Environmental, economic and agricultural surveys of an ecologically important forest edge hamlet in Darjeeling district, West Bengal, India

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ABSTRACT

Forest cover in the hill regions is essential to maintain environmental, economic and ecological balances. North Bengal accounts for 3,086 sq km (26%) of the 11,876 sq km area of classified forests in the state, and for nearly 5,000 sq km (40%) of all land under tree cover. Khumani is a Village (26.84° N, 88.60° E) in Gorubathan Block in Darjeeling District of West Bengal State, India. The survey work was done in December, 2014 by visiting the Khumani Forest Village (established in 1949) of upper Kumai and the primary data were gathered through field survey and direct contact with common people and authorized centers of the region. Surveys on the demography, agriculture, livestock management, water management, education, culture, health, waste management, disaster management, transport, biodiversity, human animal conflict were done in this area. Topographic map of the area was prepared by using the database of National Atlas and Thematic Mapping Organization (NATMO), Kolkata office. In every phase of the survey work, pictorial documentation was done. In spite of being positioned in a diverse and sensitive ecological zone, the village is not adequately managed. There is an urgent need for implementing sustainable management systems in the areas for the betterment of the socio-environmental structures. Some of the possible management strategies have been suggested for maintaining the social, environmental, economic and ecological balance of the region. Proper funds should be raised to conserve and manage these ecologically important zones of north Bengal, which should be one of the main focuses of future researches.

Keywords: Survey; Eco-sensitive; North Bengal; Biodiversity; Management
1. INTRODUCTION

The Dooars or Duars are the floodplains and foothills of the eastern Himalayas in North-East India around Bhutan. Duar means 'door' in Assamese, Bengali, Nepali, Maithili, Bhojpuri, Magahi and Telugu languages, and the region forms the gateway to Bhutan from India. This region is divided by the Sankosh river into the Eastern and the Western Dooars, consisting of an area of 8,800 km² (3,400 sq m.) [1]. The Western Dooars is known as the Bengal Dooars and the Eastern Dooars as the Assam Dooars. The Dooars region politically constitutes the plains of Darjeeling District, the whole of Jalpaiguri district and Alipurduar district and the upper region of Cooch Behar district in West Bengal and the districts of Dhubri, Kokrajhar, Barpeta, Goalpara and Bongaigaon in the state of Assam (Figure 1) [1].

The Dooars valley is specially noted for its wildlife sanctuaries, the most important of which are the Gorumara National Park (75 km from Siliguri), Chapramari wildlife sanctuary (68 km from Siliguri), Buxa Tiger Reserve (200 km from Siliguri) and Jaldapara Sanctuary (124 km from Siliguri) [2]. These sanctuaries are abounding in a fascinating diversity of rare flora and fauna. The average rainfall of the area is about 3,500 mm. Monsoon generally starts from the middle of May and continues till the end of September. Winters are cold with foggy mornings and nights. Summer is mild and constitutes a very short period of the year [3]. The altitude of Dooars area ranges from 90 to 1,750 m.

![Figure 1. Map showing the areas of North Bengal, India.](imageUrl)
Khumani is a Village (26.84° N, 88.60° E) in Gorubathan Block in Darjeeling District of West Bengal State, India. It is located 66 km. towards East from District head quarter Darjeeling, 16 km. from Gorubathan, 575 km. from State capital Kolkata. Khumani is surrounded by Nagrakata Block towards South, Gorubathan Block towards west, Mal Block towards South, Reghu Block towards North. Gorubathan is a small town in the Kalimpong subdivision of Darjeeling district of the Indian state of West Bengal. It has an average elevation of 417 metres (1,368 feet) [4].

2. METHODS OF THE SURVEY WORK

The survey work was done in December, 2014 by visiting the Khumani Forest Village (established in 1949) of upper Kumai area and the primary data were gathered through field survey and direct contact with common people and authorized centers of the region. Surveys on the demography, agriculture, livestock, water management, education, culture, health, waste management, disaster management, transport, biodiversity, human animal conflict were done in this area. Topographic map of the area was prepared by using the database of National Atlas and Thematic Mapping Organization (NATMO), Kolkata office (Figure 2).

Figure 2. Topographic map of Upper Kumai region in Gorubathan Block, North Bengal.
Information on agricultural activities is collected from the local villagers. Plant diversity was studied in the village area and information was gathered from the local forest department centre. Information regarding the transport system was collected from the local transport office and syndicate. Religious and social festival information was collected from the local people.

