

THERE IS ALTERNATIVE

**IMPACTS ON
ECOLOGY AND BIODIVERSITY DUE TO LARGE SCALE
TREE FELLING IN ROAD SIDES OF LATAGURI
ADJACENT TO GORUMARA NATIONAL PARK WITH
SUGGESTIONS FOR ALTERNATE MEASURES**

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Why Such Assessment is Necessary

This is unusual that an assessment of ecological damage caused to a National Park like GORUMARA is done by an organization, which is neither a project proponent nor a government agency concerned with any EIA Authority. It is felt need of the time to make an EIA of the development activity of any kind whether it is a 'Linear Project' or normal one. Gorumara National Park being a Reserve Forest with unique biodiversity within the Duars region of West Bengal deserves utmost care for implementation of a development project of any kind. But it is a matter of great regret that about 550 trees have been slaughtered and some thousands have been marked to be slaughtered for making an over bridge about which the forest officials, the civil administration and even the public representatives pretend not to be aware of. At least no body is disclosing any thing so as to why this mass scale destructive action on environment is being organized without making any environmental impact assessment (EIA), environmental management plan (EMP) and wildlife conservation and management plan (WCMP) for this national park, a habitat of a number of Schedule-1 animals protected by our Forest Acts and Laws. This document is prepared with scientifically collected information from the field as well as studies conducted by scientists, other stake holders like field workers and people and organizations associated with awareness development. We are not against any development activity but also strongly believe that an ecological alternative to any development project is possible to a great extent. We are to abide by a scientifically prepared EMP and WCMP in a National Park area like GORUMARA if we have to stick to the declared goal of sustainable and ecofriendly development of our country.

CHAPTER-I

PREAMBLE

The uniqueness of the state of West Bengal is its highest degree of ecological diversity due to the gracious presence of Himalayas in the north, Chhotnagpur Plateau in the east and Bay of Bengal in the south. The Ganges crisscrosses it making the land fertile. Sub Himalayan region of the state is blessed with species rich forests of Duars with a range of Protected Area Networks (PAN). Gorumara National Park, Buxa Tiger Reserve, Chapramari Wildlife Sanctuary, Gorumara National Park, Neora Valley National Park and Jaldapara National Park.

The Gorumara National Park (GNP) in Duars, West Bengal, has emerged as one of the biodiversity enriched forest area in the region and in India as well. A Wild Life Sanctuary (WLS) since 1949 and a National Park (NP) since 1992, within an enclosure of merely 80 km², is harboring a rich heritage of floral and faunal diversities, unaffected over years.

A letter¹ issued by the Divisional Forest Officer, Jalpaiguri Division to the Divisional Manager, Jalpaiguri Forest Corporation Division requests felling of trees on both the sides of the road from Lataguri to Chalsa, which is also a part of the GNP. It describes that the land is under the management of Public Works Department (PWD). This felling is being done for construction of an over-bridge in Bichabhanga on the periphery of Gorumara National Park in the district of Jalpaiguri, West Bengal, without obtaining necessary clearance under the Forest Conservation Act, 1980. As per the verdict of the Hon'ble Supreme Court in case of T. N. Godavaraman vs Union of India & Ors in 1997 a 'forest' should be defined as per broader definition, regardless of ownership mentioning the Forest Conservation Act (1980) which specifies that no state government or other authority may allow the use of any forest land for any non-forestry purpose without prior approval from the central government. The interim order of Hon'ble National Green Tribunal (Eastern Zone Bench, Kolkata) on 13th April 2017 has also upheld this decision and emphasizes upon obtaining clearance as per 1980 Forest Conservation Act². In the view of the above the question arises how could a DFO, being a responsible Govt servant with the responsibility of conserving our forests, could sound the death knell for thousands of trees close to a National Park?

Though there is no record available in the public domain, it appears from the letter of DFO, Jalpaiguri Forest Division that construction of a over bridge will lead to widening of the exiting road for about a length of 2.5km. The width will be about 40m including the existing road. This could be understood from the marking of trees for felling on both the side of the road. It is apprehended that there will be increase in the traffic flow in near future (after converting this road to NH 717) disturbing the contiguity of wildlife habitat making it more vulnerable. Increase of traffic flow, particularly during night, will have a longstanding effect on faunal behavior of GNP as most of the long ranging animals move to Neora River in the western side of it. While discussing with Indra Paik of Bichabhanga Banabasti (Forest village), Dhiren Kora, a panchayet member and ground level staff of Forest Department (who do not want to divulge their identity) that GNP suffers from dearth water during dry season.

¹ Memo No 528/28-37 dated 7th March 2017, issued by the DFO, Jalpaiguri Forest Division, instructing the Divisional Manager, Jalpaiguri Forest Corporation Division felling of trees on both the sides of the road.

² Writ Petition No. 11096(w)/2017 before The National Green Tribunal Eastern Zone Bench, Kolkata in Society For Protecting Ophiofauna & Animal Rights & Anr Vs State Of West Bengal & Ors

As per EIA Notification (2006) the proposed project of constructing an over-bridge along with widening on both the sides in the existing National Highway 717 is a Category-A project and needs appraisal by MoEFCC. A matter of further importance is that this particular project adjacent to GNP has wildlife habitat/corridor in the proposed area of construction. Issuing Environmental Clearance to this project is the sole responsibility of MoEFCC. At Stage (III) of all Category-A project appraisal process Public Consultation is essential. Nothing of this kind has been done in this case.

Biodiversity conservation and forest management are now the major concern of all the responsible societies of the world. Pollution, global warming, emission from fossil fuel combustion, poverty and deforestation are the factors responsible for the destruction of our biodiversity and natural resources (Global Summit on Climate Change (Durban Summit, 2011- extending Kyoto Protocol till 2017, Kyoto 11th December, vide COP 7, 2001& Cancun Summit, COP 16, CMP 5, 2010). A number of measures have been undertaken by Government of India, with enactment of necessary laws and rules like 'The Environment (Protection) Act, 1986', 'The Forest (Conservation) Act/Rules, 1980/2003', 'The Wild Life (Protection) Act, 1972', to conserve our natural habitats.

In the guidelines for Green Highways Project³ it is mentioned "It has been observed that in absence of any clear guidelines for transplantation of trees, transplantation activities have been kept to minimal. Often bigger or grown up trees are selected for transplantation and trees below 4 -5 years or lesser girth are felled. But due to lack of appropriate technology and equipments for transplantation, it often results in low survival rate of transplanted trees, whereas young trees can be manually transplanted. These can quickly adapt to new environment thereby have lesser chances of mortality. Hence, for all new highways projects trees of age 2 years and above shall also be considered for transplantation".

This study focuses on probable impacts on the ecological structure and functions as well as biodiversity as a whole, due to indiscriminate felling of trees on both the sides of the road passing through Lataguri, a small town in the district of Jalpaiguri, (from 26° 43' 11.7" N and 88° 46' 07.43" E at an Alt -97m to 26° 43' 50.55" N and 88° 46' 34.58" E, Alt- 96m). This road passes touching GNP in its eastern side from 26° 44' 47.36" N and 88° 46' 45.74" E to 26° 47' 40.84" N and 88° 47' 54.10" E with an average altitude of 101m. Though the national park area is in the eastern side of the road the western side of the corresponding to the stretch of GNP has a luxuriant forest cover with all the ecological characteristics of GNP.

³ Plantation, Transplantation, Beautification, Landscaping And Maintenance Activities Along National Highways, Green Highways for Sustainable Environment & Inclusive Growth Initiative towards fulfilling India's commitment for voluntary carbon emissions reduction of up to 35 % by 2030 - CoP 21 Summit, National Green Highways Mission National Highways Authority of India, Ministry of Road, Transport & Highways

CHAPTER - II

LEGAL ASPECTS

In case of any sort of non-forestry intervention within the forest areas of our country, Forest (Conservation) Act 1980 is the guiding Act and no office of the country can take a decision unless it abides by the clauses of the Act. In the historical judgment of Hon'ble Supreme Court of India in T.N. Godavarman Thirumulkpad vs Union Of India & Ors case it is stated that "The term "forest land", occurring in Section 2, will not only include "forest" as understood in the dictionary sense, but also any area recorded as forest in the Government record irrespective of the ownership. This is how it has to be understood for the purpose of Section 2 of the Act. The provisions enacted in the Forest Conservation Act, 1980 for the conservation of forests and the matters connected therewith must apply clearly to all forests so understood irrespective of the ownership or classification thereof."

Though felling of trees within and in the buffer area of a National Park is legally and ethically not desirable, trees have been felled indiscriminately by West Bengal Forest Development Corporation with permission of concerned territorial forest division i.e. DFO Jalpaiguri Division. In the plea of being acquired by The PWD of Govt. of West Bengal in the year 1921, it is claimed that no EIA and associated activities like Public Hearing etc. are required for such felling.

F No. 11-47/2006 FC Dated 6th Oct. 2006, issued by MoEF (FC Division) Govt. of India⁴ as regards to "Guidelines for preparation of projects----- under the Forest Conservation Act 1980 for diversion of forest land for construction of roads passing through a number of Divisions/ Districts / States" in point-4 states that a prior permission by the User Agency from National Board for Wildlife (NBWL) has to be obtained as per direction of Hon'ble Supreme Court in case of a road passing through National Park / Sanctuary. ***It is to note that no such permission has been accorded in this case by either NHAI or State Govt.***

Forest (Conservation) Act, 1980 (With Amendments made in 1988) and Forest (Conservation) Rules, 2003 (With Amendments made in 2004)⁵ in Chapter 2.1 state that if forest area is to be diverted for the project (including notified roadside plantations) applications has to be submitted to the State Govt. State Govt. is required to recommend the case to the MoEFCC. The rule says that

- Up to 40 ha, after being processed by RO needs to be approved by MOEFCC, Delhi
- More than 40 ha has to be processed and approved by MOEFCC, Delhi.

