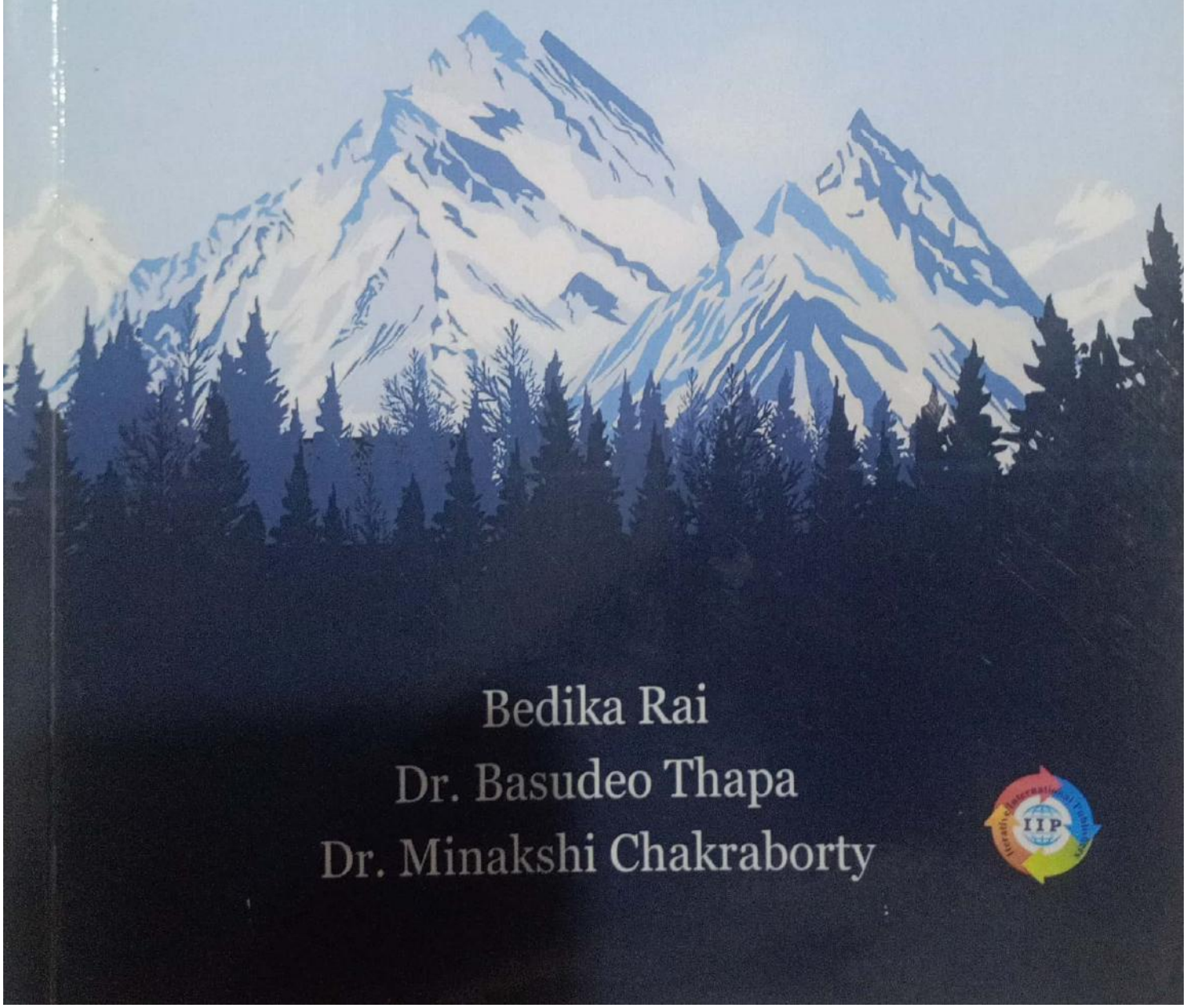
Eastern HIMALAYAS
CULTURAL DIVERSITY



Bedika Rai
Dr. Basudeo Thapa
Dr. Minakshi Chakraborty

Eastern Himalayas: Cultural Diversity

First Volume

Editors

Bedika Rai
Dr. Basudeo Thapa
Dr.Minakshi Chakraborty

Title of the Book: Eastern Himalayas: Cultural Diversity

First Volume: 2023

Editors

Bedika Rai, Assistant Professor in the Department of English, Kalipada Ghosh Tarai Mahavidyalaya, Bagdogra, Dist. Darjeeling, West Bengal.

Dr. Basudeo Thapa, Assistant Professor in the Department of Nepali, Kalipada Ghosh Tarai Mahavidyalaya, Bagdogra, Dist. Darjeeling, West Bengal.

Dr.Minakshi Chakraborty, Principal, Kalipada Ghosh Tarai Mahavidyalaya, Bagdogra, Dist. Darjeeling, West Bengal.

ISBN: 978-93-5747-691-1

MRP Rs. 349/-

Publisher, Printed at & Distribution by:
Selfypage Developers Pvt Ltd.,
Pushpagiri Complex,
Beside SBI Housing Board,
K.M. Road Chikkamagaluru, Karnataka.
Tel.: +91-8861518868
E-mail:publish@iiponline.org

IMPRINT: I I P Iterative International Publishers

For Sales Enquiries:
Contact: +91- 8861511583
E-mail: sales@iipbooks.com

Contents

Introduction 1

Bedika Rai and Dr. Basudeo Thapa

An Ethnomusicological Study of the Sherpas of Darjeeling Hills 10

Anand Sherpa

A Comparative Study on Nutritional Status between Urban and Rural School Boys in the Eastern Himalayan Belt of India 20

Sri Arindam Ghosh, Dr. Lokendra Bahadur Kathayat

Different Facets of Indigenous Ecological Living in Northeast India: An Exploration in the Light of Select Stories from Arunachal Pradesh and Nagaland 28

Dr. Arpita Dasgupta

Khortsa's 'The Tibetan Suitcase', a Himalayan Story: Symbolic Boundary of the Tibetan Identity 37

Bedika Rai

Ecology and Lepcha Folktale 45

Bishwa Bhushan Tamang

Climatic Change and its Impact on Subsistence Farming and Changing Pattern of Socio-economic Life of Indigenous People 52