Health and education information was collected from the local primary and high schools and the local sub health centre. Information on environmental activities like using sustainable agricultural practices and waste management policies is collected through surveys in the villages. Pictorial documentation was done in every phase of study [5-7].

3. ROCK TYPES

Several patterns of rocks are found in the land areas of Khumani Forest Village. Some examples are as follows:

1. **Muscovite**: It is the commonest mica. Muscovite (hydrous potassium aluminium silicate) occurs as tabular crystals often pseudo-hexagonal. It is usually colourless, grey, pale green, brown, yellow, pink or violet. Hardness ranges from 2.5 to 3.0 and Specific gravity from 2.7 to 3.0.

2. **Biotite**: Biotite (Potassium-magnesium-iron-aluminium-silicate) is a type of mica and occurs as tabular prismatic crystals with scattered grains, scales and scaly masses. It is usually black, dark green or brown coloured with specific gravity 2.5 to 3.

3. **Calcite**: It is the most common mineral and the main constituent of limestone. It is usually White or gray but sometimes colourless or tinted yellow, blue, green and pink with specific gravity 3.

4. **Quartz**: It is the principal constituent of glass and occurs as irregular grains intergrown with other minerals or as rounded grains or as microscopically grained specimens or as prismatic crystals (often twined). It is usually colourless, if pure and has any colour, if impure. It has harness 7 and specific gravity of 2.65.

5. **Granite**: Granite are coarse grained (phaneritic), light coloured (leucocratic),acidic (>66% silica content) and holocrystalline plutonic igneous rocks with medium specific gravity (2.63-2.75). These rocks are hard and compact rocks composed essentially of quartz, feldspar and mica, usually with some ferromagnesiam minerals.

6. **Quartzite**: Quartzite is very hard granular rocks produced by the recrystallisation of sandstone. They are light coloured, fine to medium grained rocks with high compactness, low to medium specific gravity.

7. **Slate**: Slates are fine grained, dark coloured metamorphic rocks with low hardness, moderate compactness and low specific gravity (2.75). It produces metallic sound and muddy odour.
4. POPULATION

In Khumani Forest village, there are 115 houses with total population of 724 people (Figure 3). The main religions of the village are Kirat (Kirat or Kirati are indigenous ethnic groups of the Himalayas extending eastward from Nepal into India, Burma and beyond. They migrated to their present locations via Assam, Burma, Tibet and Yunnan in ancient times. Prototype Tibeto-Burmans originated in the Yellow River basin around 10,000 years ago.) [8], Hindu, Buddhist and Christen. Most of the people are active as farmers, businessmen, army men and teachers.

Figure 3. Local population of Khumani Forest Village.

5. AGRICULTURE AND LIVESTOCK

In Khumani Forest village, step cultivation is practiced (Figure 4). It is method of growing crops on sides of hills or mountains by planting on graduated terraces built into the slope. Though labour-intensive, the method has been employed effectively to maximize arable land area in variable terrains and to reduce soil erosion and water loss [7]. Canal irrigation and rainfed irrigation are done in the agricultural fields.
In Khumani Forest village, the common cultivable edible plants are rice, maize, potato, lemon, raisak, green chili, tomato, squash, leaf mustard, mango, lychee, banana, pomelo, areca nut, large cardamom etc.

Areca nut is the main cash crop of this area and an important economic source of the local inhabitants. The people of Khumani Forest village usually practiced organic farming, cowdung is used as manure.

No pesticide and fertilizer is added to the fields as there is no pest attack in the agricultural areas. Most of the houses in Khumani Forest village have cultivable lands adjacent to the houses and farming is done there. Agricultural production is one of the main economic sources of the people in this area. They used to sell the foods in the markets after production.

Honey production is also an important source of earning. The inhabitants used to make artificial wooden structures in which bees take shelter and store honey (Figure 5). They periodically collect the honey and supply it to market.

The common livestock at Khumani Forest village are cows, goats and pigs. Local poultry farms are found in many houses. Meat, eggs and milk are the main livestock products which are among the important economic sources.
6. WASTE MANAGEMENT

In Khumani Forest village, the common waste materials generated are solid wastes, including plastic packets, paper boxes, plastic bottles, glass bottles, vegetable wastes etc. Solid wastes are usually collected in specific bins. Every house has their own burning places where they used to burn all the solid wastes. The unburned materials are buried in the ground. However, burial of the wastes, specially the hazardous ones, and burial of the wastes can affect the sensitive ecosystems of those areas, and can affect the inhabitants as well. Plastic and glass bottles are generally recycled by selling in the local markets after use.