All the road projects are considered in entirety. In the present case approximately 2500m length roadside forest has been either cleared or marked for clearing having a width of 40m (taking the present metaled road width to consideration). **Thus 2500m x 40m = 100,000 sq m i.e. 10ha forest is in the process of being cleared.** Therefore, it comes under second category. In this case the proposal for conversion after being processed by RO needs to be approved by MOEFCC, Delhi for Forest Clearance (FC).

Forest Clearance process involves submission of among other things

- i. Short narrative of the project Map showing required forest land, boundary of adjoining forests (1:50,000),
- ii. Undertaking to bear the costs of Compensatory Afforestation

⁴ F No. 11-47/2006 FC Dated 6th Oct. 2006, issued by MoEF (FC Division) Govt. of India.

⁵ HANDBOOK OF Forest (Conservation) Act, 1980 (With Amendments made in 1988) Forest (Conservation) Rules, 2003 (With Amendments made in 2004) Guidelines & Clarifications (Up to June,2004), GOVERNMENT OF INDIA Ministry of Environment & Forest, New Delhi, Dated 31 May, 2004.

- iii. Differential Global Positioning System (DGPS) map of the area under diversion and of the areas identified for CA.

Forest clearance is a two-stage process.

First stage clearance involves in-principle approval for which the Conditions specified are

- (i) Deposit Net Present Value of Forest (4.38 to 10.43 lakhs/ha)
- (ii) Deposition of Money for Compensatory Afforestation
- (iii) Plantation of at least double the number of trees felled
- (iv) Submission of plan for afforestation
- (v) Providing land for land for afforestation
- (vi) Submission of Certificate of compliance under FRA (Forest Right Act)

It needs to be mentioned here that no activity like felling etc. is allowed within the forestland until final clearance is accorded.

The Second stage clearance can only be requested after fulfillment of stipulated conditions of the 1st stage. Documents required for final clearance are as follows.

- (i) Proof of depositing amount for Compensatory Afforestation
- (ii) Proof of depositing amount for Net Present Value (NPV)
- (iii) Proof of depositing amount for meeting other conditions - roadside plantations, compensation for damage / dismantling of assets, etc.
- (iv) Strip chart for roadside plantations
- (v) Undertakings for compliance on other generic and specific conditions
- (vi) Certificate from the District Collector(s) on settlement of all rights under the Forest Rights Act, 2006

The proposed project being on the wildlife corridor, 'Wildlife Clearance' is mandatory. For such a clearance the case has to be referred to the State Board of Wildlife (SBWL) and the National Board of Wildlife (NBWL) even for survey in wildlife area. In case of migratory corridors elsewhere, comments of Chief Wildlife Warden of the State is required.

In F. No. 11-306/2014 FC MoEFCC to Principal Secretaries (Forest) of all States and UTs a guideline for diversion of forest land for non-forest purposes has been spelt out even in case of linear projects like expansion of roads etc., Compensatory Afforestation, NPV, Wildlife Management Plan, plantation of dwarf species, plantation of medicinal plants etc are made mandatory. It is also mentioned that the State Govt. (West Bengal in this case) will seek and obtain from the Central Govt. final/formal approval under Forest (Conservation) Act 1980 for diversion of such forestland at the earliest.

In a Memo⁶ dated 11th March 2015 Wildlife Division of MoEFCC for Wildlife Clearance with Forests and Environmental Clearance it is mentioned that "User Agencies (UA) are required to register themselves only once for submitting application for seeking Environmental, Forests and Wildlife Clearances. They can submit more than one EC, FC or WL applications with the single user-id and password. For example, if any UA desires to submit application for EC, FC and Wildlife Clearances (all three clearances), they are required to register once with the portal. There is no need to have three separate registrations.

- All linear projects and other proposals related with diversion of forestland from 0 to 40 ha. are forwarded to Regional Office.

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⁶ F No. F 6-74 2012 WL (pt) Dated 11th March 2015 Issued by Wildlife Division, MoEFCC, Govt. of India, on Wildlife Clearance with Forests and Environmental Clearance.

- All proposals related with diversion of forestland for more than 40ha excluding linear projects are forwarded directly to Head Office, Delhi for the processing at Head Office (MoEFCC, Delhi).”

In a memo F. No. 11-353/2016-FC dated 19th January 2017 by MoEFCC to Forest Department, Govt. of Haryana emphatically states, “an equivalent non-forest land has to be provided by the user agency for compensatory afforestation”. This holds good for all the states and UTs of India as well. In the present case **NO FOREST CLEARANCE has been obtained** as per Acts, Notifications and Memos stated above. There is also no point to consider that any concession is available in this case so that a Divisional Forest Officer can issue a direction to fell the trees in a Reserved Forest as important as a National Park.

CHAPTER - III

THE STUDY SITE

Lataguri is situated $26^{\circ} 43' 15.40''$ N and $88^{\circ} 46' 05.98''$ E and is the entry point of Gorumara National Park (within $26^{\circ} 47' 12.5''$ N to $26^{\circ} 43' 25.6''$ N and longitude $88^{\circ} 52' 4.2''$ E to $88^{\circ} 47' 7.3''$ E). The total area of the National Park is 79.84 sq. km (Map – 1). GNP belongs to the bio-geographical zone 7B-Lower Gangetic Plain [Rodgers & Panwar, 1988]⁷. This NP is located in the foothills of Eastern Himalayas known as Duars region and has rich biological diversity. GNP is well known as Riverine Rolling Flood Land Forests (RFF), Riverine Riparian Forests (RRF) & Sal Savannah Climax Forests (SCF) of eight major blocks of GNP (namely Dhupjhora, Gorumara, Jaldhaka, Medla Jhora, Neora, Murti, Shelkapara and Tondu). GNP can be designated as a biome, a combination of multiple ecosystems with diversified habitats.

The terrain of Gorumara National Park is differentiated into a distinct plateau and plain areas. The soil profile of the area is of alluvial and Bhabar formations. Average annual rainfall of the NP is more than 382cm but during March to May wild animals has to come out of the NP in search of water. The major economic activity of people of this locality revolves around tourism industry.

During the fieldwork two important animal species included in the Schedule-I were spotted. Elephant (*Elephas maximus*) was spotted at $26^{\circ} 45' 32.01''$ N and $88^{\circ} 47' 14.21''$ E and a King Cobra (*Ophiophagus hannah*) at $26^{\circ} 44' 07.75''$ N and $88^{\circ} 46' 36.10''$ E.

1. Forest type: The entire forest cover of Gorumara National Park comes under the North Indian Moist Tropical Forest (Champion & Seth, 1968)⁸. On the basis of the composition of the vegetation, the forest can be classified into four distinct types, Riverine forests - North Dry Deciduous Seral Sal Khair Sissoo Association (Tondu - 1, 2, 3,4a, 4b and Selkapara - Ib), Sal forests - Eastern Bhabar Sal and Eastern

Terai Sal (Gorumara, South Indong 1,2,3 and Bhogolmardi), Wet Mixed forests - Sub- Himalayan Secondary Wet Mixed Forests (Barahati - 1,3, Central - 1, Medlajhora - 1, Dhupjhora - Ib, 2 and Kakurjhora - 2) and Savannah Forests & Lower Alluvial Savannah - Sal Savannah (Jaldhaka - Ib and Dhupjhora - Ia,Ib,Ic) (Anonymous, 2007a)⁹. Gorumara National Park has only 10% (18.41 sq. km) of its total area covered by grassland. A study by Ghosh, 2012¹⁰ of GNP as a whole shows that it has a total of 595 species of angiosperms, accounted for a very high Diversity Index value (Shannon's H') at 6.3864. The species equitability or evenness 0.92 to 0.96 showing complete evenness in the distribution of individuals (Simpson's E value being 0.01 to 0.05) depicting the fact that species are almost evenly distributed within the park. The Management Plan of GNP states that the Forest Department could identify 326 plant species (tree species -158, herbs - 35, shrubs - 77, grasses - 32, climbers - 15 and

⁷ Rodgers, W.A. and Panwar, H.S. 1988. *Planning a Wildlife Protected Area Network in India (Vol. 1)*. FAO, Wildlife Institute of India. Dehradun. India.

