Mitigation measures for the proposed 33KV power line(Miao to Diyun) passing through Buffer Zonesfalling under Fringe areas of Namdapha Tiger Reserve.

Miao, Arunachal Pradesh.

Introduction:

Northeast India is a mega-biodiversity centre and Indo-Burma global biodiversity hotspot (Myer *et al.*, 2000; Mittermeier, 2004), which forms a significant portion of both the Himalaya and Indo-Burma biodiversity hotspots (Mittermeier, 2004). This region comprises of 8 states including Arunachal Pradesh which is the largest among them spanning with a geographical area of 83,743 $km^2$and is located at the foothills of Eastern Himalayas. The state harbours large patches of evergreen rainforest which comprises of huge habitat diversity and is abode to many rare, threatened and endemic flora and fauna in the region. About 13 protected areas are spread across the state, which plays a significant role in *in-situ* conservation of biological diversity. Among these protected areas, Namdapha National Park (NNP) which enjoys the dual conservation value such as Namdapha Tiger Reserve (NTR), is one of the oldest protected area of the state and known for an exceptional biological diversity, harbouring a number of diverse habitats with distinct types of speciation, including many endemic and threatened species communities, which are often limited to a particular and distinct distribution of area. This extreme richness in species variation in the NNP is based on the unique patterns of biogeography due to several factors which includes its age, unique tectonic plate and palaeoclimatic history and also its location at the confluence of distinct realms (Afrotropic, Palearctic, and Indo-Malay (Olson and Dinerstein, 2002), wide altitudinal range (e.g. ranging from 200m to more than 4000 m above sea level) leading to vast habitat diversity (from tropical to alpine; Champion and Seth, 1968). Many mammalian species occurring in the NNP, are considered to be of global and national conservation priorities, including *Panthera Tigris, Pantherapardus, Neofelisnebulosa,* snow leopard, Western hoolock gibbons *(Hoolockhoolock),* Elephants (*Eliphusmaximus*), Hornbills etc. New species are also consistently being discovered; such as the Namdapha flying squirrel and leaf deer (Datta*et al.*, 2003).

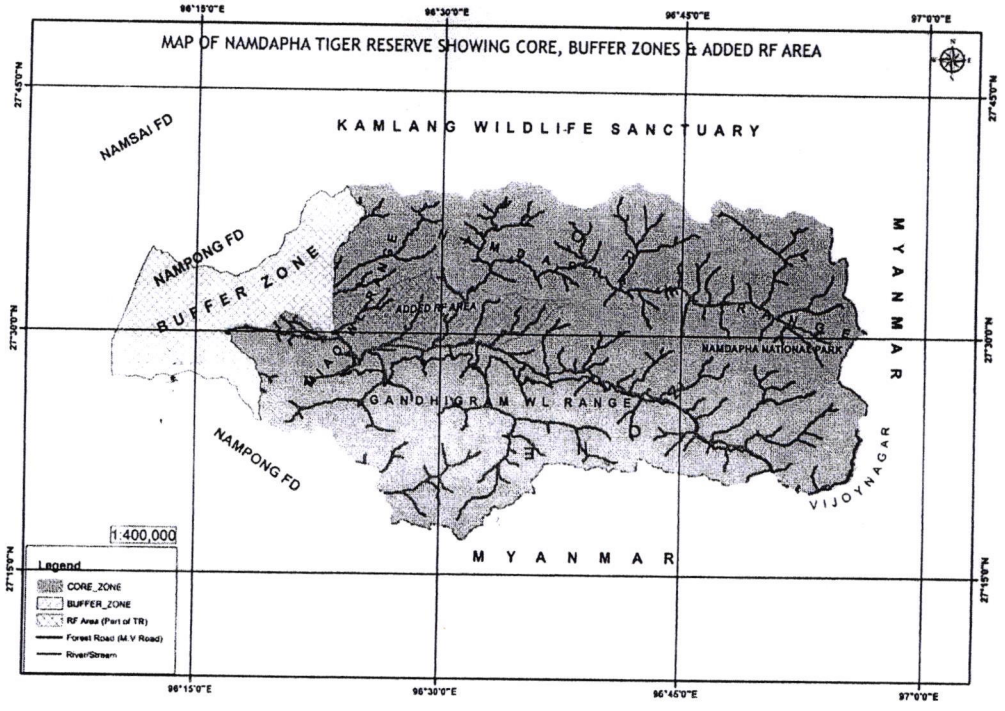
For enhancing the conservation strategy of Namdapha Tiger Reserve, buffer areas are being notified in Namdapha Tiger Reserve (NTR) with a total area of 245 $km^2$with 68 km^2 in Miao RF, 141 km^2 in Diyun RF and 36 km^2 in the surrounding Unclassed State Forests of Nampong Forest Division and Namsai Forest Division.