7. SANITATION

In Khumani Forest village, every house has separate sanitation system and toilet. Most of the toilets are constructed outside the houses, with adequate amount of water supply.

8. WATER MANAGEMENT

The main water source of Khumani Forest village is the water coming from the hills through channels like “jhoras”. An artificial cistern is made to collect and store the hill water. Network of pipeline distributes the water from the cisterns to the houses. Each house has its own water collecting and storing unit from which they get the supply. Additionally, people
used to bring water from the water sources in the hills (local “jhoras”) during the period of water crisis in April, May and June. In a few houses, roof top rainwater harvesting structures were observed. The roofs have aluminium gutters (long, hollow device that is attached to the edges of the roof to catch rain and carry it away from a building) at the corner for collecting rainwater. The roofs have inclined slope, so that water flows easily in the gutter. The rainwater falling on the roof top can be collected through these gutter channels. Pipes are connected with the gutters through which water can be collected in the cisterns and containers [6]. The collected rainwater is used for bathing, washing and drinking purpose. For irrigation, people entirely depend on rainwater.

A big canal was constructed in the village area for channelization of storm water during the rainy season (Figure 6). Channelization of storm water can reduce soil erosion and flooding.

![Figure 6. A big canal was constructed in Khumani for channelization of storm water.](image)

## 9. EDUCATION, CULTURE AND HEALTH

For primary education, there is a primary school (upto 4th standard) in the village (Khumani forest village primary school, established in 1957) with 4 teachers and 45 students. There is a high school in Gariabash, around 5-6 km. from Khumani Forest village. Students are used to travel for the school by foot from the village. For higher studies, people of Khumani Forest village usually go to the colleges of Malbazar and Siliguri.
Interestingly, there is no specific medicine shop in Khumani Forest village. There is only two small stationary shops in the area. Local medical treatment facilities are available in the sub health centre of Jhalang and Kumai tea garden hospital. People used to visit the big hospitals in Chalsa, Malbazar, Siliguri and Jalpaiguri areas for operation and emergency cases.

In Khumani Forest village, the main festivals are Dasara, Diwali, Christmas and Losar. Losar is the Buddhist festival (“Losar” in Tibetan language means New Year), which is celebrated for 15 days, however, the main celebration occurs in the first three days.

10. TRANSPORT AND CONNECTIVITY

In public transports, there are only bikes, tempos and private cars available in Khumani Forest village. No bus service is available in this area. Khumani Forest village is connected with places of Bengal and Sikkim like Siliguri, New Jalpaiguri, Gorumara forest, Lataguri forest, Murti (doors area), Jaldhaka, Bagdogra, Malbazar, Chalsa, Odlabari, Gorubathan, etc. Car is the only mode of transport, especially in case of sightseeing purpose.

11. DISASTERS

Dooars area of North Bengal are under rapid habitat destruction due to several anthropogenic pressures and developmental activities like hydro-electrical projects, development of roads, establishment of tea gardens, mining and quarrying, landslides, forest fire etc. These factors jointly have increased the fragility of the Himalayan Mountains, leading to an increase in the incidence of landslides in the region. In Khumani Forest village, frequent landslides occur, mainly during the rainy season. Landslide management is mainly done by the local people. Besides, the area is also earthquake prone [9]; small earthquake incidences are experienced in Khumani Forest village twice to thrice a year.

12. ECONOMY

Agriculture is one of the main economic sources of the inhabitants of Khumani Forest village. The people used to sell the agricultural and livestock products in the local markets of Chalsa and Malbazar. Areca nut is the main cash crop of this area and an important economic source of the local inhabitants. Only two local shops are available in the village, and a local market is arranged once in the week in the village area. People used to visit the big markets in Metali, Chalsa, Malbazar and Siliguri. Crop husbandry, animal husbandry, wild biodiversity and rural economy are subsystems of the integrated traditional resource management system.

13. BIODIVERSITY

Gorumara National Park is around 30 km. from the Khumani Forest village and around 10 km. from Chalsa. The village is surrounded by forest which is artificial plantation forest.
Khumani is very close to Gorumara, and regular migration of Elephants, Rhinoceros, Leopard etc. are observed here.