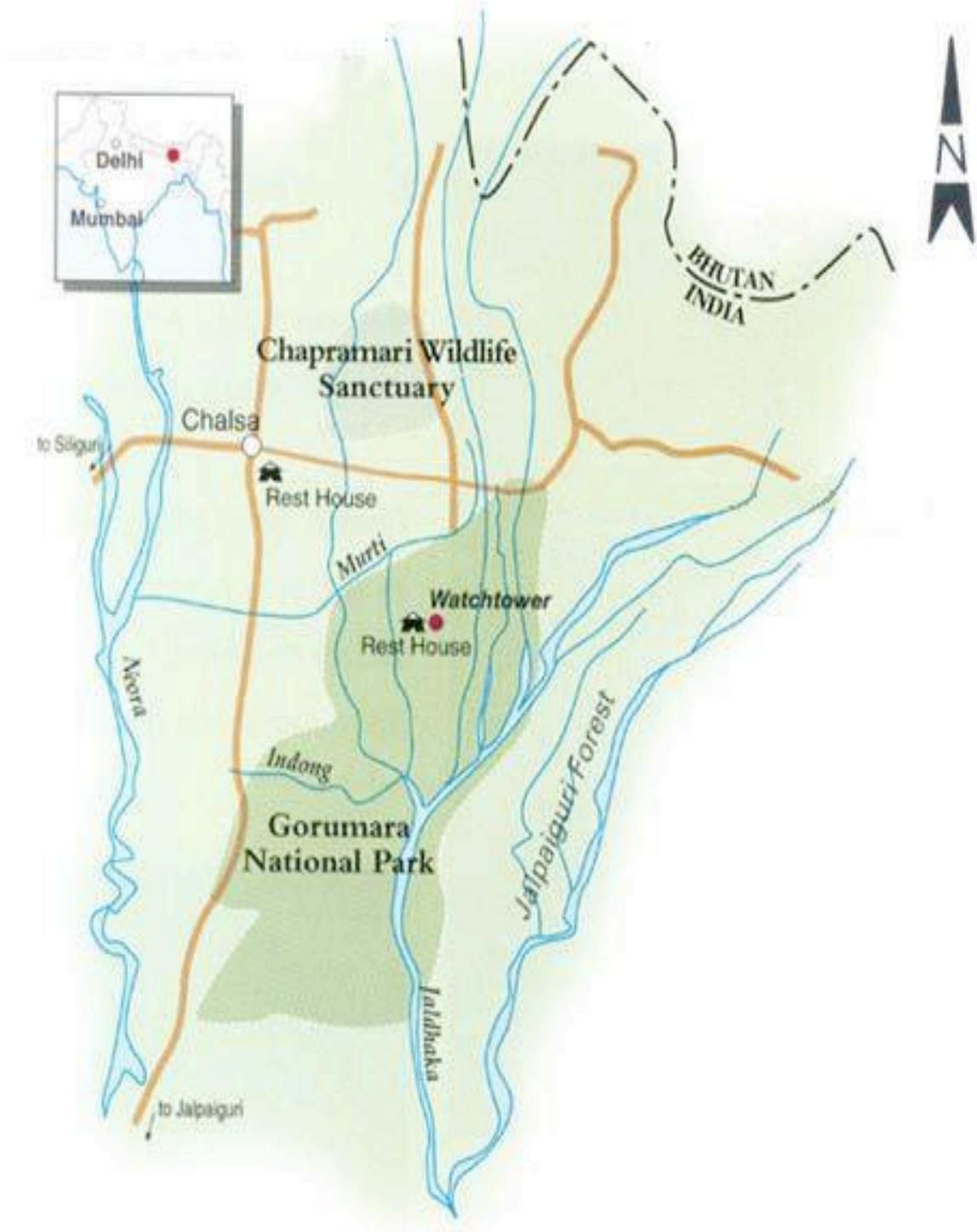
⁸ Champion, H.G. and Seth, S.K.1968. *Forest Types of India*. Government of India Publication, Delhi. 404 pp.

⁹ Anonymous. 2007a. *Management Plan: Gorumara National Park (2007-08 to 2017-18)*. Divisional Forest Officer, Wildlife Division II, Jalpaiguri, Wildlife Circle (North), Government of West Bengal. 281 pp.

¹⁰ Ghosh, S.B. Biodiversity and Wild Fodder of Gorumara National Park in West Bengal, India-Fodder Plants and Habitat of Gorumara National Park. *Journal of Environment and Ecology*. 2157-6092. 3 (1)

orchids - 9). Also, sizeable area of GNP is covered with bamboo brakes (Anonymous, 2007a). The species, which are commonly found within the forest and having importance from the economical and ecological standpoint, is *Sal (Shorea robusta)*.

2. Drainage: The park is located on the bank of rivers Murti and Raidak and has vegetation of riverine grasslands along with savannah type woodlands. Murti, Jaldhaka and Indong pass through this GNP. Another river namely Neora passes close to the GNP in its western side.



Map-1

CHAPTER - IV

METHODOLOGY FOLLOWED

The study of biodiversity in study area includes not only the study of flora and fauna w.r.t qualitative and /or quantitative enumeration and their sociological framework, but also the study of ecosystems and habitat characteristics of which they are part. The scope of the study covers all these factors along with impact identification and or prediction and conservation measures.

1. Field Study

In the disturbed area (where tree has been felled) random samples were taken to study intensively various ecological parameters so as to understand the ecological structure and functions of the study area. Random samples were taken in the field on both the sides of the road. Geographical position of the sampled plots was noted with the help of a GARMIN eTrx10 GPS handset. No sample plots could be laid within GNP, as we did not have any permission to work within the protected area.

Besides random sampling a study of all available species on both sides of the road in line transect was done to record density and composition of herbaceous vegetation, shrubs and trees. The inventory of species has been prepared basing on the data collected from both the sides of the road within 30m in both eastern and western side of the road passing in south to north direction. One time data was collected in the month of May 2017 starting from 26° 43' 15.40" N and 88° 46' 05.98" E to 26° 44' 47.36" N and 88° 46' 45.74" E.

Data for the inventory of plant species was also collected from the following points using quadrat method in the following coordinates which are not included within this line transects.

- Zero Bandh near Tundu village close to Jaldhaka river 26° 46' 18.11" N and 88° 05' 44.04" E,
- GNP entry point 26° 47' 41.80" N and 88° 04' 47' 83.01" E,
- Neora river railway bridge (on the eastern side opposite to Saraswati forest village) 26° 44' 37.70" N and 88° 45' 37.00" E,
- Railway Crossing on the Baradighi road (Lataguri- Neora More- Baradighi- Caltex More- Malbazaar) which is proposed as an alternate route for making a traffic overpass at 26° 46' 13.86" N and 88° 04' 18.72" E.
- West of the Road - GNP touching Point with the road in South - (N) 26° 44' 47.36" and (E) 88° 46' 45.74"
- West of the Road -GNP touching Point with the road in North - (N) 26° 47' 40.84" and (E) 88° 47' 54.10"
- East of the Road 26° 47' 41.80" N and 88° 47' 83.01" E
- East of the Road - GNP Gate - 26° 48' 48.59" N and 88° 47' 52.79" E

2. Secondary Information

Various publications by noted authors who worked on vegetation as well as wildlife diversity of GNP have been studied and referred to get the following information regarding GNP and other reserve forest areas adjacent to it.

- a) Identification and listing of species of conservation significance (Rare, Endangered, Endemic and Threatened- REET species) in accordance with IUCN, WCMC, BSL ZSI, WPA 1972 and Birdlife international, secondary field data base, published flora & endemic species in the study area is done. Wildlife Protection Act, 1972 and its amendments were also referred to for lists of wildlife available in its Schedules.

- b) Prediction of present and future impacts on biodiversity as a whole and identification of conservation measures framed into conservation plan taking into consideration various legal measures, regulation, and guidelines like The Biological Diversity Act, 2002, Wildlife Protection Act, 1972, Forest Conservation Act, 1980 Rare and Endangered plants (red List of Plants BSI).
- c) GNP being an MPCA (Medicinal Plant Conservation Area) various species of medicinal plants are conserved *in-situ*. A study on ethnomedicinal importance was done and earlier studies by various authors are also referred to for understanding the structure of the ecosystem.
- d) Discussion on various aspects of wildlife movement and other day-to-day management activities was done with ground level staff of Forest Department and people residing in Bichabhanga Banabasti (Forest Village) to understand the level of disturbance.

Publications on similar other habitats and problems were also studied to address various issues connected with conservation and management.

CHAPTER - V

FINDINGS

1. Flora and Fauna

The area falls in the Indomalaya eco-zone. Inside the park, the primary biomes corresponding to the eco-zone are:

1. Terai-Duars savanna and grasslands of the tropical and subtropical grasslands, savannas, and shrub lands biome
2. Lower Gangetic plains moist deciduous forests of the tropical and subtropical moist broadleaf forests biome

The entire forest tract of GNP comes under the North Indian moist tropical forest type in Champion & Seth's (1968) classification. The trees, which are commonly found within the forest and are highly important from the economic and ecological points of view includes sal (*Shorea robusta*). This species occurs here with its usual associates like Chilouni (*Schima wallichii*), Chikrasi (*Chukrasia tabularis*), Champa (*Magnolia champaca*) and Bahera (*Terminalia bellirica*). The other important species, which are also commonly seen in GNP includes Jarul (*Lagerstroemia parviflora*), Bangla badam (*Terminalia myricarpa*), Duabanga grandiflora, *Aglaia spectabilis*, *Aphanamixis polystachya*, *Bischofia javanica*, *Bombax ceiba*, *Acacia catechu*, Sisso (*Dalbergia sissoo*) and *Albizia spp.* etc. GNP area is surrounded by patches of plantations of Khair (*Acacia catechu*), *Lagerstroemia parviflora*, bamboo (*Bambusa spp.*), (Amloki) *Phyllanthus emblica*, Chalta (*Dillenia indica*) etc. A list of plant species identified during the study is attached in table-1A, Table 1B and Table 1C. In the study area 88 plant species could be identified out of which 56 species herbs and shrubs, 29 species of trees and 3 species of non-flowering plant species.

Gorumara is famous for Asiatic one horned Rhinoceros, Asian Elephant, Gour, Peacocks etc. It has approximately 48 species of mammals (carnivores and herbivores), approximately 193 species of birds, 22 species of reptiles including 7 species of turtles, 40 species of fishes and other macro and micro fauna (Anonymous, 2007a). This Protected Area is famous for one of the last small pockets in Eastern India, that harbours natural population of Greater One-horned Rhinoceros (*Rhinoceros unicornis*), along with other mega-herbivores like Asian Elephant (*Elephas maximus*), Gaur (*Bos gaurus*) and other Deer species.