The Buffer area:

Diyun RF and the surrounding USFs have diversified flora and fauna. They also act as shelter for spill-over wildlife population from the Namdapha Tiger Reserve. The buffer area has wide altitudinal range from 200 m to 1000 mamsl. Though the wildlife population has been depleted in the buffer areas, they are with high potential to harbour sustainable population of wildlife.

3(Three)villages falls under the Buffer zone of Namdapha Tiger Reserve along the proposed of 33 KV transmission in Miao- Diyun area falling under Diyun Reserve Forest under Nampong Forest Division.(FIG:1)

FIG 1 Showing map of NTR with buffer zone



Background of the Buffer Area

1) EDHAPIC CHARACTER

1.1) Geology, Rock and Soil

The geology of the buffer area is similar to that of the core. The following are the geological attributes of the area:

1. The geological formations covering the area include the Tertiary and Quaternary sequences.
2. The oldest of the Tertiary sequences comprises a group of grey to black splintery shale with thin sandstone inter-beds classified as the Disang Group (Eocene).
3. The overlying Barail Group (Oligocene) includes an assemblage of sandstone, clay, shale, and carbonaceous shale with coal.
4. The lowermost beds, called the Nagaon formation consist of hard and compact, fine grained, sandstone with minor shale and partings, is however, totally cut off in the area by the Disang thrust. The middle part of the group known as the Baragolai formation includes an alternation of sandstone, shale, carbonaceous shale and clay with minor coal layers and occasional thin seams of coal. This formation is well exposed along the northern base of the Kuwen Bum hills where the rock beds trend ENE-WSW with a southerly dip up to 60°.

5. The upper beds of Barail Group, called the Tikhakparbat formation include several thick coal seams at the base. The formation is arenaceous, comprising of medium to coarse grained, well-bedded sandstone, sandy clays, shale, and carbonaceous shale with thick coal seams. The formation in the Namchik Coalfield (outside the buffer) over the northern slope of Kuwen Bum is about 600 meter thick.
6. The Tipong Group of rocks formed during the Miocene are younger rocks overlying the Barail rocks. It has coarse ferruginous sandstone and sandy clay with occasional thin partings of shale and conglomerates. Fragments of silicified and semi carbonized fossil wood are embedded in these rocks. The lower part of Tipong rocks is a sandstone formation that is predominantly arenaceous, consisting of false bedded ferruginous sandstone with minor clay or shale partying and occasional conglomerates. The oil seepages in the area are associated with Tipong sandstone.
7. The youngest part of the Tertiary sequence comprises of pebble beds alternating with clays and soft sandstones classified as the Dihing Group. The Dihing beds are exposed at intervals along the Noa-dihing riverbed near Miao.
8. The Quaternary sequence consists of a group of older alluvium consisting of clays, loose coarse sand, gravel and boulder deposits covering Tertiary rocks along the base of the Kuwen Bum Hill and around Namchik. This group has been covered with the newer alluvium deposits of clay, sand silt and shingles.
9. The Jairampur area lies over the easterly extension of the ENE-WSW abuts directed, east, plunging Namdang syncline widening towards the east. The south limb of the syncline is at places affected by the Disang thrust. The north limb abuts against Margherita thrust passing along the base of Kuwen Bum Hill.

(1.2)*Soil*

The soil is acidic and is characterized by a surface layer of considerable depth and loamy texture with colour varying from yellowish to reddish. It consists of a thick layer of sandy loam soil rich in vegetative matter. This soil is mostly found in the forested hills which used to support the best dipterocarp forests. On the ridges and precipitous slopes, the soil depth becomes shallow while in the areas near the river banks which are liable to frequent inundations, the soil depth is larger. The soil tends to be sandy on the sloping grounds and clayey on the flat grounds.

(1.3)*Hydrology and Water Sources*

The Miao RF, Diyun RF and the USF areas comprised numerous rain-fed streams and rivers (known as *Hka* in *Singpho*and *Wa* in *Tangsa* language). Some streams are perennial while most are seasonal and remain dry in winter.