Debasree Shil

An Enquiry into Some Traditional Beliefs and Practices of the Meches of Terai-Dooars Region in Pre-Colonial India 59

Dr. Manadev Roy

Bridging the Financial Inclusion Gap: Understanding Factors Influencing Rural Customers Intent to Use Agency Banking Services 68

Dr.(CS) Pintu Prasad Jaiswal

Precision Farming Techniques Revolutionizing North Bengal's Agriculture 79

Dr. Shyam Charan Barma

Ritualistic Healing and Indigenous Medicinal Practices: A sociological Study among the Lepcha Ritualistic Lama Healers of Singhi, Kalimpong 97

Jigme Dhondup

Encouraging Sustainability through Indigenous Food Culture in the Eastern Himalayas during COVID 19 107

Mau Basu

Human- Wildlife Conflict: A Challenge to the Biodiversity Conservation in Northern West Bengal 120

Meeta Bala, Monoranjan Chowdhury

Globalisation and Socio-Economic and Political Impact: Challenges in Establishing a Sustainable Human Society 136

Pawan Gurung

Understanding the New Image of Sherpas of Darjeeling 144

Pemu Sherpa

An Analysis of Pineapple Production in Eastern Himalayan Region: A Review 156

Rahul Mahato

Socio Cultural Knowledge of Indigenous People and Their Impacts on Environment: Study of Santhals from the foothills of the Himalayan Belt

Rama Murmu

Rongnyu-Rongeet, a Lepcha Folklore and Prakash Kovid's *Teesta-Rangeet*: A Geocritical Study 171

Rippandi Lepcha

Comparative Analysis between two different Traditional Healthcare Practices of India viz. Asthavaidya System of Kerala & Local Healthcare System of Darjeeling Hills 176

Dr. Sapan Tamang

Human Rights of Indigenous Peoples in India 187

Sarat Chandra Ray

Indigenous knowledge and Traditional healing Practices in Sikkim 195

Saurav Pradhan

Innovating Cultural Identity through Indigenous Gastronomical Knowledge 207

Sharddha Shah

Changing Livelihood of Indigenous Communities – A Study of Mech Tribe in Sub-Himalayan Region of West Bengal 213

Sheela Karjee

Development-Induced Displacement of Indigenous People in Eastern Himalayas, India 219

Sneha Ghosh

Livelihood Pattern of the Tea Garden Workers in Western Dooars of Jalpaiguri District, West Bengal 227

Dr. Suraj Tamang

Change of Livelihood among Asur Community in India: An Appraisal in The Light of Indigenous Knowledge of Tribes 238

Sutapa Das

The Ahom Coins: A Historical Study 246

Tapas Biswas, Banani Sarkar

Human- Wildlife Conflict: A Challenge to the Biodiversity Conservation in Northern West Bengal

Meeta Bala
Department of Environmental Science
Kalipada Ghosh Tarai Mahavidyalaya,
Bagdogra, Darjeeling, West Bengal, India
meetab75@gmail.com

Monoranjan Chowdhury
Plant Taxonomy and Environmental Biology Lab.,
Department of Botany
University of North Bengal, Darjeeling, West Bengal, India
mchowdhury@nbu.ac.in,

Abstract

Northern West Bengal is an abode to a wide and magnificent variety of forests and wildlife. The growing dependence of humans on the forest ecosystem constantly threatens this region's biodiversity. In recent decades human and wildlife conflict has become one of the major risks to the sustenance of many wild species, thus affecting the biodiversity of this region. The incidence of conflict is predominant at the fringes of Protected Areas (PA) of this region, where there is a significant degree of interaction between humans and animals. The objective of the study is to focus on the region's human-wildlife conflict status, explore its causes, and suggest some management measures to combat the situation. The study shows that the growing human population, increasing wildlife population, rapid land use transformation, existing Siliguri-Alipurduar railway track, greater road network, growing fascination for nature based-tourism and increasing access to protected areas are the prime causes of HWC in this region. This study has also reflected some effective mitigation measures that can minimise the damage caused by HWC.

Keywords: Human-Wildlife Conflict, Northern West Bengal, Biodiversity, Protected areas, Mitigation measures, Coexistence.

I. Introduction

Northern West Bengal comprising the districts of Jalpaiguri, Darjeeling, Kalimpong, Alipurduar and Cooch Behar lies at the foothill of the great Himalayas. The area shelters the moist and dense riparian forests of the Bengal, Dooars (Duars) and the foothills of the immense Kanchenjunga range of

Himalayan Biodiversity hotspot. The distinctive climatic [illegible] characteristics make North Bengal a perfect habitat for a large [illegible] fauna and numerous endemic bird species (Das M., 2016). This [illegible] the habitat of large mammals like elephants, rhinoceros, tigers, bears and many other smaller vertebrates. Infrastructural development in this internationally important region resulted in a loss of habitat, encroachment of protected areas, and habitat destruction that posed a threat to the existence of this rich biodiversity. The study aims to focus on the region's human-wildlife conflict status, explore its causes, and review some management measures to combat the situation.

The West Bengal state includes a forest area of 11,879 sq. km. that is categorized as - Reserved Forests covering an area of 7,026 sq. km, Protected Forests of 3,772 sq. km. and that of Unclassed State Forests is 1,081 sq. km (Annual Administrative Report, 2021). The extended forest fringes of Himalayan vegetation of terai and duars regions of sub-Himalayan regions forms several important forest conservatories where biodiversity is quite rich and diverse. Gorumara National Park (Jalpaiguri), Chapramari wildlife sanctuary (Jalpaiguri) and Jaldapara National Park (Alipurduar) are situated in the Dooars region at the foothills of the Himalayas comprised of forests and grasslands inter-crossed by various rivers and streams (Annual Administrative Report, 2021). These are principally recognized as a habitat for Indian rhinoceros, bison and elephants. Neora Valley National Park (Kalimpong) was established in 1986 and Singalila National Park (Darjeeling) situated on the Singalila ridge at an elevation of above 7000 feet above sea level are the home of the endangered species, the red panda. The immaculate undisturbed habitat with its craggy inaccessible hilly landscape and profuse diverse flora and fauna make the park an imperative forested zone (Mallick J.K., 2012). Buxa Tiger Reserve (BTR) located in the Alipurduar district of Northern West Bengal runs along the international border with Bhutan at its northern boundary is known for tiger population. Jore Pokhri Wildlife Sanctuary in Darjeeling District is the habitat of the Himalayan Salamander (*Tylototriton verrucosus*), locally known as 'Gora' and elephants. Mahananda Wildlife Sanctuary (Darjeeling) is situated on the Himalayan foothills along the river Teesta is habitat of elephants. Panitanki Bitan Wildlife Sanctuary, on the foreshore of Teesta Barrage in Gajaldoba water body, helps conserve the habitat and protect the populations of aquatic and migratory birds. Senchal Game Sanctuary, established in 1915 is considered the oldest sanctuary in the country, covering an area of 38.60 sq. km. (Annual Administrative Report, 2021). The forest patches of North Bengal spread between the elevation 130 m.a.s.l to the 3636 m.a.s.l and are interrupted with huge human populated areas like cities, towns, villages, army camps due to international borders etc. and multiple tea gardens and agricultural lands. These inter mixing unplanned situation causes huge human-wildlife conflict in this

