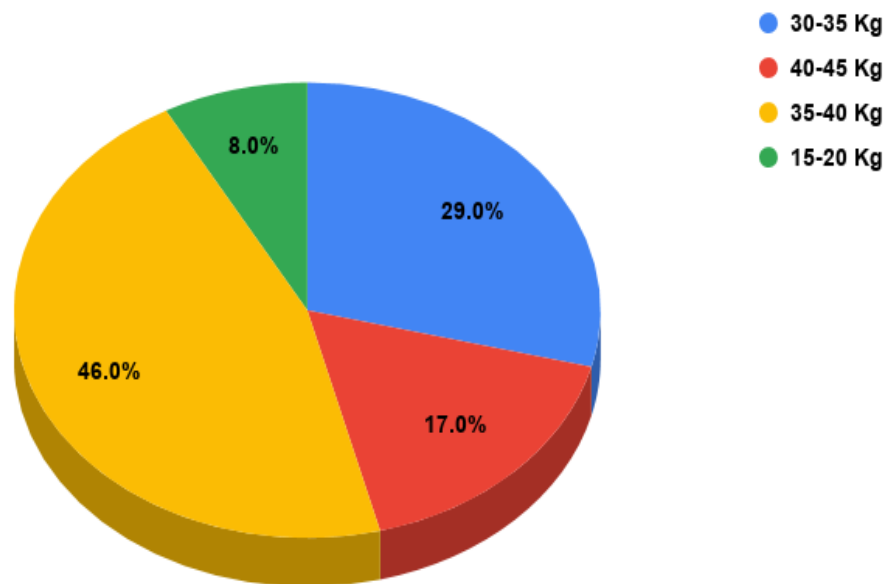


Figure 2: Daily fuelwood collection for various purposes

### Types of Industries

There were found many small, medium and heavy industries surrounding the park as well as inside the park. It is unique NP in Bangladesh having industries inside the core area of the park, where the denim and spinning mills are operating for a long time. Findings indicated that more than 150 industries were actively working in the buffer zone and the areas immediately surrounding the park (Masum *et al.*, 2015). Therefore, not only pollutants (water, air, soil and sound) of the industries but also thousands of workers from these industries are residing in the buffer zone area, creating immense disturbance to biodiversity conservation. It is revealed that the industrial setups in the study area mostly included textiles (knitting, dyeing and garments), ceramics, chemicals, poultry feeds, plastics, shoe factories, poly bags, gum, medicines and other small and medium industries. Overall, 65% of industrial setup was of textile industries, and about 17% of them were poultry feed producing industries (Figure 3). However, not only industrial pressure, but also consequently, settlements and infrastructural developments such as grocery stores, auto repair garages, and hair cutting salons have played a detrimental role in the diminishing of Sal forests.

### Agricultural Activities

Traditionally, the agricultural activities practiced by farmers inside of the BNP for decades and are considered one of the major causes of deforestation and loss of forest biodiversity. This study identified various diversifications of agricultural activities that are practiced inside the forest land, like cash crops, corn-producing activities, and some other activities. The findings are depicted in Figure. 4.60% of the respondents opined that corn-producing activities are generally practiced by local people inside the forest land, followed by 30% of cash crops and 10% of other activities.



Previous studies have reported that the agricultural activities cash crops and corn producing for Modhupur National Park (MNP) are 21% and 62%, respectively (Hossain *et al.*, 2015; Hasan *et al.*, 2020).