The major rivers are the Tirap, Namchik, DoglaiWa, Rima or Namphuk, NanonHka, NangtheWa, Noa-dihing and Buri-dihing. All these perennial rivers and streams drain into the Brahmaputra.

Collection of river bed materials like boulder, sand and shingles is being carried out in almost all the rivers and streams to meet the increasing demands of building material for road and bridge construction. This is one of the factors that contribute erosion of river banks and subsequent floods in the low lying areas.

2) *Vegetation Types*

The vegetation types of the buffer area are very similar to the low-elevation forests of the core area. As per Champion and Seth's (1968) forest types of India, the forests in the buffer of NTR fall under the following forest categories: -

(2.1) Assam valley tropical wet evergreen forests (Dipterocarp forests):

The major species in this forest are Hollong (*Dipterocarpusmacrocarpus*) and Mekai (*Shoreaassamica*). These forests are typically three-storied with *D. macrocarpus* and *S. assamica*as the dominant species. *D. macrocarpus* is present along the alluvial plains in the foot hills while at higher elevations the dominant tree is *S. assamica* which grows in soil with high gravel. The other species occurring in the upper storey are Gonsorai (*Cinnamomumcecicodaphne),*Hollock (*Terminalia myriocarpa*), Sam (*Artocarpuschaplasa*), Jutuli (*Altingiaexcelsa*), Poma (*Toonaciliata*), Dhuna (*Canariumresiniferum*and *C. strictum*), Amari (*Aglaia spectabilis*). The middle storey consists of Khokan (*Duabanga grandiflora*), Morhal (*Vativalanceaefolia*), Nahar (*Mesuaferrea*), Jamun (*Syzygiumcumini*), Sopa (*Magnolia* sp.), Phulgamari (*Endospermumchinensis*), Hingori (*Castanopsisindica*), Banderdima (*Dysoxylumbinectariferum*), Chalmugra (*Gynocardiaodorata*), Pichola (*Kydiacalycina*). The lower storey consists of species like: Thekera (*Garcinia*spp.), Tejranga (*Myristicalinifolia*), Outenga (*Dilleniaindica*). The canopy density in the upper storey varies inversely with that of the lower storey.

The undergrowth is composed of woody shrubs like Kukrathenga (*Leeaindica*), Leteku (*Baccaureasapida*), Surat (*Laporteacrenulata*), Phutki (*Melastomamalabathricum*), Nephapho (*Clerodendron*spp.), *Ixora* and shrubs like Kaupat (*Phryniums*pp.), Torani (*Alpiniaallughas*), Bogitora (*Alpiniamalaccensis*), Kol (*Musa* spp.). There are four species of bamboo: Kako (*Dendrocalamushamiltonii*), Bojal (*Pseudostachyumpolymorphum*), Bijuli (*Bambusa pallida*), Dollu (*Teinostachyumdullooa*) and three species of cane: Lejai bet (*Calamusfloribundus*), Raidang (*Calamus flagellum*) and Houka bet (*Calamuslatifolius*), and two species of palms: Tokko palm (*Livistoniajenkinsiana*) and Garugatamul (*Pinangagracilis*).There are atleast six species of grasses: Kush (*Saccharumspontaneum*), Kher (*Imperatacylindrica*), Megheli (*Erianthusarundinaceus*),Ekra (*Erianthusravenae*), Nol (*Phragmiteskarka*) which are found in the plains and Jharu (*Thysanolaena maxima*) which grow on slopes. Some common climbers found are: Gowalialata (*Vitislatifolia*), Ghilalata (*Entadaphaseoloides*), Kachoilata (*Acacia pruinescens*), Kuchai (*Acacia pennata*), Amrolialata (*Tapiriahirsuta*), Mikenia (*Mikaniamicrantha*) and Hathilota (*Baieaparviflora*).

(2.2) Assam alluvial plains semi-evergreen forests:

The Assam alluvial plain semi-evergreen forests are typically two-storied and consist of many deciduous tree species mixed with evergreen species. The common species in the upper storey are: Hollock (*Terminalia myriocarpa*), Amari (*Aglaia spectabilis*), Sam (*Artocarpuschaplasa*), Bogipoma (*Chukrasiatabularis*), Jutuli (*Altingiaexcelsa*), Dhuna (*Canariumresiniferum*) and Borpat (*Ailanthus grandis*). The middle storey consists of Mekahi (*Phoebe cooperiana*), Pichola (*Kydiacalycina*), Moj(*Albizialucida*), Morhal (*Vaticalanceafolia*), Sopa (*Magnolia* spp.), Khokan (*Duabanga grandiflora*) and Titasopa (*Micheliachampaca*) while the undergrowth consists of species like *Alpiniaallughas, Mikaniamicrantha and Musa* spp.