region, resulting loss of lives of various wildlife's, civi... of economy.

II. Materials and Methods

Study area: The study area includes the Terai and Duars region of Northern West Bengal(Fig. 1) that covers the district of Jalpaiguri,Darjeeling,Cooch Behar and Alipurduar and the newly formed Kalimpong. The present situation of the forest areas in this region is depicted in Table 1. Alipurduar and Cooch Behar have a geographical area of 3383 sq. km. and 3387 sq. km. respectively, and Darjeeling (including Kalimpong) with 3,149 sq. km. and Jalpaiguri has a geographical area of 2,844 sq. km. The data show that although Cooch Behar covers the largest geographical area but covers only 57 sq. Km., i.e. 1.68% of the total forest area, and Darjeeling has 1,204 sq. km. forest area, i.e. 38.23% of the total forest area.

Table 1. Status of Forest Area in Northern West Bengal (district-wise)

Forestry areas	Districts				West Bengal (total) (sq km)	India (total) (sq km)
	Jalpaiguri	*Darjeeling	Cooch Behar	Alipurduar		
Total geographical area (sq. km.)	2844	3149	3387	3383	88,752	32,87,240
Recorded forest area(sq. km.)	723	1204	57	1067	11,879	7,68,437
Total forest area in %	**28.75**	**38.23**	**1.68**	**31.54**	**13.38**	**23.38**
Reserved Forests (sq. km.)	1483	1115	0	-	7,054	4,23,311
Protected Forests (sq. km.)	-	217	42	-	3,772	2,17,245
Unclassed State Forests & Others (sq. km.)	90	89	15	-	1,053	1,27,881

*The newly formed Kalimpong district is included in Darjeeling district. No separate data is available.

Source: Annual Administrative Report 2020-21, Wildlife Wing, Directorate of Forests. Government of West Bengal

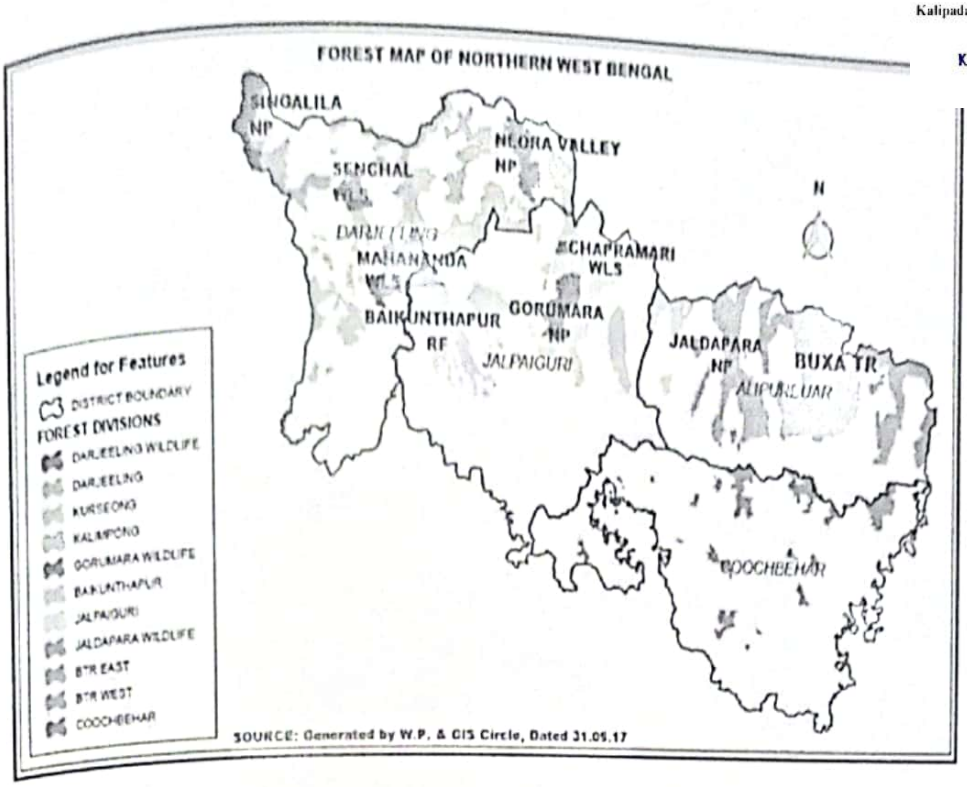


Fig. 1: Forest Map of Northern West Bengal

Table 2. Protected Areas of Northern West Bengal

Protected areas	Area (km^2)	Bio-geographic zone	District
Wildlife sanctuaries (W.L.S.)			
Buxa WLS	314.52	7B	Alipurduar
Chapramari WLS	9.60	7B	Jalpaiguri
Jorepokhri Salamander WLS	0.04	2C	Darjeeling
Mahananda WLS	158.04	7B	Darjeeling & Jalpaiguri
Senchal WLS	38.88	2C	Darjeeling
Pankhi Bitan (Bird Sanctuary)	14.09	7B	Jalpaiguri
National parks (N.P.)			
Buxa N.P.	117.10	7B	Alipurduar
Jaldapara N.P.	216.34	7B	Alipurduar
Gorumara N.P.	79.45	7B	Jalpaiguri
Neora Valley N.P.	159.8917	2C	Kalimpong
Singalila N.P.	78.60	2C	Darjeeling