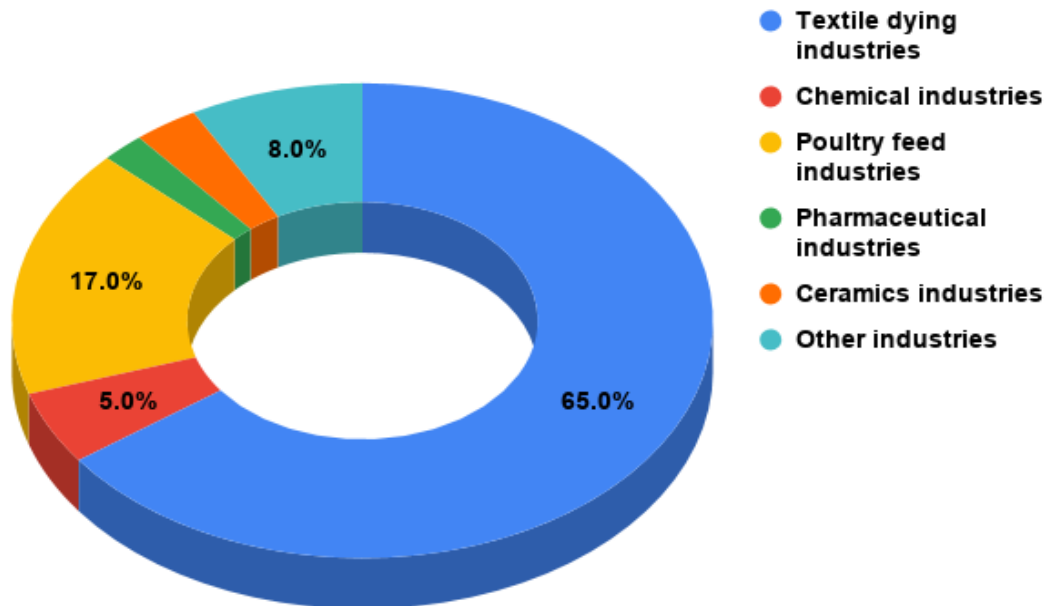


Figure 3: Types of industries in the buffer zone of Bhawal National Park

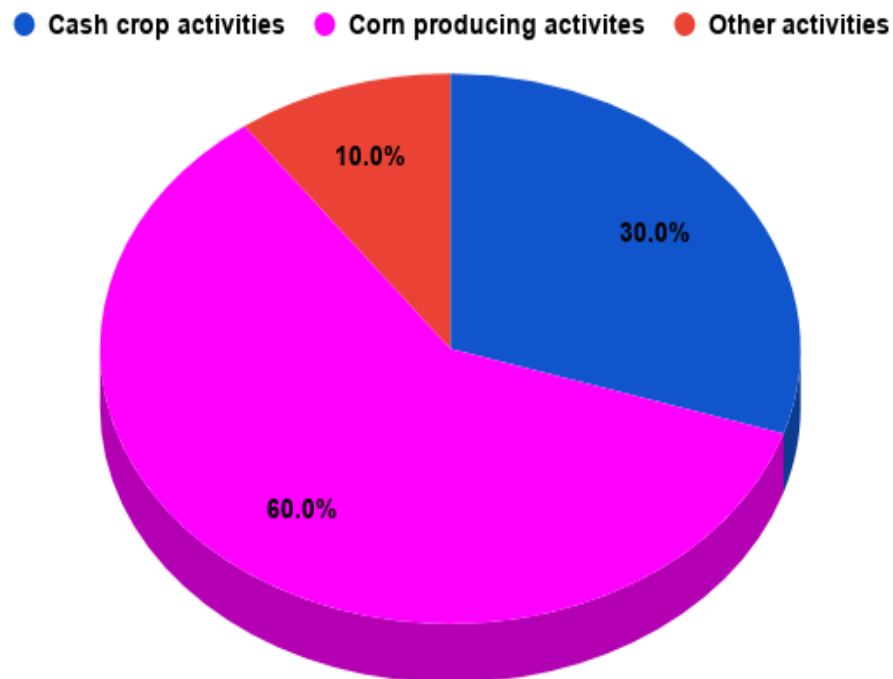


Figure 4: Agricultural activities inside of the BNP

## Forest Fire

Forest fire is an utmost cause for degradation and depletion of forest resources (Hossain *et al.*, 2015). A forest fire may occur from natural and anthropogenic sources (Rahman and Vacik, 2009). Typically, at Sal forest, fire may occur in dry (summer) season by the friction of dry leaves of trees on the ground. Besides, when the fire source, such as an open flame, smoking, and electric sparks, or other sources of ignition, comes into contact of combustibles, a fire occurs. Present study revealed that 60% of respondents believed that BNP's wildfire has happened due to natural activities (Figure 5). Moreover, smoking by cigarettes or *bidi* may be a severe anthropogenic cause of forest fire, which accounts for 17%. Similarly, 16% respondents opined that forest fire appears owing to people's carelessness, while 7% of respondents admit that forest fire happened by prohibited activities of the local inhabitant. In contrast, in the MNP, forest fires are caused by smoking (67%), and 21% by illegal human activities (Hossain *et al.*, 2015).