2. Endangered Species of GNP

Destruction of their habitat over the years, has brought the rhinos to the brink of extinction. These animals are among the worlds' most endangered species. Rhinos of Jaldapara and Gorumara were not that much fortunate. Low population density led them to live a more or less solitary life. In addition to that, limited favourable green pastures and wallowing pools, made them a bit aggressive particularly in the driest months (Bhattacharya and Chakraborty2016).

Schedule-I wildlife mammalian species found in this region are (Mandal. S, 2007¹¹)

- i. Greater One-horned Rhinoceros (*Rhinoceros unicornis*),
- ii. Asian Elephant (*Elephas maximus*),
- iii. Gaur (*Bos gaurus*)

¹¹ Mandal S, Wild Fauna of Gorumara National Park, Jalpaiguri, West Bengal. INTAS POLIVET, Vol 8 No.1: 257-261.

- iv. Tiger (*Panthera tigris*)
- v. Leopard (*Panthera pardus*)
- vi. Malabar giant squirrel, (*Ratufa indica*)

Schedule-I Reptile species and also in IUCN vulnerable list

- i. Python (*Python reticulates*)
- ii. King Cobra (*Ophiophagus hannah*)

Dubey *et al.* 2015¹² reported 128 avifaunal taxa belonging to 49 families were recorded from Gorumara and Jaldapara National Park. The forest understory found to be the most preferred nesting niche for birds. Insectivores were most prominent feeding guilds. Bengal Florican (*Houbaropsis bengalensis*) Schedule-I Bird species and also critically endangered (IUCN Red Listed). The study also reports that heavy traffic flow of NH-31 (now NH 717) disturbs the natural environment of adjacent reserve.

Butter fly species like Bicolor Cupid (*Shijimia moorei*) and Malayan Nawab (*Charaxes moori*) are the species of butterflies placed in Schedule-I of the Wildlife Protection Act, 1972. A species namely Witch (*Araotes lapithis lapithis*) reported from this NP is also included in Schedule II of above Act. 314 of the butterflies were recorded initially as part of an inventory building exercise and published in the form of a book¹³.

3. Plants of Medicinal Value

Earlier study done by Saha *et al.*, 2013 has identified 127 species of medicinal plants, which are directly used by the local people. Of these, 36 are trees, 34 are shrubs and climbers and 57 are herbaceous plants¹⁴. During this study some of these species could also be identified. GNP being a declared Medicinal Plant Conservation Area (MPCA) there are lot of medicinal plants within it. But outside GNP, *i.e.* in the present study area there are six species of trees and 18 species of herbs and shrubs found to be available and are regularly used by local people. Table -2 gives a record of all such species as described by Saha *et al.* 2013. These species are both important for its conservation value and for the economic use value.

¹² S K Dubey, D Chakraborty, M Mitra, R Bhattacharya and A B Neogy. Avifaunal assemblages at Gorumara and Jaldapara National Parks in India with reference to habitat association and feeding guild. Asian Journal of Conservation Biology, 2015. Vol. 4 No. 2, pp. 151-160

¹³ Anonymous 2013. A Pictorial Guide: Butterflies of Gorumara National Park, Department of Forest, Govt of West Bengal.

¹⁴ G. Saha, R. Biswas and A. P. Das Survey of medicinal plants in the Gorumara National Park, Jalpaiguri, West Bengal, India, *Pleione* 7(1): 127 - 137. 2013.

CHAPTER - VI**CONSERVATION STATUS OF SOME PLANT SPECIES IN GNP**

As per the checklist of species available within GNP area following are the plant species, which are ecologically significant with proper status against them. The names in first brackets indicate local name and third brackets indicate conservation status of each species (Das *et al.*)¹⁵.

These are:

- i. *Ampelocissus barbata* of Vitaceae [EN]-Shrub
- ii. *Celastrus paniculatus* of Celastraceae [EN] – Woody liana
- iii. *Cinnamomum bejolghota* of Lauraceae [VU] - Tree
- iv. *Desmodium motorium* (Ban chandal) of Fabaceae [VU] -Shrub
- v. *Gynocardia odorata* (Chalmogra) of Flacourtiaceae [EN] - Tree
- vi. *Gymnema sylvestre* (Gurmar) of Asclepiadaceae [VU] -Herb
- vii. *Helminthostachys zeylanica* (Ekbir) of Helminthostachyaceae [EN]-Peridophyte
- viii. *Lycopodium cernuum* (Nagbeli) of Lycopodiaceae [EN] -Pteridophyte
- ix. *Ophioglossum reticulatum* (Ektir) of Ophioglossaceae [EN] -Pteridophyte
- x. *Pericampylus glaucus* (Pipal Pati) of Menispermaceae [VU]- Woody climber
- xi. *Persea glaucescens* syn. *Machilus glaucescens* of Lauraceae [CR] -Tree
- xii. *Rauvolfia serpentina* (Sarpagandha) of Apocynaceae [EN] - Shrub
- xiii. *Stereospermum colais* (Padri) of Bignoniaceae [VU] - Tree

* **Note:** NT-Near threatened, EN-Endangered, VU-Vulnerable, LC-Least Concern, CR-Critically endangered.

During the present study 6 (six) species of conservation importance are found in the study area. Out of the six one is a tree species (*Gynocardia odorata*) three shrub and herb species (*Rauvolfia serpentina*, *Gymnema sylvestre* and *Helminthostachys zeylanica*) and two Priridophytes (*Helminthostachys zeylanica* and *Lycopodium cernuum*) needs *in situ* conservation efforts. It needs to mentioned here with due importance that a quick study could identify these species outside GNP are and if a rigorous study is done there could be many more species of rare, endangered and threatened (RET) category even outside the GNP deserving *in situ* conservation.

¹⁵ D. Das, B. K. Pramanik and S. K. Mollay. A Model Classical Ecological Report on Vegetation dynamics in Gorumara National Park in West Bengal, India *Int. J. Phar. & Biomed. Res.* **2015**, 2 (2): 1-14

CHAPTER - VII

IMPACTS

Large scale tree felling in the buffer zone of GNP is going to have a cascading effect on the ecosystems as well as species diversity of the National Park and on its buffer zone. It is apprehended that there will be huge adverse impact on wildlife habitat and their corridors, on the species structure of floral component and the functional interrelationship between its physical and biological components of the GNP. Therefore a review is needed to be undertaken in larger interest of ecology of the GNP and looming large threat of climate change. It is evident that the proposed over bridge on the railway track will enhance road traffic to a great extent. The present traffic load is hardly 300 vehicles/day as per a local study. Increased traffic flow will also have many adverse effects.

Enrichment of Atmospheric Carbon

Release of sequestered Carbon in the form of CO₂ to the atmosphere due to felling of trees has been huge. In the following steps contribution of CO₂ to the total GHG is calculated.

i) Biomass Estimation

Data obtained from the documents signed by the Beat Officer, Central Beat, Lataguri 551 (five hundred and fifty one) trees were felled or are marked to be felled within 3rd April 2017 to 7th April 2017. Girth at breast height (GBH) and height of the trees were measured and recorded by the Beat Officer, Central Beat of Lataguri, under Jalpaiguri Forest Division of the Forest Department (FD), Govt. of West Bengal. Total volume calculated by the FD from GBH and height of the trees felled and marked to be felled is 322.721m³ (cubic meters). In other words about 323m³ of timber has been removed/awaiting removal during the process of felling. The Beat Officer of FD must have used the 'volume table' for calculating the volume of the trees. In this case no attempt has been made to calculate volume using universally used General Volume Equation devised by Food and Agriculture Organization (FAO¹⁶).

General volume equations (GVEs), i.e. regression functions in volume, diameter and height are selected for each species. The GVEs are obtained from randomly selected tree data by applying multiple regression methods. The following regression equation is used in this case.

$$\text{Formula used: } V = a + bD^2H$$

Where V = volume under bark (m³), D = diameter at breast height (1.37 m) over bark (As obtained from the data prepared by the Forest Beat Officer stated above), H = height of tree (m), a is the intercept and b is regression coefficient. The best-fit regression equation is used to estimate the volume of trees.

Note:- This Biomass is only timber biomass which is otherwise known as above ground 'merchantable' in the terms of International Timber Market. Total biomass removed due to felling include the following-

Total biomass of a tree = Above Ground 'merchantable'/timber biomass + Above ground non-merchantable biomass which include components such as removable barks, tree tops, branches, twigs, foliage, sometimes stumps) + below ground root biomass.

¹⁶ FAO Corporate Document Repository Chapter IV: Volume tables and equations:
<http://www.fao.org/documents/>

a) Estimation of above ground 'merchantable' biomass.

This biomass is estimated using volume and specific gravity of *Schima wallichii* according to Richter and Dallwitz, 2000¹⁷ as most of the trees felled are of this species. *Schima wallichii* is locally known as Chiloni/ Chillon/ Makri sal. Here specific gravity of *S. wallichii* is considered to be 6.85, the mid-value of the range stated by the author. The logic behind taking mid-value is that it can represent all the trees felled as there are trees of various girth classes and heights.