Reserves			
Buxa Tiger Reserve	760.87 Core Area: 390 .58 Buffer area: 37 0.29	7B	
Eastern Duars Elephant Reserve	977.51 Core area: 484 Buffer area: 49 3.51	7B	Alipurduar and Ja lpaiguri

Source: Annual Administrative Report 2020-21, Wildlife Wing, Directorate of Forests. Government of West Bengal

III. Methodology

A structured review of the information was compiled by searching published literature, local newspapers, state forest reports, census reports, newsletters etc. on a web-based platform such as Web of Science, Scopus, and Google Scholar. The search strings used for the literature survey were comprised of "Human wildlife conflict", "Forest of North Bengal", "Cause and mitigation ON human animal conflicts" etc. in the title, abstract and keyword section during web search. Data were collected from various data sources, like, to gather the current situation of Human-Wildlife Conflict in the Northern West Bengal region. The data thus collected are analyzed and compiled in the paper. Some mitigation and preventive measures are suggested to combat this huge biodiversity and economic loss in this region.

IV. Result and Discussions

1. Major Wildlife's Involved in Conflict

In northern West Bengal, livestock depredation is the most common form of human-wildlife conflict followed by crop damage, hut damage and human injury or death (Annual Administrative Report, 2020-21). Major mega fauna involved in conflict in this region are Asian Elephant (*Elephas maximus*), Leopard (*Panthera pardus*) and Gaur (Bos gaurus). Elephants, being a far-ranging animal, are more vulnerable to habitat degradation and loss of natural habitat. Thus they get involved in considerable conflicts with humans than any other conflict-prone animals. Similarly, due to the increasing human population, constant land use pattern change and decrease in wild prey within the protected areas resulted in the leopards' frequent areas near human settlements and killing livestock. That consequently led to human-leopard conflict through shooting, poisoning and electrocution. Moreover, leopards are stalking and ambush

predators and tea Estates provide them with an ideal site for prey. their densely packed tea bushes, they also have big trees, with pepper vines climbing around them. Attacks on humans within these places are unintentional and motivated by self-defense because these offer enough cover and safety, especially to female leopards for breeding and rearing leopard offspring (Naha D. et al., 2020). The population of gaur has grown inside protected areas as a result of conservation initiatives and a decline in their main predators. Moreover, the shrinkage of natural habitat and increased cattle grazing inside the forest resulted in a shortage of fodder for these herbivores that consequently compels these animals to sneak out of the protected areas into human habitation leading to conflicts (Manoj K., et al., 2013).

2. Consequences of Human-Wildlife Conflict on Livelihood and Economy

Economic loss due to crop and hut damage, human death and injury is one of the major outcomes due to human-wildlife conflict. Forest fringe communities suffer the most physical and economic damage from human-wildlife conflict. A sizable amount of money is being paid every year by the State and the Central Government as ex-gratia payment relief to the affected for wildlife depredation. A sharp increase in the ex-gratia payment for compensation against the human death and injury, crop and hut damage as well as livestock kills through the year from 2016 to 2021 in Northern West Bengal were noticed (Fig 2). The ex-gratia compensation against human injury and death has increased by almost four times since 2017 to 2021. The influence of this damage on fringe communities is worse as they considerably depend on livestock and agriculture for their livelihood. Though the monetary compensation is provided to stabilize the economic damage but the amount are often inadequate and is time-taking process (Manral,U., et al., 2016).

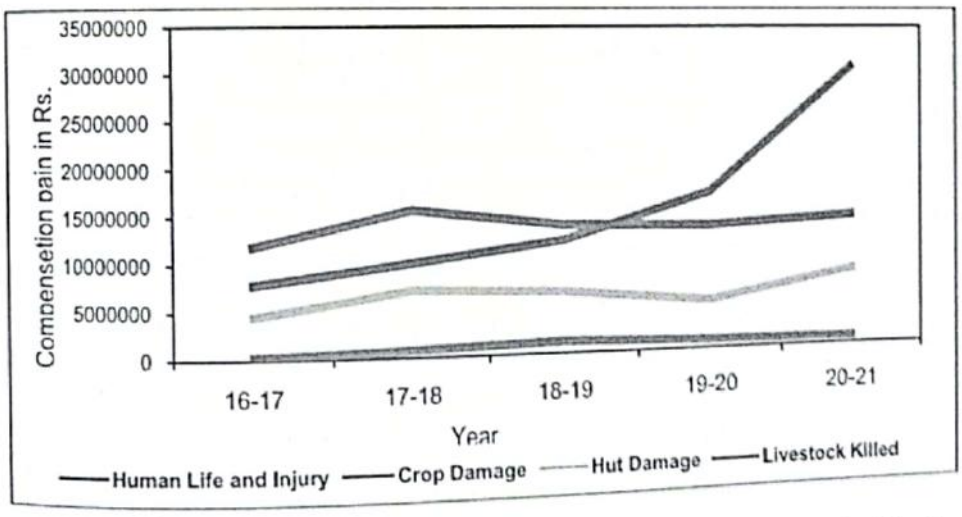


Figure. 2: Year-wise ex-gratia payment for compensation (in Rs.) in Northern West Bengal (Annual Administrative Report, 2016-21)

V. Reasons for Human-Wildlife Conflict

Growing human population: Northern West Bengal not only acts as the primary connection between northeast India and the rest of India but also shares an international border with Bangladesh, Nepal and Bhutan, which has received many international migrants since the India-Pakistan partition. Due to its strategic location, growing urbanization and conducive weather conditions, this region has been a favourite destination for traders and industrialists (Debnath, M., & Ray, S, 2017). As per 2011 Census report, Northern West Bengal has a population of 85.39 lakhs, an increase from 71.81 lakhs in the 2001 census. The total population growth in this decade was 18.91 per cent, while it was 9.15 per cent in the previous decade. This indicates that Northern West Bengal's population growth rate has doubled. Moreover, as per Census 2011, this region accommodates a high human density of 500-800 persons per sq. km. One of the leading causes of human-wildlife conflict is escalating human population around the protected areas. The rise in human population results in the growth of resource demand, increasing the frequency and intensity of such conflict incidences. This resulted in rising cases of encroachment into the wildlife domain. Consequently, those wildlife species that fail to adapt to the changed habitat either invade the peripheral habitats or decline in number (Mekonen,S., 2020).