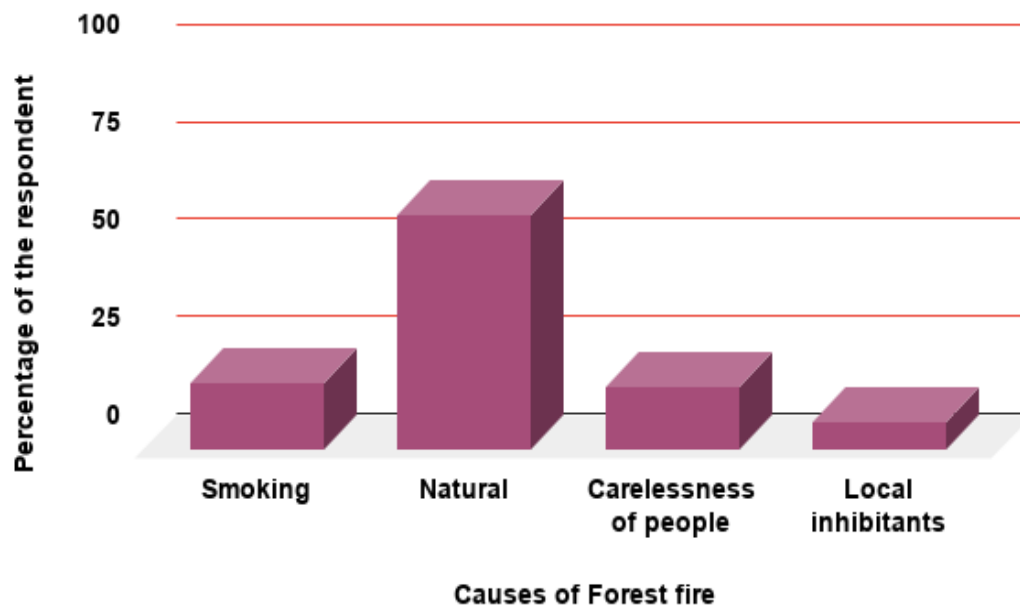


Figure 5: Causes of forest fire in BNP

## Forest Land Encroachment

Forest land encroachment is one of the key reasons for forest habitat degradation (Hossain *et al.*, 2015; Islam *et al.*, 2017). This is due to the expansion of farmland, the development of new settlements, and the setup of industries such as clothing manufacturers, spinning mills and dyestuffs, pharmaceuticals, and poultry feed industries (Chowdhury, 2013). Almost 70% of the forest habitat has been destroyed due to such practices over the last few decades (Rahman, Nishat and Vacik, 2009). As shown in Figure 6, 57% of respondents in the study area assumed that forest land has encroached by the establishment of new industries around the BNP, followed by 27% by the development of new settlements and 16% by the expansion of agricultural lands. Sunderland *et al.* (2011) have found encroachment of forest land is the major forest conservation problems. The

Sal forests are under constant anthropogenic pressure from all sides as there were no boundaries or demarcations off the forest. The areas under encroachments are estimated at 0.036 million ha, and the number of encroachers is about 100,000.