Merchantable/Aboveground Biomass (in tonnes) of the trees felled = Volume (in m³) x specific gravity of *S. wallichii* i.e. 322.721m³ x 6.85tonnes = 2210.639 tonnes

This is only the above ground timber biomass of the trees felled as stated above.

b) Aboveground non- merchantable biomass: This biomass could not be calculated in the field directly. There is also no such acceptable formula available in India to get an idea of the biomass of the removable barks, tree top, leaves, twigs, non-commercial tree trunks and branches. Here a 'Calculator' used by 'Canada's National Forest Inventory' has been used for the category "Mixedwood Plains - Unidentified Hardwood - Treed Broadleaf - Dense Forest" (Website- https://nfi.nfis.org/en/biomass_stand_nonmerch) only to understand the probable ratio of this category to merchantable timber biomass.

The ratio is - 1.9: 0.9 i.e. Aboveground merchantable biomass: Aboveground non-merchantable biomass. Using this ratio the aboveground non-merchantable biomass in this case is 1047.145 tonnes (0.9/1.9 x 2210.639)

c) Belowground /root biomass: The root system weighs 24% (IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4) for tropical moist deciduous forests as much as the above-ground weight of the tree.

Therefore the root biomass is 2210.639 tonnes x 0.24= 530.554 tonnes.

Biomass of aboveground non-merchantable components and root system is going to be decomposed / burnt as fuel wood from the day of felling.

This immediately decomposable/fuel wood biomass is 1047.145tonnes+530.554 tonnes = 1577.699 tonnes i.e. this is about 42% of the total biomass which is a significant amount.

Therefore the total biomass = Merchantable/Aboveground Biomass + Root biomass + Aboveground non-merchantable biomass i.e. 2210.639 + 530.554 + 1047.145 = 3788.338 tonnes is the biomass of the 551 trees felled/about to be felled.

ii) Estimation of Carbon stored in the felled trees

Estimation of carbon stored or in other words supposed carbon loss due to wood removal is done following 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use¹⁸) in Tropical and Subtropical forests. The conversion factor for converting biomass to carbon is 0.49.

Therefore the amount carbon emitted / going to be emitted due to this large scale felling is -

$$3788.338\text{tonnes} \times 0.49 = 1856.286 \text{ tonnes of Carbon}$$

¹⁷ H. G. Richter and M. J. Dallwitz (2000 onwards). 'Commercial timbers: descriptions, illustrations, identification, and information retrieval.' In English, French, German, and Spanish. Version: 4th May 2000. <http://biodiversity.uno.edu/delta/>.

¹⁸ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use

iii) Calculation of Carbon Dioxide sequestered in the felled trees

Determination of the weight of carbon dioxide sequestered in the felled trees during the period of their existence is calculated by multiplying the weight of carbon in the tree by 3.67¹⁹.

$$1856.286 \text{ tonnes carbon} \times 3.67 = 6812.568 \text{ tonnes of CO}_2$$

The calculations depict that almost 7000 tonnes of CO₂ has been/going to be unleashed to the atmosphere in spite of the fact that there were alternate ways to . This CO₂ is going to add to the pool of GHG that is already present in the atmosphere.

For the sake of argument if it is accepted that the timber part (merchantable biomass) is not going to be decomposed immediately then the immediately decomposable part is going to release 2861.278 tonnes of CO₂.

Impact on Plant Species Diversity

When land is cleared for roads, it often facilitates the spread of invasive species. The area along the road also provides an ideal habitat for invasive species like *Lantana camara*, *Eupatorium odoratum*, which are already becoming threat to GNP. Roads can facilitate invasions because these plants face less competition from plants in a newly cleared area. Among the flowering plants, *Eupatorium odoratum*, *Lantana camara*, *Mikania indica* and *Ageratum conyzoides* exhibited aggressive invasions in this forest area. A study by Pickering and Hill²⁰ states that initial physical disturbance from the construction of the road, vehicular traffic and regular maintenance of the road and right-of-way cause recurring physical disturbance that may benefit introduced species.

Generally impact of rainfall is more intense on the edge of the road than in the interior forest, which can cause more damage to the saplings near the road. Dispersal of seeds and other propagules are heavily disturbed in the wide roads ultimately leading to isolation and reduced viability of the affected vegetation on both the sides of the road.

Habitat Loss and Fragmentation

As such a road dissect contiguous habitat patches resulting in higher edge-to-interior ratios. This causes increased disturbance to long ranging animals like elephants, Gaur, Rhinos etc. Fragmentation of habitat has caused substantial decline in amphibian population worldwide during the last century (Stuart et al, 2004). The present road passing through Garumara has envisaged number of road-kills of ophifauna in the past. Further widening and making this road will aggravate the problem.

In Gorumara, it is specifically mentioned by the field level forest staff and so also by the villagers that during late winter and summer water scarcity compels long-ranging animals to move westwards to Neora river in search of water. The existing road is a hurdle and therefore many road kills and confrontations have been recorded. One such artificial water source made at GARAPI is now facing problem of existence due to lack of management. The proposed alternate route (Annexure II) being west to GNP will minimize this confrontation and road kills.

Due to road widening, population of arboreal animals such as rhesus monkeys may be fragmented into small sub-populations. The fragmented subpopulations suffer due to inbreeding depression, loss of genetic variability and finally to local population extinction. A study of similar type has established the adverse impact of road widening in Namdapha National Park (Murali Krishna *et al.* 2013)²¹.

¹⁹ http://www.ncsec.org/cadre2/team18_2/students/helpCalcCO2.htm

²⁰ Pickering C, Hill W. Roadside weeds of the snowy mountains, Australia. Mt Res Dev 2007;27:359–67

²¹ Murali Krishna. C, A. Kumar, P C Ray, K. Sarma, A. Devi and M.L. Khan Impact of road widening on wildlife in Namdapha National Park, Arunachal Pradesh, India: a conservation issue. *Asian Journal of Conservation Biology*, July 2013. Vol. 2 No. 1, pp. 76–78

Increase in Road kill

Road mortality is one factor, which is potentially important in declining populations of amphibians and reptiles' worldwide (Fahrig, 1995)²² such studies are given very less importance. Several studies have quantified road kills of many different taxa, e.g. toads, birds, mammals, amphibians, and reptiles, butterflies, snakes, mammals, birds and reptiles (Drews, 1995)²³, deer and other ungulates (Groot Bruinderink and Hazebroek, 1996)²⁴.

When a road crosses through an animal's preferred habitat, the chances increase for road mortality. Widening of road due to construction of fly-over within the vicinity of the GNP will enhance probability of road kill of some animal species, as they have to cross a wider road. Risk of mortality as they cause animals to spend more time around the road. When animals cross roads, mortality is often the result. In fact, road mortality is the leading source of mortality to many wildlife populations. Some animals are prone to road mortality due to their natural defense mechanisms, which although effective when dealing with natural predation, are often poorly equipped to handle the dangers posed by cars.

Reptiles like snakes and turtles sometimes bask on the warm asphalt of the road to regulate their body temperatures. Turtles often perceive cars as a threat and draw into their shell to protect themselves, which can put them at risk for getting struck by a vehicle because they stay on the road longer. Snakes may also become immobilized when approached by a vehicle and may remain immobilized for a minute after it passes. Venomous snakes may be less inclined to flee from a perceived threat because they typically use venom for defense.

Movement during particular life stages can also result in peaks in mortality. In some snake species, the male can increase its home range up to 6 times as it searches for a mate. Many reptiles begin dispersing immediately after hatching, which also results in mortality peaks. Some studies have reported movement rates as the single greatest factor influencing the risk of road mortality.

Animals with large home ranges have a high chance of encountering roads as they traverse such large distances.

Barrier Effect on Wildlife

It is generally conceived that road widening will have no additional effect on wildlife but Wildlife Institute of India (WII)²⁵ is of the opinion that all such up-gradations lead to both enhancement of traffic volume and velocity and therefore become hindrance to animal movement across the highway. By using a model of 'barrier effect' in both two and four lane section and some species specific characters like body length, behavior, average group size, average time taken to cross the road, road width, traffic volume and heterogeneity of vehicles WII has inferred that all these factors influence the success of crossing over by the animal species. It also depicts that a wide road pose as a 'barrier' to their movement. While it may reflect in a decline of their mortality, it will also deprive them from using their entire habitat and may ultimately lead to a decline in their genetic fitness.

²² Fahrig, L., Pedlar, J.H., Pope, S.E., Taylor, P.D. and Wegner, J.F. 1995. Effect of road traffic on amphibian density. *Biological Conservation* 73: 177-182.

²³ Drews, C. 1995. Road kills of animals by public traffic in Mikumi National Park, Tanzania, with notes on baboon mortality. *African Journal of Ecology* 33: 89-100.

²⁴ Groot Bruinderink, G.W.T.A. and Hazebroek, E. 1996. Ungulate traffic collisions in Europe. *Conservation Biology* 10(4): 1059-1067.

²⁵ Wildlife Institute of India, 2016 Ecofriendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife.

The well-known direct effects of roads on birds include habitat loss and fragmentation, vehicle-caused mortality, pollution, and poisoning. Nevertheless, indirect effects may exert a greater influence on bird populations. These effects include noise, artificial light, barriers to movement, and edges associated with roads. Moreover, indirect and direct effects may act synergistically to cause decreases in population density and species richness. Of the many effects of roads, it appears that road mortality and traffic noise may have the most substantial effects on birds relative to other effects and taxonomic groups²⁶. Increasing habitat loss and fragmentation and predicted species distribution shifts due to climate change are likely to compound the overall effects of roads on birds.

Lack of sufficient numbers of saltlicks is another reason of conflict that Gorumara faces. Natural licks provide minerals like sodium, calcium, iron, phosphorus and many trace elements are required for physical proper growth of wildlife. In the natural process harsh weather conditions expose these licks present in the subsoil and are used by animals. There are available techniques for making these saltlicks artificially available for wildlife that requires regular monitoring.