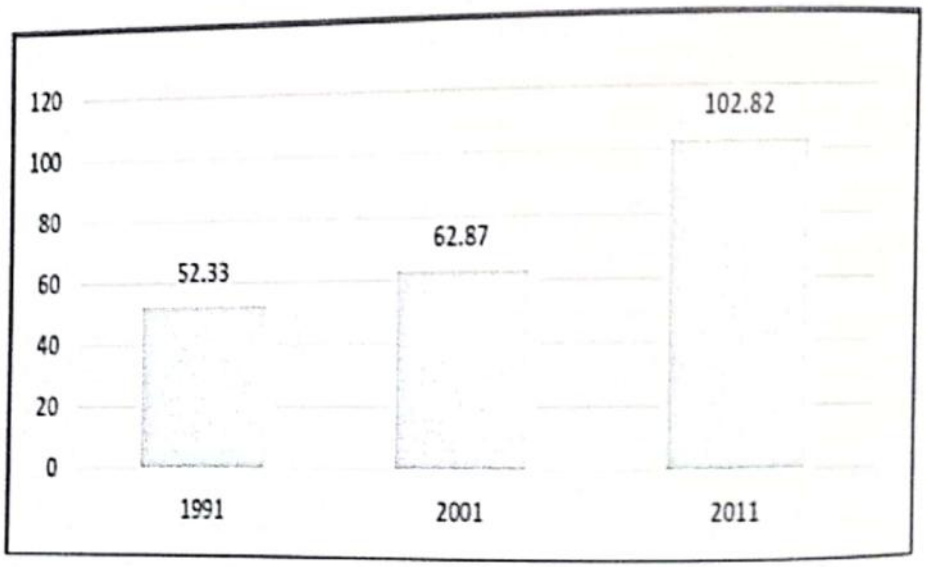


Figure 3: Population (in lakhs) in Northern West Bengal (Source: Census 2011)

- ***Increasing wildlife population:*** Adequate protection and habitat management within the protected areas of this region has led to a considerable increase in the megafauna population, particularly bison, rhino, leopard and elephant. Fig. 4 shows the population status of these

megafauna in protected areas of Northern West Bengal. These species' societal structure, habitat, and food requirements are arduous to accommodate within the human-defined habitation range, which often results in an environmental crisis and raises inter-specific competition. For a similar reason, rhinos are usually found in the fringes of their natural habitat (far-flung as 50 km) to meet their pasturage needs (Deb, S., et al., 2018).

[illegible]	[illegible]
1989	175
1993	186
1997	230
1998	250
2002	327
2005	328
2007	350
2010	529
2013	550
2014	590
2017	488

[illegible]	Number of Leopard
1984	41
1989	79
1992	63(BTR-W)
1993	13
2002	247
2004	242
2012	105(BTR-W)

Year	Number of Gaur
1989-90	240
1993-94	425
1997-98	550
1998-99	560
2002-03	1284
2009-10	1315
2013-14	2097

Year	Number of [illegible]
1993	45
1997	58
1999	74
2000	73
2002	96
2004	121
2006	135
2008	144
2009	160
2012	211
2013	231
2014	239
2015	255
2019	289
2022	347

Figure 4: Population Status of the megafauna in protected areas of Northern West Bengal

Source: Wildife Annual report, 2013-14, Annual Admistrative Report 2020-21

- ***Land use transformation:*** North Bengal landscape underwent a severe change in the 18th century when British planters cleared large tracts of forests to establish commercial tea plantations. Subsequently, many tribal people from the Chotanagpur plateau, Central India, were brought in by the British to work as daily labourer in these gardens. After Independence and the aftermath of the Indo-China war in 1962, a large number of army settlements were also established here, clearing vast tracts of forest lands". (Chatterjee, P., 2001). Nonetheless, the fragmentation of forests continued with escalating human immigration from neighbouring states and countries, resulting in remarkable Landuse and Land Cover conversion in the region (Naha, D., et al., 2019). Generally, an extension of infrastructures, like railways, roads, industries, development of unplanned human settlement, dolomite sediment deposition, etc., are the main factors for altering the region's land use and land cover parameters. This region experienced considerable change in the patterns of land use

and land cover (LULC) classes, namely agriculture, vegetation, and plantation, which have declined by 6.95%, 2.93% and 1.90% respectively. On the other hand, three LULC categories, water body, barren land and built-up, have increased by 1.29%, 2.71% and 6.95% respectively (Chamling, M., & Bera, B., 2020). "Illegal and unscientific mining, expansion of agricultural land, unplanned growth of the human settlement, an increase of tea plantation, an extension of railway track, etc., have accelerated the land use and land cover (LULC) change. Besides, the additional water and sediments discharge through the river networks of this region chocked the streams, resulting in river bank erosion, bank failure, shifting of the braided river course, flood hazards, thus directly changing the LULC system of this region" (Chamling, M., & Bera, B., 2020).

- ***Existing Siliguri-Alipurduar Railway track*:** Highways and railways, one of the significant reasons for worldwide wildlife death, have caused direct destruction of habitat, deterioration of habitat condition, habitat discontinuity, population seclusion and arduous access to important habitats. In India, many wild animals are also being killed yearly due to highways and railways (Sarma, U. K., et al., 2006). The statistics from the Ministry of Railways dispensed in the Lok Sabha state that elephant kills on railway tracks have nearly twice from 10 to 19 amidst 2019 and 2021. The mortality of other wild species has risen by 1.5 times – from 44 in 2019 to 69 in 2021 (India Times). This region is earmarked with a 161 Km long railway line between the Alipurduar Junction and the Siliguri Junction that passes through a coalesce of forested areas, elephant corridors, rivers and streams, croplands, army establishments, tea gardens, and human settlements spread in the districts of Alipurduar, Jalpaiguri and Darjeeling. This route witnessed 27 elephant deaths in train accidents between 1974 and 2002, which increased to 65 amidst 2004 and 2015 (Roy, M., and Sukumar, R., 2017). Apart from this, deaths of 6 bison and one leopard have been reported to be killed on this route between 2004 and 2012 (Manoj, K., et al., 2013). The proposed augmentation of the broad gauge rail line New Jalpaiguri-Sevoke-Rangpo that passes through the Mahananda Wildlife Sanctuary, sheltering significant habitat and corridor for the elephants, has increased impending threats to the other wild species too (Manoj, K., et al., 2013). Moreover, developmental projects like Hydro-electric projects, National Highways passing through the protected areas cause many adverse impacts on wildlife which may lead to mortality by promoting the growth of invasive organisms, causing road kills by vehicle strikes, and exhibiting behavioral changes in wild animals leading to their extinction (Boston, K., 2016).