Gorumara was a reserve forest since 1895 (Figure 7). The park was declared a Wildlife Sanctuary in 1949, on account of its breeding population of Indian rhinoceros. It was declared an Indian National Park on January 31, 1994. Originally as small as 7 km², Gorumara has grown by incorporating neighbouring lands to about 80 km². It has 48 species of Carnivores & Herbivores, 193 species of Birds, 22 species of Reptiles and 27 species of fishes [10]. The flora includes Sal forests with common teak, rain tree (Shirish), and Bombax (also known as silk cotton tree or Shimul). The area is also rich in Bamboo groves, terai grassland vegetation, tropical riverine reeds and tropical orchids [11].

This is the most important and crucial migratory corridor of the Asiatic Elephant (Elephas maximus) and is also the residence of the Great Indian one horned Rhinoceros (Rhinoceros unicornis) and herds of Gaur (Bos gaurus). Other fauna of the park include leopard (Panthera pardus), jungle cat (Felis chaus), leopard cat (Prionailurus bengalensis), fishing cat (Prionailurus viverrinus), monkeys (ex. Macaca mulatta), different species of deer, the small Indian civet (Viverricula indica), large India civet (Viverra zibetha), Malayan giant squirrel (Ratufa bicolor), wild pigs (Sus scrofa), turtles, pythons. The Park’s biodiversity is reflected in its wonderful avifauna comprising Hornbills, Hoopoe, woodpeckers, Green pigeons, Ibis, Crested serpent Eagle, nightjars, owls, Red Jungle Fowl and Peacock and many migratory birds as Brahminy duck, Whistling Teals [10]. The major conservation focus of the park is to maintain a viable breeding community of Indian rhinoceroses.

**Figure 7.** Gorumara National Park.
14. MAN-ANIMAL CONFLICTS

Human and wildlife conflict is much debated in recent times as it poses a major threat to survival of many wild animal species in different parts of the world. Human-Wildlife Conflict (HWC) occurs when wildlife requirements overlap with those of human populations, creating costs both to residents and wild animals [12]. Man-animal conflict has been in existence for as long as humans have existed and wild animals and people have shared the same landscapes and resources [13]. Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common inside and around Protected Areas. With increasing population and pressure on forest areas, human-wildlife interaction and resultant conflict is also increasing [14]. Doosar are of North Bengal is immensely rich in biodiversity, and has diverse fauna which live in close proximity to human beings. Communities living in and around Protected Areas are not included as primary stakeholders. In many instances, these communities are highly marginalized and living in difficult circumstances.

Since, elephants have wide home ranges, typically between 100 and 1000 km², a fragmented habitat or obstruction to traditional migration path is bound to bring many human-elephant conflicts resulting in damage to agricultural crops, property, household and injury and mortality to both humans and elephants. Cultivated crops are easy source of forage for elephants which is nutritious and healthy too.

West Bengal, owing to its strategic geographical location in terms of biodiversity, acts as inter-state and inter-country elephant corridors at several points, both at south Bengal and at North Bengal [15]. Khumani Forest village is very close to the Gorumara and Lataguri reserve forest and an important area of elephant corridor. In Khumani Forest village, the man animal conflict is mainly centered on the attacks of elephants in the agricultural fields. The village people used to protect the crop fields from elephant attacks by burning woods in the nighttime and use crackers for the attacking elephants. Besides, there are examples of the attacks of Rhinoceros and Bison on human population. Leopard attacks on humans are very rare, but they used to kill the livestocks in the villages.

15. LOCAL ENVIRONMENTAL ACTIVITIES

The local inhabitants of the Khumani Forest village established an environmental organization, “Water and Nature Conservation Centre” in 2011. It is a registered organization, operated by 15 villagers. Their activities include:

A. Water conservation.
B. Landslide management.
C. Banning of plastics in the village area.
D. Rural Development and literacy.
E. Afforestation programmes.
F. Soil erosion and landslide reduction by planting tress like banana, peepal etc.
16. CONCLUSIONS

There are several environmental, social and economic aspects in Khumani Forest village, which should be in focus for proper management of the village area. Some of the sustainable management strategies applicable for this area are mentioned below:

1. Dooars have become the emerging tourist spots of West Bengal for pleasure trips, biological and geographical excursions and medical research works. In spite of getting so much attention in the recent time, the areas are not adequately developed. There is an urgent need for implementing sustainable management systems in the areas for the betterment of the socio-environmental structures. Some of the implementable management systems are as follows.

2. For reducing the water crisis in Khumani Forest village in April-May season, micro scale rainwater harvesting structures should be installed in the houses. Filtering systems should be provided to the local inhabitants so that they can use the rainwater for drinking purpose after purifying it.