Increase in Human-Wildlife Conflict (HWH)

The degree of HWH in GNP could be understood from the following data, which is available in the public domain²⁷. Payment of Ex-gratia Relief for animal depredation in 2013 was Rs 32,29,087 by the Forest Department. 18 persons were killed and 123 were injured in the year in the vicinity of GNP during the said year. Other aspects include livestock killed, hut damage and crop damage. It is therefore, apprehended that tree felling, over bridge construction and consequent widening of roads will further aggravate this problem.

Other Impacts

Increased traffic volume close to GNP will ensure more pollutants like Pb, Cd, Cu, and Zn concentrations to increase in the air. These are natural pollutants generated due to burning of fossil fuel. The toxic metals will have a negative impact on the biome as a whole and may surpass tolerable limit.

A study by Neher *et al.* 2013 shows that soil samples were more alkaline near the road and acidic in the adjacent native forest. In GNP earlier studies show that topsoil is always acidic (pH is close to 6) primarily due to litter decomposition, which produce organic acids. Soil suitability study of different tree species shows that the pH lower than 7 is always suitable for sal (*Shorea robusta*), a leading tree species of this forest area. The study by Neher *et al.* 2013 says that proximity to all road types made the soils more alkaline (pH 7.7) relative to the acidic soil of the adjacent native forest (pH 5.6). Therefore secondarily, road presence will affect soil chemistry. In the long run changed chemical nature of soil will becomes unsuitable for the native vegetation composition of a part of GNP.

This would certainly initiate concretization though construction of more tourist and real estate mushrooming across the length of this highway. A beautiful forest, which is already seeing ingress of lacs of visitors and affecting wild life, would be turning into a human habitat and endangering wild life badly in days to come.

²⁶ Koklolk, A.V.A, P. Clevenger, C.C. St Clair and D.S. Proppe 2011. Effects of Road Networks on Bird Population. Conservation Biology 25: 241-249.

²⁷ Mukherjee, N. 2016. A Brief Appraisal of Human Wildlife Conflict in Jalpaiguri and Alipurduar Districts of West Bengal, International Journal of Scientific and Research Publications, 6 (8): 131-136.

CHAPTER - VIII

SUGGESTIVE MEASURES (Ecological Alternatives)

Although important for economic development, excessive road expansion into wildlife habitats, and roads that are poorly planned and do not integrate wildlife safety into their planning, will cause irreparable harm to wildlife. Integrated conservation planning that provides long-term solutions for reducing the impacts of linear intrusions like roads on wildlife need to be urgently developed for the country.

Wildlife encompasses both wild animals and plants. Strategy for conservation of wildlife does not only mean protection of rare and endangered species rather taking up a holistic management plan of all the species in the habitat. Now a days landscape conservation is more relevant that conservation in the species level only. In a National Park linear development projects such as roads are invariably in conflict with the objectives of conservation.

A National Parks, in our country, are conservation areas of highest order because they have valuable wildlife habitats within it and corridors around it. These wildlife corridors are also being severely impacted due to developmental projects inside forestland. Manoj *et al.* (2013)²⁸ while reviewing the forest wildlife scenario of northern West Bengal have suggested that for every project environmental impact assessment must be carried out by an external independent agency.

1. It is suggested that vehicles which use the aforesaid stretch of National Highway No. 717 can avail of an already existing alternate route passing through– Lataguri-Neora More-Baradighi-Caltex More-Malbazaar. This route can suitably bear heavy traffic movement between Malbazar and Chalsa. This road is under the Pradhan Mantri Gram Sadak Yojana (PMGSY) and has bitumen surface. This road will have least impact on wildlife in particular and biodiversity at large because it does not have good forest in either side of it. In this case the Flyover can be built at the Railway Crossing having GPS bearing (N) 26° 46' 13.86" and (E) 88° 44' 18.72" at an altitude of 102m. Two maps with the alternate route marked is annexed and marked as 'Annexure I' and Annexure II. Annexure I shows a graphical view of the alternate route where as Annexure II gives an idea about the vegetation cover of the alternate route. The proposed alternate route does not have a good vegetation cover on its either side for a considerable stretch and never touches GNP at any point. This route was used successfully on 6th and 7th April 2017, on the days while tree felling and protests were going on, on NH 717.

National Wildlife Action Plan - 2002-2016, states that the "Ministry of Surface Transport... to plan roads, highways, expressways in such a manner that all national parks and sanctuaries are bypassed and integrity of the PA is maintained. Wildlife corridors also need to be avoided, or mitigative measures (such as restricting night traffic) need to be employed." This principle must serve as the cornerstone of any road plan that is being conceived in the vicinity of any Wildlife Sanctuary or Protected Area.

There are some precedents to such situations too, e.g. the NH is diverted to other side (north) side of Brahmaputra to avoid road passing through the middle of Kaziranga National Park to avoid disturbance of wildlife. The NGT had earlier ordered a ban on roadside shops and eateries along the animal corridors near Kaziranga, among a slew of directions in the wake of increasing wildlife

²⁸ Manoj K., Bhattacharyya R. and Padhy P .K. Forest and Wildlife Scenarios of Northern West Bengal, India: A Review. *Int. Res. J. Biological Sci.* **2(7)**, 70-79.

casualties due to vehicular movement on the adjacent highway. In August 2015 National Green Tribunal (NGT) asked the Assam government to ensure that no construction whatsoever was permitted in and around the Kaziranga National Park, and directed it to submit a map of Kaziranga showing its boundaries and offending structures within five kilometers of the park boundaries.

2. It is also suggested that the present road (NH No 717) passing adjacent to the GNP be closed every night i.e. dusk to dawn to enable the wildlife to use their corridors freely across the road. During this period the alternate road stated above may be used causing very little damage to GNP.

Potential measures for mitigating the detrimental effects of roads on bird population include noise-reduction strategies and changes to roadway lighting and traffic flow.

3. To reduce impacts of roads, the width of cleared area should be reduced and traffic consolidated to fewer individual vehicles on the road. The forest edge should be cultivated to maximize the insulating effect and maintain low-resource-adapted native plant communities within the forest. By reducing the transportation system's physical footprint and cultivating native vegetation borders, it may be possible to maintain natural plant communities and stem the introduction of chemicals into the environment²⁹.
4. Participatory *in situ* conservation strategies are to be properly implemented in order to save species of RET category as stated above as well as wildlife species of Schedule I and Schedule II. This needs knowing the places of availability of the species, their niche strategy and their reproduction/propagation behavior and makes people aware so that every stakeholder can take proper care.
5. Similarly conservation of medicinal plants available in the study area deserves proper attention of the conservators. Canopy exposer due to large scale felling of trees will harm the ground vegetation to a large extent. Most of the medicinal plant species belong to the category of herbs and shrubs. Therefore, these species needs rehabilitation and participatory conservation in a new area.
6. A wildlife conservation and management plan (WCMP) has to be prepared with experts in the field. This may include structural options and non-structural options like suitably made canopy bridges for Rhesus monkey population and other arboreal animals, holistic habitat management plan, corridor plantings, local traffic management etc. It is evident that movement of wildlife does not confine to the boundaries of a national park. Whether a long ranging or short ranging animal, they can roam within the park and always use its periphery, also known as its buffer zone as their niche. This proposed wildlife conservation and management plan should address all these issues.
7. Ample arrangement of water sources by making new water holes and management of existing water holes like that of the existing one at GARAPI has to be done. There is also lack of sufficient saltlicks for wildlife within the Park. Artificial saltlicks are to be suitably placed as per suggestions of WCMP to provide required nutrients supplementing their diet.
8. No measures were taken for plantation to compensate the loss even India is a signatory of CoP-13 (Bali 2013) agreement on 'Compensated Conservation' intended to compensate the countries for maintaining and increasing carbon pools of their forests³⁰. Immediate measures

²⁹ Deborah A. Neher, D. Asmussen, S Taylor Lovell. Roads in northern hardwood forests affect adjacent plant communities and soil chemistry in proportion to the maintained roadside area. Science of the Total Environment 449 (2013) 320–327

³⁰ MOEFCC, National Policy On REDD+

have to be taken to compensate the loss by planting tree species indigenous to the region. Identification of land outside forest area has to be done to compensate this loss according to the laws of the land.

To **conclude** it can be emphatically said that there is enough space available in making alternate conservation strategies to protect the National Park. Neither the Forest Administration nor the Project Proponent has opted to go by the rules of this country. The wildlife habitat of Garumara National Park has not been treated in the manner that a Protected Area of the present world should get. There is no doubt of the fact that a blunder has been committed to the GNP by felling such a large number of trees which can hardly be undone. Making an over bridge or widening of a road within a wildlife habitat can not be called as a 'development project' unless it addresses the issues concerned with not only wildlife management but also with the whole LANDSCAPE MANAGEMENT in and around Lataguri.