Following is the list of bamboos, canes and climbers in these forests:

1. Bamboo: Bijuli (*Bambusa pallida*), Kako (*Dendrocalamushamiltonii*)
2. Cane: Raidang (*Calamus flagellum*), Hauka (*Calamuslatifolius*), Lejai (*Calamusfloribundus*)
3. Climbers: Ghilalata*(Entadaphaseoloides)*, Kochoikaint (*Acacia pruinescens*), Amrolialota (*Tapiriahirsuta*), and Kuchai (*Acacia)*

(2.3) Eastern Hollock forests:

The Eastern Hollock forests have an evergreen understory and a deciduous upper storey. These forests are generally found on alluvial flats along the river and stream banks. Hollock (*Terminalia myriocarpa*) is the dominant species. However, at present, Hollock has considerably reduced in numbers due to logging. The floristic composition these forests are as follows: The upper storey consists of Khokan (*Duabanga grandiflora*), Hilika (*Terminalia chebula*), Bohera (*Terminalia bellerica*), Titachampa or Champ (*Micheliachampaca*), Sopa (*Magnolia* spp.), Hatipaila (*Pterospermumacerifolium*), Gamari (*Gmelinaarborea*), Amari (*Aglaia spectabilis*), Sam (*Artocarpuschaplasha*), Urium (*Bischofiajavanica*), Dhuna (*Canariumresiniferum*), Udal (*Sterculiavillosa*), Borpat (*Ailanthus grandis*), Bogipoma (*Chukrasiatabularis*) and Jutuli (*Altingiaexcelsa*). The middle storey consists of Outenga*(Dilleniaindica)*, Banderdima (*Dysoxylumbinectariferum*), Hingori (*Castanopsisindica*), Jamuk (*Syzygiumcumini*), Pichola (*Kydiacalycina*), Boromthuri (*Talaumahodgsonii*) Morolia (*Macarangadenticulata*), Chalmugra (*Gynocardiaodorata*), Morhal(*Vaticalanceafolia*), Moj (*Albizialucida*), Satiana/Chatiana (*Alstoniascholaris*) and undergrowth like Ghetu (*Clerodendroninfortunatum*), Kaupat (*Phryniumimbricatum*), Tora (*Alpiniaallughas*), Surat (*Laporteacrenulata*), Jeng*(Calamus erectus*) and *Eupatorium* spp.

3)Fauna.

The buffer areas of the Tiger Reserve almost had similar faunal diversity and habitat conditions as that of the core area. However, due to anthropogenic activities in the buffer areas, it has reduced wildlife population and degraded the habitat. There is a record of presence of rich diversity from the buffer areas in the earlier past where there are reports of tiger sighting and other important wildlife sighting from the buffer areas.

Major Conspicuous Changes in the Habitat since Inception:

The buffer area was declared in the year 2012 and since then there have been a considerable conspicuous changes in the habitat since its inception. Land use changes occurred due to logging, conversion of forested land to tea estates and clearing of forest land for agriculture purposes. Also there has been a considerableloss of natural forests due to coal mining in the last decade. The areanow is in a degraded state with no natural forest in the village area. The community residing the area is totally dependent on farming for their livelihood generation with tea cultivation being the major cash crop. There areoccasional reports of Human-Animal conflict from the area. Reports of wild elephant raids in the paddy fields during crop ripening is documented from the area and also reports of loss of poultry due to attack from small carnivores. The village members are also prolific hunters and often visit the forest for hunting.

ECOLOGICAL THREATS:

1) Large electrical transmission lines are a hindrance for bird movement and a major reason for many Bird kill (includes migratory bird). Bird kill occur due to collision with the power lines which are often not visible to the birds during their flight.

2) Accidental killings of domestic as well as wildlife due to power leakages from the electrical poles.

3) Also further felling of existing trees will lead to creation of canopy distance which is not suitable for arboreal animals like squirrels and some tree dwelling species.

MITIGATION PLAN TO MINIMISE THE ECOLOGICAL DAMAGE:

1) ***Install bird diverters in the power lines to save birds from getting electrocuted***:
Many bird species have poor frontal vision because of which they collide with power lines during their flight. So there is a need to install bird diverters in the powerlines to avoid the bird kills.