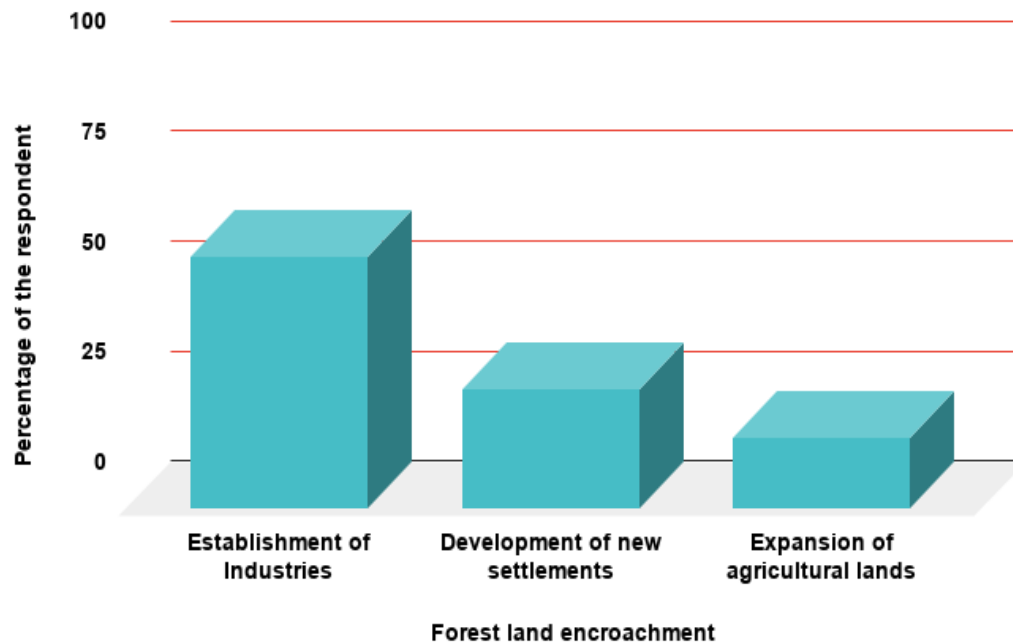


Figure 6: Causes of forest land encroachment in BNP

### Timber Felling

It was found that timber forest products are used for various purposes of development activities. As presented in Figure 7, about 50% of respondents opined that the timber forest products are directly going to saw mill around the forest to make furniture and other household ornamental products. In contrast, 34% of respondents assumed that wood is getting sold to the brickfield for burning bricks, and 16% respondents revealed that trees are logged illegally by some local people. The result of this study is similar to the previous study conducted by Hossain *et al.* (2015) for MNP, in which timber forest products were used by saw mill (54%) and brickfield (29%). Another study by Sunderland *et al.* (2011) indicated that illicit removal of timber forest products from the forest is the major forest conservation barrier, which is responsible for depletion and degradation of forest biodiversity. Besides, the main causes of timber logging are wide gap between the demand and supply of wood and its consequent high prices, and unemployment in rural areas increasing the dependency on wood collection from forest.

### *Forest biodiversity status*

#### Floral Diversity

It is found that the Sal forest is rapidly disappearing due to illegal logging, lack of proper management system of clear-felling, and forest encroachment by industries (Sunderland *et al.*,

2011). Consequently, the biodiversity of the forest is shrinking at an alarming rate. This study revealed that the number of tree species in BNP is 22, followed by grass (12), shrub (10) and climbers (6). Further, the study has found that the number of herb species existing in BNP is 5. The number of tree, shrub and grass species have declined by roughly one-third compared to the species that studies recorded in 1973 (Ismail and Mia, 1973) and half compared to the studies of 2009 (Rahman, Nishat and Vacik, 2009). Over the last few decades, this practice has destroyed about 70% of the forest habitat. Because of recent military activities, ground fires are destroying flora, kill medicinal herbs and shrubs as well, although they are still disappearing by human intervention and present practice (Chowdhury, 2013).