Table 1A: List of Shrub and Herb Species Found Within Study Area

	Scientific Name	Family	Conservation status
1.	<i>Achyropermum wallichianum</i>	Lamiaceae	Rare
2.	<i>Ageratum conyzoides</i>	Asteraceae	Common
3.	<i>Amaranthus sp.</i>	Amaranthaceae	Frequent
4.	<i>Amaranthus viridis</i>	Amaranthaceae	Rare
5.	<i>Andrographis paniculata</i>	Acanthaceae	Common
6.	<i>Asparagus recemosus</i>	Liliaceae	Frequent
7.	<i>Axonopus compressus</i>	Poaceae	Common
8.	<i>Bauhinia purpurea</i>	Fabaceae	Least abundant
9.	<i>Bombax ceiba</i>	Bombacaceae	Frequent
10.	<i>Cardiospermum helicacabum</i>	Sapindaceae	Common
11.	<i>Cassia tora</i>	Fabaceae	Common
12.	<i>Centella asiatica</i>	Apiaceae	Frequent
13.	<i>Cheilocostus speciosus</i>	Zingiberaceae	Frequent
14.	<i>Clerodendrum indicum</i>	Verbenaceae	Frequent
15.	<i>Crinum sp.</i>	Liliaceae	Less abundant
16.	<i>Crotalaria palida</i>	Fabaceae	Frequent
17.	<i>Croton oblongifolius</i>	Euphorbiaceae	Rare
18.	<i>Cynodon dactylon</i>	Poaceae	Common
19.	<i>Cynoglossum amabile</i>	Boraginaceae	Common
20.	<i>Cyperus sp.</i>	Cyperaceae	Frequent
21.	<i>Dactyloctenium indicum</i>	Poaceae	Least abundant
22.	<i>Digitaria sanguinalis</i>	Poaceae	Less abundant
23.	<i>Dioscorea alata</i>	Dioscoreaceae	Common
24.	<i>Dioscorea bulbifera</i>	Dioscoreaceae	Common
25.	<i>Dioscorea pentaphylla</i>	Dioscoreaceae	Common
26.	<i>Eclipta prostrate</i>	Asteraceae	Less abundant
27.	<i>Glycosmis arborea</i>	Rutaceae	Frequent
28.	<i>Grewia asiatica</i>	Euphorbiaceae	Less abundant
29.	<i>Heliotropium indicum</i>	Boraginaceae	Common
30.	<i>Helminthostachys zeylanica</i>	Helminthostachyaceae	Endangered
31.	<i>Holarrhena pubescens</i>	Apocynaceae	Common
32.	<i>Holmskioidea sanguine</i>	Lamiaceae	Rare
33.	<i>Lassia spinosa</i>	Araceae	Less abundant
34.	<i>Leucas indica</i>	Lamiaceae	Common
35.	<i>Luffa aegyptiaca</i>	Cucurbitaceae	Rare
36.	<i>Macardonia procumbens</i>	Scrophulariaceae	Frequent
37.	<i>Melastoma malabathicum</i>	Melastomataceae	Frequent
38.	<i>Mucuna prurita</i>	Fabaceae	Frequent
39.	<i>Oplismenus burmanii</i>	Poaceae	Common
40.	<i>Osbeckia chinensis</i>	Melastomataceae	Less abundant
41.	<i>Oxalis corniculata</i>	Oxalidaceae	Less abundant
42.	<i>Paspalidum flavidum</i>	Poaceae	Rare
43.	<i>Phyllanthus simplex</i>	Euphorbiaceae	Frequent
44.	<i>Phyllanthus virgatus</i>	Euphorbiaceae	Frequent
45.	<i>Physalis minima</i>	Solanaceae	Common

46.	<i>Plumbago zeylanica</i>	Plumbaginaceae	Less abundant
47.	<i>Polygonum sp.</i>	Polygonaceae	Less abundant
48.	<i>Rauwolfia serpentine</i>	Apocynaceae	Frequent
49.	<i>Ruellia prostrate</i>	Acanthaceae	Less abundant
50.	<i>Scoparia dulcis</i>	Scrophulariaceae	Frequent
51.	<i>Sida acuta</i>	Malvaceae	More common
52.	<i>Smilax prolifera</i>	Smilacaceae	Rare
53.	<i>Solanum nigrum</i>	Solanaceae	Rare
54.	<i>Solanum Americana</i>	Solanaceae	Frequent
55.	<i>Tabernemontana divericata</i>	Apocynaceae	Common
56.	<i>Wrightia tinctoria</i>	Apocynaceae	Common

Table 1B: List of Tree Species Found Within Study Area

Sl No.	Scientific Name	Family
1.	<i>Aesculus indica</i>	Sapindaceae
2.	<i>Amoora spectabilis</i>	Meliaceae
3.	<i>Baccaurea sapida</i>	Phyllanthaceae
4.	<i>Casearia graveolens</i>	Salicaceae
5.	<i>Cassia fistula</i>	Fabaceae
6.	<i>Dillenia indica</i>	Dilleniaceae
7.	<i>Duabanga sonneratioides</i>	Lythraceae
8.	<i>Garcinia elliptica</i>	Clusiaceae
9.	<i>Gynocardia odorata</i>	Achriaceae
10.	<i>Ilex godajam</i>	Aquifoliaceae
11.	<i>Lagerstroemia flos-reginae</i>	Lythraceae
12.	<i>Lannea coromandelica</i>	Anacardiaceae
13.	<i>Litsea chinensis</i>	Lauraceae
14.	<i>Litsea hookerii</i>	Lauraceae
15.	<i>Magnolia pterocarpa</i>	Magnoliaceae
16.	<i>Mallotus philippensis</i>	Euphorbiaceae
17.	<i>Michelia champaca</i>	Magnoliaceae
18.	<i>Phyllanthus emblica</i>	Euphorbiaceae
19.	<i>Premna bengalensis</i>	Lamiaceae
20.	<i>Saurauia roxburghii</i>	Ericales
21.	<i>Schima wallichii</i>	Theaceae
22.	<i>Shorea robusta</i>	Dipterocarpaceae
23.	<i>Syzygium formosum</i>	Myrtaceae
24.	<i>Sloanea sterculacea</i>	Elaeocarpaceae
25.	<i>Sterculia villosa</i>	Sterculiaceae
26.	<i>Syzygium jambolanum</i>	Myrtaceae
26.	<i>Terminalia belirica</i>	Terminaliaceae
27.	<i>Terminalia chebula</i>	Terminaliaceae
28.	<i>Tetrameles nudiflora</i>	Tetramilaceae
29.	<i>Wrightia arborea</i>	Apocynaceae

Table 1C: List of Fern Species Found Within Study Area

Sl No	Scientific Name	Family
1	<i>Helminthostachys zeylanica</i>	Helminthostachyaceae
2	<i>Diplazium esculantum</i>	Athyriaceae
3	<i>Ophioglossum reticulatum</i>	Ophioglossaceae

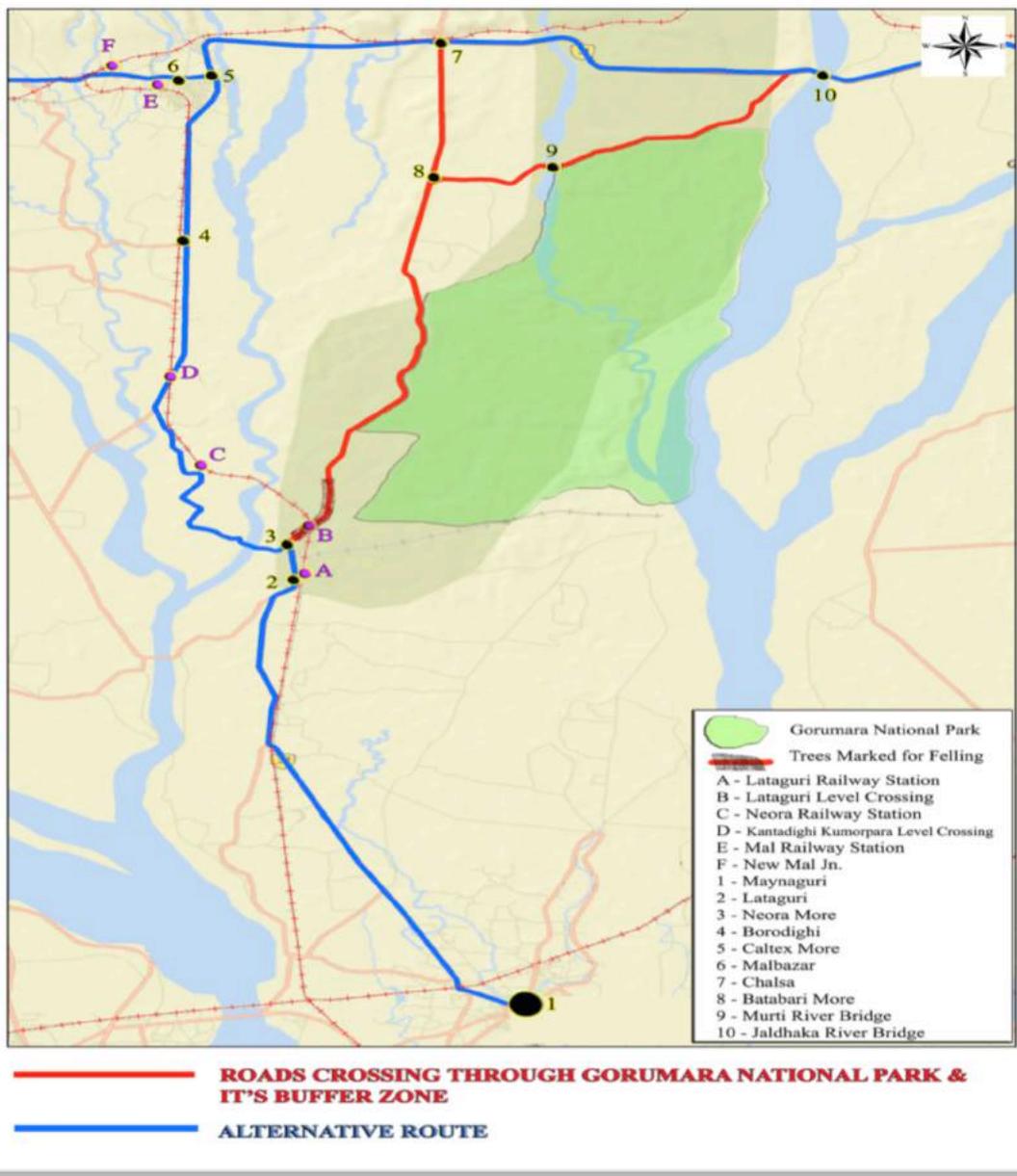
Table 2: List of Medicinal plants available in the study site (Ref: Saha *et al.* 2013)