3. Adequate health services should be provided to the local inhabitants of Khumani Forest village. Local Sub Health centers with doctors, nurses and basic medical facilities should be established in these areas. Availability of operation theatre in the nearby hospitals should be done.

4. Local training centers should be established for teaching the local people about the importance of natural resources of Khumani Forest village. The initiatives of the local people can effectively protect the natural assets of those areas. Implementation of successful joint forest management programme can improve the socio-biological conditions.

5. Portfolio of tourism products should be developed by utilizing its unique ecological assets [16]. As these areas are the attraction for tourists, development of handicrafts made from the forest bioresources could be beneficial for the economic development of the local communities.

6. West Bengal is the cultural capital of India. It has constantly produced thoughts, ideas and events which have brought forth freshness and rejuvenation in the society both in India and the world. The specific components of Cultural Tourism which can be implemented in these areas include Fairs and Festivals Tourism, Arts and Crafts Tourism and Village Tourism.

7. Tourism carrying capacity is defined as the maximum number of people that may visit the tourist destination without causing destruction of the physical, economic and socio cultural environment and an unacceptable decrease in the quality of visitors’ satisfaction. The carrying capacity assessment and sustainability of tourism in the circuits identified is an important component of the ecotourism study as it will form the basis for resource allocation and future development [17].

8. There is lack of gross knowledge among villagers on the advantages of afforestation in the Hill areas. Specific training and awareness efforts from the Forest Department have to be
undertaken to educate people on the drawbacks of deforestation and the long term effects it has on climate. Ecological restoration should be done by restoring the damaged, degraded and areas destructed by landslides. Focus should be given on areas critically important to floral and faunal habitat, water catchments and areas important with social and cultural values. A better understanding of corridor management can reduce the incidences of elephant encroachment and attacks.

9. Organic farming is one of the several approaches found to meet the objectives of sustainable agriculture. Organic farming is a production system that sustains the health of soils, ecosystem and the people. Organic farming works in harmony with the nature rather than against it. It relies on ecological processes adapted to local conditions, rather than the use of inputs with adverse effects in the long run. Encouraging and supporting the farmers towards Organic farming in Khumani Forest village should be done by government initiatives.

10. The effects of climate change are more severe in the Himalayas compared to the other regions [18]. The annual and seasonal temperature trends in the Kanchenjunga landscape indicate an increase at the rate 0.01 – 0.015 °C/year, with higher altitudes experiencing greater warming [19]. Likewise, among the administrative units, Darjeeling was the most vulnerable compared to Sikkim, eastern Nepal and western Bhutan. Extensive studies on the effects of climate change on Khumani Forest village and adjoining areas like Jaldhaka, Jhalang, Bindu should be done, as this zone represents one of the richest biodiversity zones of India.

11. Like any other protected area in India, the adjoining forest areas of Khumani Forest village suffer from illegal cattle grazing, firewood collection, encroachment on the fringes and poaching. However, due to inaccessibility and difficult terrain, the biotic pressures are still not very acute. More intense survey works and management practices should be done for mitigating the anthropogenic threats.

12. Separate waste collection and disposal system should be operated by the government for safeguarding the sensitive ecosystems of the areas. Effective management design should be done for plastic wastes generated in these areas.

13. The vehicles used in the areas should be monitored regularly so that the vehicular pollution could be checked in the areas. Installation of the modern devices in the vehicles for pollution control should be done and routine checking system should be implemented.

14. To reduce the pressure on the forest and the drudgery to which women are subjected due to use of smoke producing “chullas”, an alternative fuel policy should be evolved and implemented. Large scale installation of solar panels in these areas would be beneficial. Biogas is a cheap, pollution free alternative energy source. It can also reduce the annual emission of CO₂ from households. One biogas plant can save approximately 2 tons of fuel wood, 0.8 tons of agricultural wastes and 50 litres of kerosene per household per person. Implementation of biogas plant in Khumani Forest village area can reduce the pressure on fuel wood [7].
15. Dooars area of North Bengal are under rapid habitat destruction due to several anthropogenic pressures and developmental activities like hydro-electrical projects (figure 8), development of roads, establishment of tea gardens, mining and quarrying, landslides, forest fire etc. These factors jointly have increased the fragility of the Himalayan Mountains, leading to an increase in the incidence of landslides in the region. Proper implementation of disaster management plan should be done in this area.

16. Proper land use pattern should be done, keeping the socio-economic and ecological parameters in view.

![Figure 8. Jaldhaka Hydroelectric Project near Khumani Forest Village.](image)

References


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