Habitat destruction or fragmentation often results in food sca
the forest habitat that forces the animals to stray in human inh

- ***Scarcity of fodder within protected areas***: In addition to encroachment and transformation of forest land to agricultural land and plantation for tea (*Camellia sinensis* (L.) Kuntze), teak *Tectona grandis* L.f.) and sal (*Shorea robusta* C.F.Gaertn.), unrestrained cattle grazing within the protected areas leads to a shortage of fodder for wild herbivores. Moreover, the increasing population of wild herbivores within the protected areas impose a greater demand for fodder. Increasing demand and the dietary overlap among the wild and domestic herbivores often risks their survival and may result in human-wildlife conflict (Manoj, K., et al., 2013). Furthermore, due to poor monitoring and restoration management by the forest department, invasive plant species like *Lantana camara* L., *Parthenium hysterophorus* L. and *Mikania micrantha* Kunth etc. rapidly replace the native natural fodder, thus resulting in food scarcity for wild herbivores within the protected areas. Thus fragmented and resource-limited habitat in this region forces megafauna like elephants, guar to look for crops as fodder (Naha, D., et al., 2019).

- ***Growing fascination for nature based-tourism and increasing access to Protected Areas***: Tourism is one of the largest business sectors in the global economy, accounting for $3.6 trillion in economic activity and 8% of jobs worldwide. The contribution of wildlife tourism to countries' economies has increased significantly. The share of wildlife tourism is claimed to form 9% of global GDP in 2011 (INTOSAI WGEA, 2013). In 2019, approximately 92 million domestic tourists arrived in West Bengal, while over 1.6 million foreign tourists have been recorded. North Bengal has distinctive features regarding natural, cultural, ethnic and social resources. The beauty and exquisiteness of the mountains, the forest of Terai and Dooars, and the folkways of the rural area surrounding the forests in North Bengal fascinate tourists from all over the world (Jamwal, R., 2020). "With increased tourism comes pressure to develop areas and make them more inclusive and resort-like. Building more accommodations, businesses, and amenities within these communities and destinations damages and destroys habitats. By damaging the local environment, the pressure on native species is increased" (Folk, E., 2019). Ecotourism has an adverse impact on wildlife. It is responsible for destroying the habitat, changing their behaviour or altering their physiology. Wildlife species are frequently susceptible to getting disturbed during their mating periods and the growing stages of their young ones. Interruption during courting and mating, or during raising

their young ones, can depreciate comprehensive breeding success. This imposes a critical threat to the survival and conservation of wildlife. Tourists are usually ardent to view mother-offspring groups, and thus it invites significant attention to limit and administer any tourism around them (INTOSAI WGEA, 2013).

- ***Natural calamities:*** Animals living in the Protected areas are often vulnerable to natural disasters like earthquakes, floods and forest fires in this region. Many animals die, are drowned or buried alive by soil or snow; are crushed to death in collapsed burrows; are smashed against trees and rocks, or are pelted by hailstones. Forest fires have tremendously increased due to frequent human interference and visits to the forest. Forest fire is a conducive factor responsible for destroying timber, wildlife and other forest products covering large forest areas. Being a part of the Ganga-Brammhaputra-Megha basin, Northern West Bengal is extremely flood prone. Torsha River and its tributaries, Chirakhoa, Holong and Buritorsha, often flow above the danger mark during heavy rainfall every year, thus risking the survival of wildlife in the protected areas.

VI. Mitigation Measures - Methods and Recommendations

There are several approaches to minimise and avoid HWC. Some of the measures that are generally followed in northern West Bengal are discussed below.

- ***Retaining Animals in their Habitats:*** An increasing population of wild animals and a shortage of water and fodder within the forest compel these wild animals to move into human settlements to meet their needs. A sufficient water supply through waterholes and fodder within the forest can help prevent animals from wandering out of forests. Plantation of fodder grass, along with regular coppicing and pollarding of fodder plants, can prevent elephants and other herbivorous herds from being confined to the forest. Removing invasive species like Lantana, Parthenium, and Mikania from wildlife habitats can facilitate better habitat management and ecological restoration.

- ***Restricting Animals in their Habitats:*** This can be achi... installation of barriers like pillars/precast blocks along the ... of rails cutting the forests to deter the movement of wild animals. These structures proved effective and pervasive as a blockade for crop protection. Deep trenches can be influential around small forest blocks, where the border between wildlife habitat and human settlements is well-defined (Panda, P. P., et al., 2020). Solar-powered fencing, though successful in reducing human-animal conflict, but responsible for injuring/killing animals. Rail fencing is more effective and environmentally benign than solar electric fences and deep trenches, which were only partially successful and are still being proposed in this area. In this area, bio-fencing using thorny plant species is both affordable and popular. The residents of the forest area may be encouraged to alternate cropping with unpalatable crops that are suitable for local climatic and edaphic conditions, like chilli, citrus, patchouli, homaloma, ghost chilli, lemon grass, citronella, and wild turmeric in forest periphery to avert animals from entering and raiding the farmlands (Panda, P. P., et al., 2020).