Scientific name	Local name	Parts used	Uses
TREE SPECIES			
1. <i>Cassia fistula</i>	<i>Bandarlathi</i>	Leaves, bark, root, seeds.	Purgative, laxative, astringent, antipyretic, demulcent, tonic; ringworm, syphilis, skin disease, leprosy, ulcers, ophthalmic diseases, dyspepsia, constipation, fever, diabetes.
2. <i>Dillenia indica</i>	<i>Chalta</i>	Barks, leaves, fruits	Stomachache, fever, cough, astringent, laxative .
3. <i>Phyllanthus emblica</i>	<i>Amlaki</i>		
4. <i>Shorea robusta</i>	<i>Sal</i>	Resin and leaves	Diarrhoea, astringent, dysentery, fumigating, incense.
5. <i>Syzygium jambolanum</i>	<i>Jam</i>	Bark, leaves and fruits	Bark is carminative, diuretic, digestive. The tender leaves are used for vomiting. The fruits and seeds are used in diabetes.
6. <i>Terminalia belirica</i>	<i>Kathbadam</i>	Fruits and bark	One of the ingredients of the triphala of ayurvedic medicine, anaemia, leuco-derma, astringent, pungent, laxative, bronchitis, acrid, anthelmintic, inflammation, disease of eye and nose, problems of bladder and piles.
7. <i>Terminalia chebula</i>	<i>Haritaki</i>	Fruits	Used in stomachic, expectorant, carminative, anthelmintic, tonic, alterative, astringent, dysentery, vomiting, anaemia, elephantiasis, disease of eye, hiccups, tonic.
HERB AND SHRUB SPECIES			
8. <i>Ageratum conyzoides</i>	<i>Bhusbhuse</i>	Leaves, flowers, roots, whole plant	Leaves used in wounds, cuts and burns; root juice antibiotic, plants used febrifuge.
9. <i>Andrographis paniculata</i>	<i>Kalmegh</i>	Whole plant	Dental disease, antibacterial, anti-inflammatory, fever, dysentery, diarrhea, cough, sore throat, tonsillitis, bronchitis, hypertension, snake bite
10. <i>Asparagus recemosus</i>	<i>Satamuli</i>	Roots	Used in dysentery, diarrhea, leprosy, diabetes, jaundice, urinary disorders; anti-fungal and anti bacterial
11. <i>Dioscorea alata</i>	<i>Chuprialu</i>	Tubers	Diuretic, anthelmintic, diabetes, leprosy, gonorrhoea, strangury, contraceptive
12. <i>Dioscorea bulbifera</i>	<i>Chuprialu</i>	Tubers	Tonic, aphrodisiac, stomachic, expectorant, anthelmintic; dyspepsia, urinary discharge,

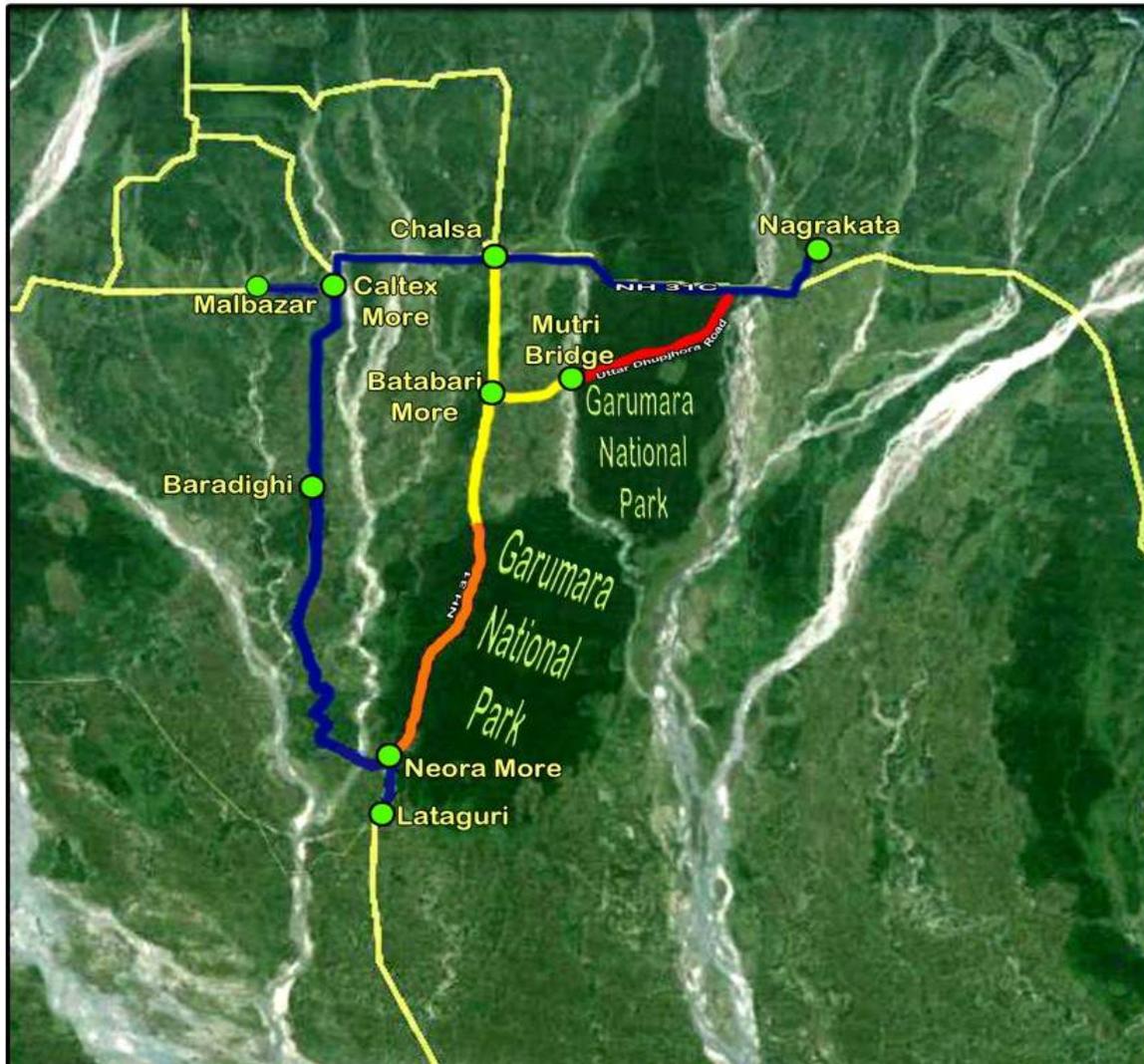
			bronchitis, leucoderma, piles, tumours, strangury, asthma, ulcers.
13. <i>Dioscorea pentaphylla</i>	<i>Pachpata alu</i>	Tubers, shoot	Used in dropsy, rheumatism, anti-inflammatory
14. <i>Holarrhena pubescens</i>	<i>Kurchi</i>	Bark, stem latex	Dysentery, lung diseases, tumour, skin eruption, irritation.
15. <i>Lassia spinosa</i>	<i>Kantakacu</i>	Leaves, inflorescence	Plant recommended for colic, rheumatism, and intestinal diseases
16. <i>Leucas indica</i>	<i>Murti</i>	Leaves, young twig	Leaf juice highly recommended in diabetes, useful as nasal drop
17. <i>Oxalis corniculata</i>	<i>Ambalisak</i>	Whole plant	Dysentery, diarrhea, piles, asthma, skin disease; refrigerant, appetizer
18. <i>Plumbago zeylanica</i>	<i>Chita</i>	Roots	Ulcers, rheumatism, paralysis, syphilis, leprosy, various skin problems; stimulants.
19. <i>Phyllanthus virgatus</i>	<i>Bidhira</i>	Roots	Fresh roots used to treat viral hepatitis
20. <i>Physalis minima</i>	<i>Bantepari</i>	Whole plant	Colic, ulcers, cough, bronchitis
21. <i>Rauvolfia serpentina</i>	<i>Sarpagandha</i>	Roots	Hypnotic, sedative, snake bite, blood pressure, insomnia, scorpion sting.
22. <i>Scoparia dulcis</i>	<i>Misti pata</i>	Whole plant	Piles, diuretic, hyperthermia, cough, sore throat, boils, menorrhagia.
23. <i>Sida acuta</i>	<i>Jharugachh</i>	Leaves and Roots	Leaves and roots used in stomachic and antipyretic, used in nervous and urinary disorders.
24. <i>Solanum americana</i>	<i>Kalebegun</i>	Tender shoots	The plant is useful in rheumatism, swellings, cough, asthma, bronchitis, wounds, ulcers, vomiting, leprosy, skin diseases and fever.

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Annexure II



10 km (approx) stretch of NH 31 between GNP and Territorial Forest - highly prone to road -kill



7 km (approx) stretch of Uttar Dhupjhora road connecting Murti Bridge and NH 31 C along northern side of GNP-highly prone to road -kill.



ALTERNATE ROUTE