2) ***Creation of Physical barriers***:
There is a need to restrict wild elephants in their natural habitats and also prevent them from entering the village or near the large electrical poles to avoid accidental killings due to power leakages. For this physical barriers like elephant trench can be constructed in the pathway from where the elephants enter the village area.

3) ***Creation of Plantations***:
Create local fruit bearing tree plantation, fodder and bamboo plantation in the periphery of the village to augment wildlife and also act as a diversion for crop raiding wild animals.

4) **Employment generation**:

80% of the population residing in these fringe villagers are dependent on agriculture for their livelihood. Since the agriculture area is scarce, they clear forests for establishing new areas under agriculture. As a result there is a huge loss of forest cover every year in the area. An Alternative source of livelihood generation in the form of poultry, piggery and also been keeping should be introduced in the area. This will help in income generation and also help minimising their dependence on forests.

5) ***Equipping the Forest department and Communities for effective Management***:
For smooth monitoring and management of the fringe villages, Namdapha Tiger Reserve should be equipped with a vehicle, High beam torches, crackers and several field gadgets.

6) ***Erection of Watch towers:***

Watch Towers are needed to be constructed at several points in the buffer village for monitoring of wild elephant movement during the crop harvesting season.

7) ***Awareness and Training***:

There is a continuous need for generating awareness among the local community to imbibe a sense of responsibility for conserving our natural resources. To meet this objective timely awareness programmes on the importance of conservation should be held in the fringe area.

Also hands on training on bee-keeping, poultry and piggery keeping should be provided by inviting experts from respective fields.

8) ***Installation of night vision signage and hoardings***:

Since a road passes nearby to the buffer village, Posters and billboards play an important role as early warning system in human psychology while in constant movement. Therefore, signage having night vision properties should be installed along the roadside in the areas where animals frequently visit. Signals indicating speed limit to avoid collision, animals crossing warning, reduce excessive honking etc. may be applied

9) ***Canopy connectivity for animal crossings***:

Since the area is already devoid of large trees, felling of trees should be bare minimum. Attempt should be made to keep canopy connectivity so that the small arboreal and mammals can use it as a means of passage for their crossings.

10) ***Waste Management Plan***:

The non-biodegradable waste generated during the implementation of the project shall be duly taken care of by the executing agency during the implementation of the said project.

CONCLUSION:

The mitigation plan is an effort to imbibe an efficient management planning to find a solution where in development and conservation walk in tandem. It is in no way a roadblock to developmental project but a solution where we endeavour to minimise the damage that may occur as a result of developmental projects.

FINANCIAL FORECAST

Financial (33kV Transmission line Miao to Diyun)

Sl no	Description of works	Qty	Rate	Amount	Remarks
1	Creation of plantation (Bamboo, Fodder, Fruit bearing trees plantation)	20 Hect.	17289/- per Hect.	345780	
2	Employment generation (Poultry, Piggery, bee keeping)for 3 nos village @ 5 beneficirey per village	5 nos beneficiary	30000/-	450000	for 3 nos villages
3	Erection and Watch tower at strategic point	3 nos	365000/- each	1095000	As per Plint area rate
4	Awareness and training	4 nos	100000/- each	400000	
5	Installation of night vision vinyl sheet signage 1'2x0'90 on size with MS angle post at vulnerable and strategic places	10 nos	25000/-	250000	Along the M.V. Road, starting from M'Pen.
6	Canopy connectivity for animal crossings by planatation of tall saplling.	800 Sapling	20000/- per Hect.	200000	As per norms
7	Construction of check gate with hut at 17.063 Sqm at vulnerable site of Deban	1 nos	495300/- each	495300	As per Plint area rate
8	Engagement of protection squad 5 nos at 10000/- for 4 months for 5 years.	5 nos	10000/-	1000000	During vulnerable periods
9	a) Rescue of wild animals & treatment from Forest area to Mini zoo Miao.	5 years	L/S	300000	As an when required
	b) Identification of rich wildlife habitat/corridors and marking of the areas to be converted to community reserve i.e, documentation.	5 Nos	25,000/-	125000	Survey/demarcation of Biodiversity hotspot
10	Waste management plan	2 nos	100000/-	200000	
			Grand Total	**4861080**	
			Say Rs.	**4861000**	

(Rupees Forty Eight Lakh Sixty One Thousand) Only

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