- ***Mitigation measures on Siliguri–Alipurduar line:*** Although several preventive measures have been followed at the traffic and railway transport department levels by Northern Frontier Railways, like limiting the train speed from dusk to dawn in vulnerable stretches, Laser Speed Radar Gun being installed to detect high speeding trains in elephant zones, signage boards being provided at all recognized elephant corridors to alert the loco driver, sirens with a honey bee buzzing sound being installed at the level crossing gates of sensitive locations, solar lights being provided at sensitive areas to avert elephants from crossing railway tracks, active participation and effective coordination of the stakeholders which includes Forest department, Northern frontier Railways, tea garden managements, villagers and people living along the rail track is required (Rao, R., 2019). The inhabitants of forest areas should abstain from cultivating crops for 1 km on both sides of the railway tracks. Vegetation along the tracks should be cleared to secure the best possible visibility for loco pilots. Strengthening patrolling and arrangement of additional watch towers by the sides of the tracks in the vulnerable crossing points should be prioritized. The proposed wildlife crossing structures, like overpasses and underpasses, connecting the habitats, should be completed to reduce railway animal mortalities. GPS-enabled radio collars for elephants could assist the railway official in tracking their movement and prevent collisions.

- ***Mitigation measures for human-leopard conflict***: Le... and other large carnivores in their behaviour and ability ... predators that frequent the edges of protected habi... ambush their prey. The focus should be placed on the habitats of these animals outside of forest regions, such as tea gardens, to lessen human-leopard confrontations. Hot spots where people are attacked should be found and closely watched. Forewarning mechanisms such as the installation of motion-enabled sensors with hooters/alarms should be initiated by Forest and Wildlife officials. Livestock grazing within the forests should be discouraged to maintain adequate food availability for the herbivores and avoid attack by predators. Efforts to raise the number of wild herbivores should be initiated to support a constant provision of food comparable to the carnivores within the forest. Moreover, the Wildlife squads need to be trained better in immobilization techniques and equipped with better trapping mechanisms for the leopards involved in the conflict. Reinforcement of the centers for treatment, caretaking and rehabilitating rescued and injured animals should be done. Extensive education and awareness programme should be taken up, especially in tea gardens and villages in the fringe forests, to create awareness about these animals' behaviours and precautions to be taken up for the Man-Animal Conflicts.

- ***Financial measures***: Economic tools, such as compensation and ex-gratia, combined with crop and livestock insurance, can help relieve the conflicts. Some constraints that render the system unsuccessful include the lengthy process of money refund, underrating losses, and inconsistent disbursement (Manoj, K., et al., 2013). The use of digital technology, such as online applications, can accelerate the process of compensation payment. Compensation is a reactive measure and cannot be considered a satisfactory solution to HWC. "Many authors have advocated insurance schemes for crops and livestock to be a more innovative and practical approach. Insurance involves paying a premium and claiming the insured amount in case of livestock or crop depredation. This changes people's attitude towards wildlife and makes them more proactive and responsible towards their conservation" (Manoj, K., et al., 2013).

- ***Restoration of habitat corridors***: As per the report by the non-profit Wildlife Trust of India (WTI) titled Right of Passage, Northern West Bengal has 14 elephant corridors, a narrow belt of vegetated land extending from anywhere between 5 km and 50 km and connecting two wildlife habitats. Regular monitoring and patrolling of the corridor areas should be done, especially during seasonal movements of the elephants. Establishing secured corridors and habitat restoration of the passages

should be prioritized for long-term conservation planning. Encroachment and conversion of forest lands for plantation should be discouraged.

- ***Sustainable developmental work:*** The administration's urgent need and goal for the nation's economic development is supposedly a vast road and rail network. But when they are built within the protected areas, roads and railroads should be on a flyover so that animals may pass below freely and all sorts of unintended mishaps and wildlife fatalities can be easily avoided. The construction of a flyover bridge with such high construction costs necessitates additional funding, which can be obtained through tolls collected from users, and uniform policies should be developed for the construction of a road and railway network inside the protected region. Unplanned additional human settlements and agricultural land usage close to protected areas and animal corridors are the cause of another disaster. To reduce disputes, the undesirable settlement sites should be removed, replaced or managed scientifically.

VII.Conclusion

The rich biodiversity of Northern West Bengal is grappling with heterogeneous challenges associated with HWC. Unplanned urbanization coupled with rising human and wildlife populations, rampant land-use transformation, railways through protected areas, growing fascination for nature based-tourism and increasing access to Protected Areas and natural calamities has escalated the conflict in this region. Although human-wildlife conflict cannot be eradicated, an effort to minimize the magnitude of losses must be taken. Several preventive and mitigation measures, like physical structures, habitat management and restoration, financial mechanisms, strengthening coordination among the administrative bodies etc., are being employed to minimize the losses due to conflict. But the present scenario of this region necessitates a transition from wildlife centric approach, where actions are focused on preventing the negative interaction between humans and wildlife, to an approach that promotes constructive interactions, a perspective of tolerance and the coexistence of humans with wildlife, especially when the size and extent of forest resources are shrinking due to rapid development.

Acknowledgement

We sincerely thank the Census of India, Government of India, the Wildlife Wing, Directorate of Forests, Government of West Bengal, and the Ministry of Environment, Forests and Climate Change, Government of India, for making available on their respective official websites their annual reports, information,

and data regarding the census of major megafauna, conser ..., human-wildlife conflict, and mitigation measures.

References

[1] Annual Administrative Report (2017-18). Wildlife Wing, Directorate of Forests. Government of West Bengal. https://www.westbengalforest.gov.in/upload/publication/pub1.pdf Accessed April 17, 2023

[2] Annual Administrative Report (2018-19). Wildlife Wing, Directorate of Forests. Government of West Bengal https://www.westbengalforest.gov.in/upload/publication/Annual%20Administrative%20Report%2018-19.pdf Accessed April 17, 2023

[3] Annual Administrative Report (2019-20). Wildlife Wing, Directorate of Forests. Government of West Bengal https://www.westbengalforest.gov.in/upload/publication/AAR-2019-20.pdf Accessed April 17, 2023

[4] Annual Administrative Report (2020-21). Wildlife Wing, Directorate of Forests. Government of West Bengal https://www.westbengalforest.gov.in/upload/publication/ANNUAL%20ADMINISTRATIVE%20REPORT%202020-2021.pdf Accessed April 17, 2023

[5] Baloch M.R., Sherpa S., Chakraborty A. 10 Oct 2017, "Human-Elephant conflict-an intricate tale from the kurseong forest division of northern west Bengal" The Indian Forester, Vol 143(10), pp. 1050-1054

[6] Boston, K. (2016). The potential effects of forest roads on the environment and mitigating their impacts. Current Forestry Reports, 2, 215-222.