Figure 7: Wood collection for development purposes

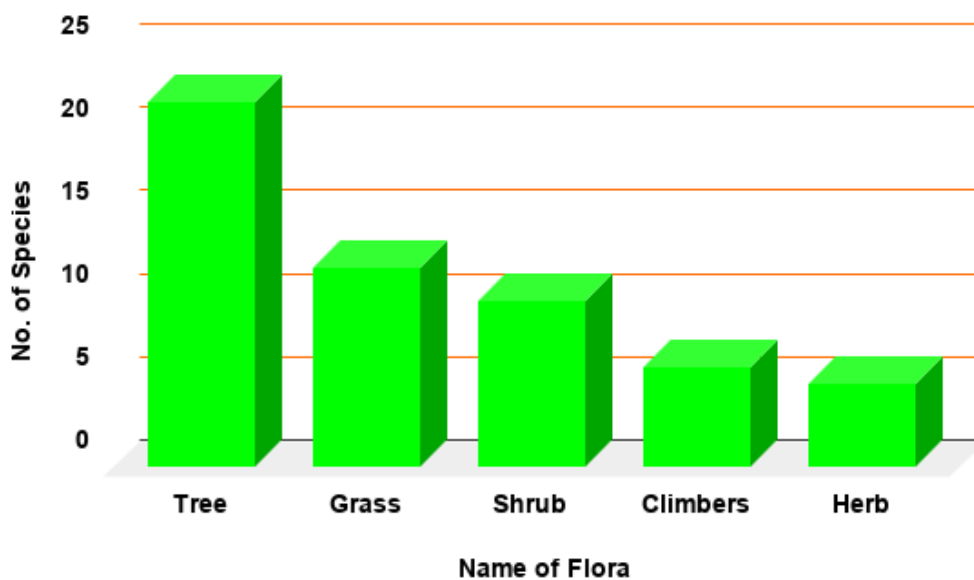


Figure 8: Status of floral diversity of the BNP

## Faunal Diversity

As a consequence of population and industrial setup, forest is losing its natural habitation, and resulting into the wildlife losing their habitats and food. The results of faunal diversity are shown in Figure 9. The number of bird species existing in the BNP is 29, followed by reptiles (11), mammals (9), and amphibians (4). A significant difference and apparent decline are recorded in the number of wildlife species if compared with previous studies of Sarker and Huq (1985) and Kabir and Ahmed (2005). Loss of birds from the study area is recorded unusually high, with an estimated rate of loss of roughly three-quarters. The reason behind these is military and ground fire activities that extensively disturb wild animals and destroy their habitat and food. Furthermore, visitors walking through the park often disturb wildlife because they are not restricted to footpaths and designated areas (Rahman and Vacik, 2009).

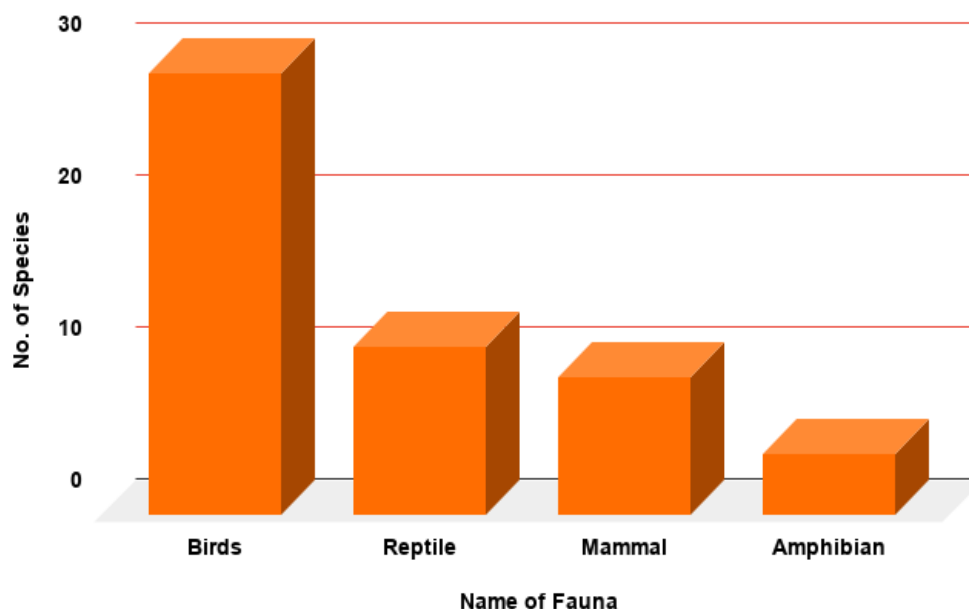


Figure 9: Status of faunal diversity of the BNP

## Conclusion

Sal forest is the only plain land forest in Bangladesh and is important from both national economic and environmental perspectives. This study discovers that the existing Sal forest management practices are inadequate and inefficient to manage the forests sustainably. There is a problem of forest administration too between different line departments. This study has identified the factors responsible for forest degradation and biodiversity loss, which are extensive fuelwood collection for cooking purposes, industrial pressure, forest land encroachment, expansion of agricultural lands, and illicit removal of timber wood. It is confirmed that the number of floral species had declined one-third compared to number of species recorded in previous studies. The faunal diversity has significantly decreased than ever before. It is observed that ground fire, military activities, industrial pollution, population expansion, uncontrolled visitors are responsible for

biodiversity loss. The future existence of the Sal forest depends on due attention given by political leadership and reduced urbanization.

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