[7] Chamling, M., & Bera, B. (2020). Spatio-temporal patterns of land use/land cover change in the Bhutan–Bengal foothill region between 1987 and 2019: study towards geospatial applications and policy making. Earth Systems and Environment, Vol. 4, pp. 117-130. https://doi.org/10.1007/s41748-020-00150-0

[8] Chatterjee, P., 2001, A time for tea: Women, labor, and post/colonial politics on an Indian plantation. Duke University Press.

[9] Deb, S., Debnath, M. K., Chakraborty, S., Weindorf, D. C., Kumar, D., Deb, D., & Choudhury, A. (2018). Anthropogenic impacts on forest land use and land cover change: modelling future possibilities in the Himalayan Terai. Anthropocene, Vol. 21, pp. 32-41. https://doi.org/10.1016/j.ancene.2018.01.001

[10] Debnath, M., & Ray, S. (2017). Spatial pattern and distribution of migration and immigration in West Bengal from neighbouring states and countries: An appraisal. Khoj: An International Peer Reviewed Journal of Geography, Vol. 4(1), pp. 26-35. https://doi.org/10.5958/2455-6963.2017.00003.0

[11] Folk E., 2019, 'The impacts of 'eco-tourism", https://theecologist.org/2019/jan/18/impacts-eco-tourism Accessed April 16, 2023

[12] Government of West Bengal, 2023, Protected Area, Wildlife Wing, Directorate of Forests. Government of West Bengal, http://www.wildbengal.com/ , Accessed April 16, 2023

[13] India times, 29 Jun 2022, '45 Elephants, 150 Wild Animals Killed After Being Hit By Trains Between 2019-21, Says Govt', https://www.indiatimes.com/news/india/elephants-and-wild-animals-hit-by-trains-573506.html Accessed April 16, 2023

[14] INTOSAI WGEA, June 2013, 'Impact of Tourism on Wildlife Conservation', https://www.environmental-auditing.org/media/2939/2013_wgea_wild-life_view.pdf Accessed April 16, 2023

[15] Jamwal, R., April 2020, Tourism industry of North Bengal-from Geographical point of view, Innovations Number 61, https://journal-innovations.com/assets/uploads/doc/61394-42-57.23105.pdf Accessed April 16, 2023

[16] Mallick, J. K. 2012 "Mammals of Kalimpong Hills, Darjeeling District, West Bengal, India". Journal of Threatened Taxa, pp. 3103-3136.

[17] Manoj, K., Bhattacharyya, R. and Padhy, P.K., July 2013. Forest and wildlife scenarios of Northern West Bengal, India: a review. International Research Journal of Biological Sciences, Vol. 2(7), pp.70-79.

[18] Manral, U., Sengupta, S., Hussain, S. A., Rana, S. A. K. S. H. I., & Badola, R. U. C. H. I. 2016. Human wildlife conflict in India: a review of economic implication of loss and preventive measures. Indian Forester, 142(10), 928-940.

[19] Mekonen, S. (2020). Coexistence between human and wildlife: the nature, causes and mitigations of human wildlife conflict around Bale Mountains National Park, Southeast Ethiopia. BMC ecology, Vol. 20(1), pp. 51. https://doi.org/10.1186/s12898-020-00319-1

[20] Naha, D., Dash, S. K., Chettri, A., Chaudhary, P., Sonker, G., Heurich, M., Rawat, G. S., & Sathyakumar, S., 2020. Landscape predictors of human-leopard conflicts within multi-use areas of the Himalayan region. Scientific reports, 10(1), 11129. https://doi.org/10.1038/s41598-020-67980-w

[21] Naha, D., Sathyakumar, S., Dash, S., Chettri, A., & Rawat, G. S. (2019). Assessment ar - prediction of spatial patterns of human-elephant conflicts in changing land cover scenarios of a human-dominated landscape in North Bengal. PloS one, Vol. 14(2), e0210580.

[22] Pai M., 6 Dec 2008, Biodiversity-North Bengal, http://biodiversity-mohanpai.blogspot.com/2008/12/biodiversity-north-bengal.html Accessed April 16, 2023

[23] Panda, P. P., Noyal, T., & Dasgupta, S., 2020. 'Best practices of human–elephant conflict management in India', Elephant Cell, Wildlife Institute of India, Dehradun, Uttarakhand.

[24] Rao R., 4 Nov 2019, Railpost, 'IR employees take great efforts to save elephants from being hit', https://www.railpost.in/ir-employees-take-great-efforts-to-save-elephants-from-being-hit/ Accessed April 16, 2023.

[25] Roy, M., and Sukumar, R. 2017. Railways and wildlife: A case study of train-elephant collisions in northern West Bengal, India. Railway ecology, pp. 157-177. https://doi.org/10.1007/978-3-319-57496-7_10 Accessed April 16, 2023

[26] Sarma, U. K., Easa, P. S., & Menon, V., 2006, Deadly tracks-a scientific approach to understanding and mitigating elephant mortality due to train hits in Assam. Wildlife Trust of India, New Delhi.

[27] Tourist arrivals to West Bengal India 2013-2019 by type, Published by Statista Research Department, Jul 27, 2021.

[28] Wildlife Annual Report (2016-17). Wildlife Wing, Directorate of Forests. Government of West Bengal. https://www.westbengalforest.gov.in/upload/publication/aa_2016_2017.pdf Accessed April 17, 2023

[29] Wildlife Annual Report 2013–14. Wildlife Wing, Directorate of Forests. Government of West Bengal, http://www.wildbengal.com/admin_wildlife/upload/3383Wildlife%20Annual%20Report%2013-14.pdf Accessed April 19, 2023

[30] Wildlife Annual Report 2015(2). Wildlife Wing, Directorate of Forests. Government of West Bengal, http://www.wildbengal.com/admin_wildlife/upload/7811Wildlife%20Annual%20Report%2014-15(2).pdf Accessed April 19, 2023

[31] Wildlife Annual Report 2015-16. Wildlife Wing, Directorate of Forests. Government of West Bengal. https://www.westbengalforest.gov.in/upload/publication/pub18.pdf Accessed April 17, 2023